1992

Handicap International Physical Therapy Assistant Training Manual

Susan. Eitel
Loyola University Chicago

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Handicap International came to Thailand in 1981 with the purpose of meeting the need for low cost prosthetic devices using appropriate technologies for amputees in camps and evacuation sites along the Thai-Cambodian border. In 1984, Handicap International expanded its operations to include Physical Therapy and rehabilitation. The current program at this border has the objective of training Khmer refugees and displaced persons in the basic techniques of Physical Therapy.

From 1984 to 1988, the expatriates working within this program developed individual course work in each of those camps having a Physical Therapy Assistants (PTA) training program. This process was often very time-consuming. There was little or no continuity between the consecutive missions of the expatriates, and there was no standardization between the different camps in order to integrate the activities of the program as a whole.

In 1989, a decision was made to develop a standardized PTA curriculum in the camps along the border. The team of Physical Therapists and Occupational Therapists working for Handicap International in Thailand cooperated in the preparation and application of this curriculum. This Manual is the result of the first comprehensive attempt at meeting this need.

In order to avoid confusion in terminology which may possibly arise from the combination of French, Belgian and American nationals who worked together in the development of
the Manual, it should be noted that the following terms are
directly interchangeable.

<table>
<thead>
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<th>Term used in the Manual</th>
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In using the Manual in the field, it may be found that
certain topic areas are too detailed and others too
generalized. As a pilot exercise, the team in Thailand is
currently testing the manual in order to identify those
areas requiring future modifications.

Through a continuing process of monitoring, evaluation
and feedback, it is intended that the Manual may be
progressively improved in order to meet the basic training
needs of the Physical Therapy Assistant.

All users and other interested individuals and groups
are invited to send comments, suggestions as well as
descriptions of application experiences, to:

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Handicap International
14 av. Berthelot
69007 Lyon
France
LOYOLA UNIVERSITY CHICAGO

HANDICAP INTERNATIONAL PHYSICAL THERAPY
ASSISTANT TRAINING MANUAL

VOLUME 1
CHAPTERS 1 - 23

A THESIS SUBMITTED TO
THE FACULTY OF THE DIVISION OF CURRICULUM AND INSTRUCTION
IN CANDIDACY FOR THE DEGREE OF
MASTER OF ARTS

DEPARTMENT OF CURRICULUM AND INSTRUCTION

by

SUSAN EITEL

CHICAGO, ILLINOIS
February 1992
PREFACE

This document was developed and printed outside of the United States and thus some variation in paper size, format and printing has occurred. In order to facilitate the use of chapters independently from one another, pagination occurs continuously within specific chapters but not across the entire manual.

This document serves as the thesis with permission from the graduate school to submit in this format rather than traditional format.
The thesis submitted by Susan Eitel has been read and approved by the following committee:

Dr. Todd Hoover, Director
Associate Professor, Curriculum and Instruction
Loyola University Chicago

Dr. Barney Berlin, Director
Associate Professor, Curriculum and Instruction
Loyola University Chicago

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given final approval by the committee with reference to content and form.

The thesis is therefore accepted in partial fulfillment of the requirements for the degree of Master of Arts.

April 5, 1992
Date

Todd Hoover
Director's Signature
ACKNOWLEDGEMENTS

The preparation and production of this Manual has only been made possible through the efforts of the Handicap International team in Thailand composed of Physical Therapists, Occupational Therapists, and office support personnel.

During the process of developing appropriate and standardized training courses for Physical Therapy Assistants (PTA), the following key contributors devoted countless hours of both their work and leisure time to the wide range of tasks involved.

Sophie Bouchet, Occupational Therapist
Marie-Francine Demarecaus, Physical Therapist
Peter De Roo, Physical Therapist
Patrick Girault, Physical Therapist
Jill Graebner, Physical Therapist
Patrice Renard, Physical Therapist
Krista Viaene, Physical Therapist

Other individuals who provided valuable assistance were:

Sonia Bertrand
Myriam Houtart
Frederic Banda
Jean-Christophe Latteur
Maite Idiart
Martine Relyveld
Thierry Mulpas
Valerie Bernard
Serge Rochatte
Luci Standley
Pierre Janssens
Claudia Montaufray
Sumitra Jantham
Claude Magnier

The complete manuscript was typed and set out by Luci Standley.

Special appreciation and sincere thanks are due to
Luci, Sonia, Myriam, Jean-Christophe, Sumitra, Fred, and Claude for their assistance and hard work in compiling the final product.

Appreciation is also extended to Susan Walker, the Regional Director of Handicap International, for her continued support throughout the project.

The illustration used in this Manual were assembled from a variety of sources. Some of these illustrations have been modified and others have been directly incorporated. David Werner's publication, "Disabled Village Children", was extensively utilized for this purpose.

Appreciation is extended to all authors listed in the Reference Section.
VITA

The author, Susan Paisley Eitel, was born in Colorado Springs, Colorado.

In September 1983, Miss Eitel received a Bachelor's Degree in Physical Therapy from Northwestern University Physical Therapy School.

In 1984, Miss Eitel entered Loyola University seeking further study on adult education/training.

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________________________  _______________________
Date                             Director's Signature
CHAPTER 1

INTRODUCTION TO

PHYSICAL THERAPY
PHYSICAL THERAPY makes the body better by using movement and motivation.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. compare curative, preventative, and adaptive treatment.
2. explain Physical Therapy and how a Physical Therapist uses movement and motivation to help others.
3. describe the 4 steps in the rehabilitation process.
4. explain autonomy and state why it is important.
5. describe a medical team and why communication is important between members of a medical team.

CHAPTER CONTENTS

A. INTRODUCTION
B. WHAT IS A PATIENT?
C. CAUSES AND CONSEQUENCES OF BODY PROBLEMS
D. TYPES OF TREATMENTS
E. PHYSICAL THERAPY
F. REHABILITATION
G. MEDICAL TEAM
H. CHAPTER SUMMARY
A. INTRODUCTION

The work of Physical Therapy is new in many countries.

More information about Physical Therapy and demonstration of Physical Therapy work is needed to help people understand and accept Physical Therapy.

This chapter is written to help explain what Physical Therapy is, and how Physical Therapy can help others.

Before discussing Physical Therapy in detail, basic information for all health professionals (doctors, nurses, health workers) will be presented.

B. WHAT IS A PATIENT?

When a person feels he has a problem with his body, he may ask for help.

If a person receives help from a hospital or medical professional, he is called a patient.

A patient is a word used to identify a person who receives medical care to help make his body problems better.

A patient must be cared for as a whole person ... the problem with his body is only a part of who this person is.

REMEMBER ... 

Not every person is a patient, but every patient is a person.
C. CAUSES AND CONSEQUENCES OF BODY PROBLEMS

In this section we will present:

1. causes of a patient's body problem

2. consequences of a patient's body problem
   (what happens after the patient has a problem).

1. CAUSES OF A PATIENT'S BODY PROBLEM

Questions:

1. Think about the people you have seen in a hospital. List 5 different types of problems that these patients had.

   ______________________________________
   ______________________________________
   ______________________________________
   ______________________________________
   ______________________________________

2. Look at the problems in question #1. What are the causes of these problems?

   ______________________________________
   ______________________________________
   ______________________________________
   ______________________________________
   ______________________________________
There are many, many different kinds of problems that a person can have with his body.

The main causes of a person's body problems could be:

**CONGENITAL**
- problems you have when you are born (abnormal body shape, or movement)

**DISEASE**
- problems caused from small body attackers inside your body (TB, Leprosy, Polio)

**TRAUMA**
- problem from direct injury to the body (mine injury, car accident, bullet wound)

**OTHER**
- problems from unknown reasons psychological, lack of food

2. CONSEQUENCES OF A PERSON'S BODY PROBLEM
   (what happens after the body has a problem)

After your body has a problem, four things could happen.

a. your body can recover (get better) and be normal for simple problems and with good care, many people recover to normal

b. your body can recover (get better), but will always have a limitation some people have body problems that are so severe that the body can never become normal (disabled, handicapped)

c. your body can develop more problems if a patient does not have good care, he can develop new diseases or problems with movement

d. you can die some problems are so severe that the patient will die because of these problems
D. TYPES OF TREATMENTS

A treatment is working with a person to help him decrease, avoid, or adapt to a body problem.

3 types of treatments used with patients are:

1. CURATIVE TREATMENT
   Help a person recover as much as possible after he has a problem.

2. PREVENTATIVE TREATMENT
   Help a person avoid a body problem before it starts.

3. ADAPTIVE TREATMENT
   Help a person with permanent limitations to use his body as well as possible (equipment).
The chart below shows where preventative, curative, and adaptive treatments are used AFTER a patient has a problem.

**PREVENTATIVE**
- want to avoid death
- want to avoid more body problems

**CURATIVE**
- want to recover to normal
- want to recover as much as possible

**ADAPTIVE**
- (for handicapped) want to use his body as well as he can
Activity:

Below is a list of specific treatments for patients. For each treatment, please write if it is adaptive, preventative, or curative treatment. There may be more than one answer for each question.

1. giving medicine
2. teaching about TB
3. giving a wheelchair
4. turning a patient in bed
5. braces for walking
6. wound care
7. food supplement
8. movement for the limbs
9. breathing exercises
10. hand device for eating
11. changes in the house for the patient
12. washing a patient

After answering all questions, discuss your answers with others in your class. Include what is prevented, what is cured, or what is adapted.
E. PHYSICAL THERAPY

As we have said before, Physical Therapy makes the body better by using movement and motivation.

Specific information given in this section includes:

1. What Physical Therapy does not use in working with patients.
2. Different movements to prevent and cure patients' body problems.
4. Summary of types of patients that need Physical Therapy.

1. WHAT PHYSICAL THERAPY DOES NOT USE IN WORKING WITH PATIENTS

* Physical Therapy does not use injections.
* Physical Therapy does not use pills.
* Physical Therapy does not use herbs.
* Physical Therapy does not use surgery.
* Physical Therapy does not use magic.

2. DIFFERENT MOVES TO PREVENT AND CURE PATIENT'S BODY PROBLEMS

Doctors use different medicines to treat different patients.

In the same way, PTAs use different movements to treat different patients.

The movements that a PTA uses will depend on what a patient needs.

A PTA can lift, pull, push, massage, turn, and position patients.
PICTURES OF DIFFERENT PHYSICAL THERAPY TREATMENTS AND TECHNIQUES

LIFTING

STRETCHING

MASSAGE

BANDAGING

BALANCE

AUTONOMY/TRANSFERS
When the PTA applies movements correctly, these movements can:

* make a patient stronger
* prevent tightness or stiffness
* increase the control of movement
* help blood circulation and wound healing
* increase the amount of movement
* prevent pressure sores
* make breathing easier
* increase balance
* prevent respiratory problems
* help the patient stand and walk

The chart on the following page gives examples of specific Physical Therapy techniques and what problems that these techniques can help avoid and cure.
<table>
<thead>
<tr>
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<th>PREVENTATIVE (helps to avoid)</th>
<th>CURATIVE (helps to cure and recover)</th>
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<tr>
<td>STRENGTHENING</td>
<td>- muscle weakness</td>
<td>- increase strength</td>
</tr>
<tr>
<td></td>
<td>- dependent patient</td>
<td>- increase blood circulation</td>
</tr>
<tr>
<td>STRETCHING</td>
<td>- more deformities and joint tightness</td>
<td>- increase movement at a joint</td>
</tr>
<tr>
<td>RANGE OF MOTION</td>
<td>- joint tightness</td>
<td>- maintain the movement at a joint</td>
</tr>
<tr>
<td></td>
<td>- contractures</td>
<td></td>
</tr>
<tr>
<td>MASSAGE</td>
<td>- hard, tight skin</td>
<td>- soften hard skin areas</td>
</tr>
<tr>
<td></td>
<td>- pressure sores</td>
<td>- increase wound healing</td>
</tr>
<tr>
<td></td>
<td>- immovable scar</td>
<td>- relax tight muscles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- increase blood circulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- decrease swelling</td>
</tr>
<tr>
<td>RESPIRATORY TRAINING</td>
<td>- respiratory problems (breathing)</td>
<td>- remove secretions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- increase air in and out of the lungs</td>
</tr>
<tr>
<td>POSITIONING</td>
<td>- pressure sores</td>
<td>- decrease pressure sores</td>
</tr>
<tr>
<td></td>
<td>- respiratory problems</td>
<td>- remove secretions</td>
</tr>
<tr>
<td></td>
<td>- contractures</td>
<td>- decrease contractures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- improve psychology</td>
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<tr>
<td>TRANSFERS</td>
<td>- harmful movements</td>
<td>- help patient move more independently</td>
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<tr>
<td></td>
<td>- to patient or helper</td>
<td>- make transfers more easy, quick and safe</td>
</tr>
<tr>
<td>BALANCE TRAINING</td>
<td>- patient falling</td>
<td>- increase balance in sitting or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>standing</td>
</tr>
<tr>
<td>GAIT TRAINING (walking)</td>
<td>- bad habits in walking</td>
<td>- help patient walk safely, correctly and effectively</td>
</tr>
<tr>
<td></td>
<td>- joint damage from bad walking</td>
<td></td>
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Questions:

1. A patient has stiffness in his arms and legs. Can Physical Therapy help this patient?  
   Yes _____  No _____
   If no, why not? ____________________________________________
   ____________________________________________
   If yes, how? ____________________________________________
   ____________________________________________

2. What is a Physical Therapy treatment used to prevent joint stiffness?
   ____________________________________________
   ____________________________________________
   Why is it important to prevent joint stiffness?
   ____________________________________________
   ____________________________________________

3. What are 2 Physical Therapy techniques used to prevent pressure sores?
   ____________________________________________
   ____________________________________________

4. A patient has respiratory problems. How can Physical Therapy help this patient?
   ____________________________________________
   ____________________________________________

Specific information and instruction about each of these techniques is given in Volume 2 - Physical Therapy Treatments and Devices.
3. MOTIVATION AS A PART OF ALL PHYSICAL THERAPY TREATMENT

We have said that Physical Therapy uses different movements to treat different patients.

In addition, Physical Therapy uses MOTIVATION in the treatment of all patients.

Motivation is a way to help someone want to do something. If someone is "motivated", he will want to do something more completely, correctly, and more reliably.

If the patient is "motivated" to recover, he will follow the treatments and instructions more completely, correctly, and reliably.

In other health areas the patient needs little or no motivation because he can passively receive treatment.

Example:

* The doctor gives an injection, the patient does nothing.
* The laboratory man takes blood, the patient does nothing.
* The nurse gives pills, the patient swallows them.

In Physical Therapy, the PTA and patient (and family) WORK TOGETHER. In most Physical Therapy treatments, the patient must be active to help recover or maintain normal body movement.

A small effort by the patient or family will generally cause a small result in the recovery of the patient.

The PTA can use many different methods to help motivate the patient (and family) to follow treatments as well as possible.

Suggestions to increase patient motivation are:

* Showing interest in the patient and his progress
* Showing encouragement and energy in treatments
* Clearly explaining each treatment (to the patient and family)
Showing interest in the patient and his progress

The PTA can help to motivate a patient if the PTA takes care of the whole person and not just the specific body problem.

Showing interest includes:

- speaking to the patient about his problem and about other topics
- giving the patient attention and eye contact when working with him
- speaking with or greeting the patient informally outside of treatment times
- identifying areas of recovery (even small ones) and responding positively to these improvements

Examples of showing interest in a patient are given in the pictures below.
Many times when a person has a problem with his body, he may feel depressed and not want to do much.

The PTA must help to support and encourage the patient to work to recover as much as possible.

Encouragement and energy includes:

- eye contact and attention during treatment
- friendly smile when greeting the patient
- giving positive response to hard work
- using a voice with energy when "coaching" different activities

Examples of giving encouragement and energy in treatment are given in the pictures on the following page.
Just a bit more and you can ring the bell!
clearly explaining each treatment (to the patient and family)

The PTA must use simple language when working with a patient or the patient's family.

The patient/family will not understand medical words. Medical words can make an explanation more difficult than it needs to be.

The goal of explaining is to have the patient and family understand.

The PTA can explain by simple words, demonstration, example, or other ways that will help the patient and family understand.

When the PTA explains treatment, he should include:

- what the treatment is
- why the treatment is given
- what the goal is
- what would happen if this treatment wasn't given
- what the patient is expected to do
- what the family is expected to do
- how often the treatment needs to be made
- how the treatment can be changed and still have the same result.

After explanation, the PTA must ask if the patient or family has questions.

If the patient/family are expected to continue this treatment independently, the patient/family should demonstrate the treatment while the PTA observes to see that they understand.

REMEMBER!

MOVEMENT is the heart of Physical Therapy, but without MOTIVATION, the heart stops beating.
F. REHABILITATION

Rehabilitation is a step-by-step process to help the patient recover and have a "normal" life as much as possible.

There are 3 steps in the rehabilitation process:

1. Physical Therapy treatments using movement and motivation.
2. Equipment for autonomy.
3. House/community adaptations.
4. Social integration.

1. PHYSICAL THERAPY TREATMENTS USING MOVEMENT AND MOTIVATION

Physical therapy treatments using movement and motivation are the first step toward successful rehabilitation.

For some patients, treatment with movement is the only step needed to help the patient recover and have a "normal" life.

Example:

* A young man had a broken leg. He wore a plaster cast for 3 months. At the end of 3 months he had stiffness of his knee and weakness in his leg.

Physical therapy used strengthening and stretching exercises to help this boy. After 2 months, both legs worked equally well.
For other patients, treatment using movements helps to prepare the patient for the next step in rehabilitation.

Preparing the patient means to try to help the patient be as strong as possible, have normal movements in the joints, good skin condition, and good motivation.

Example

* A man has lost his leg below the knee. The PTA works with him to strengthen the leg and body, massage to help heal the wound and to prevent the scar from becoming hard, range of motion to prevent joint stiffness, and balance exercises.

After all of this preparation, the patient’s body has recovered as much as possible, but will continue to have a limitation.. in this case, no leg.

Equipment (artificial leg-prosthesis) can be given to help this patient have a normal life as much as possible.
2. EQUIPMENT FOR AUTONOMY

Equipment is something added to the patient's body to help the body work (function) better. Another name for equipment is "device".

Autonomy is the idea to have the patient do as much as possible without help from someone else.

Equipment for autonomy is anything applied to the patient's body that will help the patient do as much as he can without help from someone else.

Different types of equipment that will help the patient to be more independent in moving from one place to another are:

- crutches
- wheelchairs
- canes
- braces
- prostheses

For more details see WALKING AIDS, BRACES FOR THE LOWER LIMBS, and WHEELCHAIRS chapters.
Different types of equipment that will help the patient to be more independent in eating, dressing and bathing.

devices for eating

devices for dressing

devices for bathing

For more details see DEVICES FOR AUTONOMY.

In some cases, the PTA may be able to make the equipment. In most cases (especially for devices that help in moving from place to place), a TECHNICIAN must work together with the patient and the PTA to make a device.
This is called adaptive treatment. Equipment given is sometimes called adaptive equipment.

NOTE:

Not all patients will want or need equipment. The PTA must explain what the equipment is for and how it can help.

A patient should be motivated - never forced - to wear equipment.
3. HOUSE/COMMUNITY ADAPTATIONS

When a patient returns home, there may need to be some changes made in the house and community to continue to help the patient be as independent as possible. (See HOUSE ADAPTATIONS)

Question:

A patient had an accident and he will never walk again. He returns home in a wheelchair. Please list 3 things that need to be adapted in the home to make him independent in his wheelchair.

4. SOCIAL INTEGRATION

Social integration is the way of helping a person be accepted within a community.

As much as possible, the PTA must work together with the patient, family, and community to help with this integration.

Ways to help integrate a person into a community are:

* education

* finding work or ways the person can contribute to the community

* follow-up
education

The PTA must take time to explain to the local health worker and members of a community about a patient with a disability.

This explanation should include:

- causes of the patient’s limitation

- STRONG messages that the disability is not contagious (cannot be given to others)

- emphasis on what a patient CAN do

- remind others that he is a person with a limitation; (he continues to feel, think, learn and laugh)

- answer questions so that there is no fear or big mystery that follows the patient.

Questions:

1. A patient had a disease that caused damage to the skin. This patient continues to take medicine and cannot give the disease to others. The community was afraid of this man and forced him to live alone in a house far away. Is this a good example of successful integration?

   Yes _______ No _______

   Explain your answer.
Questions: (continued)

2. A patient had an accident and now she cannot move her legs at all. She has no wheelchair and see remains in her bed all day. What things can you do to help "rehabilitate" this woman.

* finding work or ways the person can contribute to the community

A very good way to be accepted by a community is to be able to help the community.

A person with a handicap can work or help a community in many different ways. It only takes a little time to find the right activity for the right person!

The PTA should help identify ways that the patient can help within the community.

With this work, the patient’s ABILITIES will be reinforced and his DISABILITIES less important.
Questions:

1. A man lost his leg above the knee. He received a prosthesis, was instructed how to use it and then sent back home to his village. One month later the PTA sees the patient without his prosthesis and begging for money in the street. Was this successful integration?

   Yes ______  No ______

Explain your answer.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2. Return to Question #1. Explain what you would do to try and prevent this person from having a life as a beggar.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Example: A woman with no movement or feeling in his legs.

* follow-up

The PTA should continue to visit the patient and patient's family to observe the patient's physical condition AND the integration of the patient into the community.

After leaving the hospital it is best if the PTA can visit 1-2 times each week.

After 1-2 months, these visits can be decreased as the PTA feels confident that the patient is integrated, active, and managing well.

IN SUMMARY

Rehabilitation is not limited to decreasing the patient's problem.

Rehabilitation is the process to help the patient recover and have a "normal" life as much as possible.

This process includes Physical Therapy treatment and may also include equipment, house adaptations, and assistance to help be accepted by the community.
A "team" is 2 or more people working together for a common goal. One person is not a team!

A medical team is people working together for a common goal. The goal of a medical team is to help the patient.

The medical team works together to help the patient recover as much as possible while helping to prevent more problems or death.

Questions:

1. Why is a team needed to help treat patients?

   __________________________________________________________

   __________________________________________________________

   __________________________________________________________

2. Would it be better to have only one person to take care of ALL of the patient's needs? Yes _____ No _____

   Explain your answer.

   __________________________________________________________

   __________________________________________________________

   __________________________________________________________

There are many different members of a medical team. Each member is responsible to HELP THE PATIENT.
Below is a diagram showing the different members of a medical team.

Note: The medical team that you work with may be different from the one shown in the diagram.
Question:
Look at the diagram on the previous page and compare this with the medical team that you will work with.

What is different?

________________________________________________________________________

________________________________________________________________________

What is the same?

________________________________________________________________________

________________________________________________________________________

All the members of the medical team can help the patient in different ways.

Examples:
* A surgeon will make surgery to try and help the patient.
* A nurse will do wound care.
* A PTA will stretch tight muscles/joints.
* A Public Health Worker will teach the patient how to prevent diseases.

For some work, different members of the medical team can help the patient in the same ways.

Examples:
* Doctors and nurses can give injections.
* Nurses and PTAs can help to position and turn the patient in bed.
* PTAs and Public Health Workers can travel to the patient's home to help integrate the patient into society.
The following pages help to summarize the work of a HEALTH WORKER, DOCTOR, NURSE, and PTA.

These are general work descriptions; the specific work of these team members may or may not be the same with each medical team.

<table>
<thead>
<tr>
<th>Medical Team Member</th>
<th>how they help the patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HEALTH WORKERS</td>
<td>* prevent a patient's body problem by educating about how to avoid disease</td>
</tr>
<tr>
<td></td>
<td>* can send people with body problems to a doctor so they can receive treatment</td>
</tr>
<tr>
<td>2. DOCTORS</td>
<td>* prevent some patients' body problems (diseases) by giving medicine (pills or injections)</td>
</tr>
<tr>
<td></td>
<td>* cure some patients' body problems by giving medicine (pills or injections)</td>
</tr>
<tr>
<td></td>
<td>* cure some patients' body problems by surgery (removing or repairing a body part)</td>
</tr>
<tr>
<td>3. NURSES</td>
<td>* help the doctor prevent some patients' body problems (diseases) by giving medicine (pills or injections)</td>
</tr>
<tr>
<td></td>
<td>* help the doctor cure some patients' body problems by giving medicine</td>
</tr>
<tr>
<td></td>
<td>* help the doctor cure some patients' body problems by helping with surgery</td>
</tr>
<tr>
<td></td>
<td>* help prevent more problems by taking good care of the patient in bed</td>
</tr>
</tbody>
</table>
4. PHYSICAL THERAPY ASSISTANTS

* prevent more problems by moving and positioning the patient in bed.
* cure some patients' body problems by motivating the patient and helping him move as normally as possible
* help people adapt when they have body problems that can never recover to normal

Communication is very important.

All members of a medical team must work TOGETHER to share information, ideas, and provide more complete care for the patient.

Examples of why COMMUNICATION between members of a medical team is important.

* A doctor sees a patient with a broken leg. The doctor tells the patient not to put any weight on this leg for 1 month because the bone will break again.

The doctor does not tell this to the PTA. When the patient comes for physical therapy, the PTA asks the patient to walk normally. The patient is afraid to say what the doctor told him. The patient walks and the bone rebreaks.

Question:

How could this can have been prevented?
* A midwife helps a woman deliver her baby. When the child is born, the midwife sees that the baby's foot has an abnormal position. The midwife tells the PTA and the PTA begins treatment to correct the position of the foot. After many months of treatment the foot is in a good position.

Question:
How did good communication help this child?

* A health worker visits the home of a family and sees a person who cannot move his legs. This patient stays in bed all day.

Question:
How can the public health worker help this patient?

There are many more examples of how communication with the patient/family and communication between members of a medical team can only help the patient.

Again, Physical Therapy is new in many countries. A PTA is an important member of a medical team.

Other members of a medical team must know the work of Physical Therapy to know what to communicate and know how Physical Therapy can help.

It is the PTA's responsibility to explain and demonstrate the work of Physical Therapy.
A patient is a person who receives medical care to help make his body problem better.

Treatment is working with a person to help him decrease, avoid, or adapt to a body problem.

3 types of treatments are:

CURATIVE help a person recover as much as possible after he has a problem

PREVENTATIVE help a person avoid a body problem before it starts.

ADAPTIVE help a person with permanent limitations use his body as well as possible.

Physical Therapy makes the body better by using movement and motivation.

Movement includes application of pushing, pulling, lifting, turning, massaging, positioning. Different movements are used with different patients.

Motivation is a way to help someone want to do something. The PTA must help to motivate all patients so that they follow treatments more correctly, completely and reliably.

3 suggestions to help motivate patients are:

* showing interest in the patient and his progress
* giving encouragement and energy in treatments
* clearly explaining each treatment to the patient and family

What Physical Therapy does NOT use:

- injections
- pills
- herbs
- surgery
- magic
Rehabilitation is a step-by-step process to help the patient recover and have a "normal" life as much as possible.

4 steps in the rehabilitation process are:

- movement and motivation (Physical Therapy)
- equipment for autonomy
- house/community adaptations
- social integration

A medical team is people working together to help the patient recover as much as possible while helping to prevent more problems of deaths.

Communication is very important. All members of a medical team must WORK TOGETHER to share information, ideas, and provide more COMPLETE care for the patient.
CHAPTER 2

THE BODY AND
MEDICAL VOCABULARY
BODY PARTS and MEDICAL VOCABULARY are explained to help ensure good professional communications.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. identify all main body parts presented in this chapter.
2. describe anatomical position and explain why it is important.
3. apply medical vocabulary for locations.
4. apply medical vocabulary for body positions and directions of body movements.

CHAPTER CONTENTS

A. INTRODUCTION
B. MAIN PARTS OF THE BODY
C. ANATOMICAL POSITION
D. MEDICAL VOCABULARY
E. CHAPTER SUMMARY
A. INTRODUCTION

The first chapter discussed patients, types of treatment, Physical Therapy and rehabilitation.

We have also said that the PTA will be part of a medical team working together to help a patient recover.

The members of a medical team need to be able to communicate with each other.

This chapter provides names of main body parts and specific medical vocabulary that will help the PTA communicate with other members of a medical team.

B. MAIN PARTS OF THE BODY

Activity:

Here is a picture of a human body.

On this picture, please name as many body parts as you can.

The main parts of the body can be seen on the next four pages.
back

butt

calf

heel

chest

abdomen (stomach)

forefoot

(view)
Questions:

1. A man is sitting in a chair. Please list 2 body parts that contact the surface on the chair.

2. What is the name of the body part that is between the knee and the hip?

3. What is the name of the body part that connects the arm to the forearm?

4. What is the name of the body part that includes the thumb and the fingers?

5. How many toes does a normal person have on one foot?

6. What is the name of the body part that connects the head to the trunk?

7. Please list 8 different parts of the upper limb.

8. Where is the calf located (in the upper limb or lower limb)?

9. What part of the foot touches the ground first when you walk?

10. Please list the 3 different parts of the trunk.
C. ANATOMICAL POSITION

Anatomical position is:

* standing position with the back straight
* head and feet facing forward
* PALMS FACING FORWARD
* elbows and knees are straight

Anatomical position is used as the reference position when describing locations and positions of the body. (See following pages.)
D. MEDICAL VOCABULARY

Information given in this section includes:

1. when to use medical vocabulary
2. medical vocabulary for locations
3. medical vocabulary for body positions and directions of body movements.

1. When to use medical vocabulary

Physical Therapy Assistants (PTAs) will work with medics, nurses and other health workers.

These people will use special medical language to describe locations of problems, positions, movements, and patient diseases.

The PTA must learn this medical language to be able to communicate with the people that they work with.

Patients will NOT know this special language.

The vocabulary used with patients must be very simple and clear.

It is important that patients understand what you tell them.
In summary, medical vocabulary is used with health professionals.

Medical vocabulary is not used with patients and families because they will not understand what you tell them.

2. Medical vocabulary for locations

Medical vocabulary for locations describe where something is.

The PTA must learn the meaning of the medical vocabulary for locations that are given below.

<table>
<thead>
<tr>
<th>Medical vocabulary</th>
<th>Simple (common) vocabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior (Ventral)</td>
<td>in front of</td>
</tr>
<tr>
<td>Posterior (Dorsal)</td>
<td>in back of (behind)</td>
</tr>
<tr>
<td>Distal</td>
<td>farther from the trunk</td>
</tr>
<tr>
<td>Proximal</td>
<td>nearer to the trunk</td>
</tr>
<tr>
<td>Superior</td>
<td>above</td>
</tr>
<tr>
<td>Inferior</td>
<td>below</td>
</tr>
<tr>
<td>Medial (Internal)</td>
<td>to the inside</td>
</tr>
<tr>
<td>Lateral (External)</td>
<td>to the outside</td>
</tr>
</tbody>
</table>
superior

posterior
(dorsal)

inferior

(________ view)

anterior
(ventral)
Activity:

Anterior view means you are looking at the front of someone.
Posterior view means you are looking at the back of someone.
Lateral view means you are looking at the side of someone.

Turn to pages 3, 4, 5, 6, 7, and 12, and on each page write the type of view that you see.

Questions:

1. Are your eyes on the ventral or dorsal side of your head?

2. Are your feet superior or inferior to your knees?

3. What body parts are proximal to your wrist?

4. In anatomical position, is the palm facing anteriorly or posteriorly?

5. A person is sitting on your posterior side. Describe (in your own words) where this person is.

6. Is the calf on the anterior or posterior side of the leg?
Questions: (continued)

7. Compare the location of the arm with the forearm.

__________________________________________________________

8. Compare the location of the thigh with the leg.

__________________________________________________________

Activity:

Check (✓) the correct answer to identify where the dark area is on the left leg.

- internal (medial) side of leg
- distal to ankle
- dorsal side of leg
- ventral side of leg
- proximal to knee
- superior to ankle
- posterior side of leg
- proximal to ankle
- distal to knee
- superior to knee
- anterior side of leg
- lateral (external) side of leg
Activity:

Draw a picture (anterior view) of the right upper limb in anatomical position.

Draw a triangle (△) on the proximal part of the forearm.

* Is the triangle (△) superior or inferior to the shoulder?

* Is the triangle (△) on the dorsal or ventral side of the arm?

* Is the triangle (△) proximal or distal to the wrist?

3. Medical vocabulary for body positions and directions of body movement.

Our body parts can rest in many different positions and move in many directions (see ARTHOLOGY chapter, volume 1).

The PTA needs to be able to describe these positions or movements clearly to other health professionals.

The PTA must learn the meaning of the medical vocabulary given for positions and body movements.
<table>
<thead>
<tr>
<th>Medical vocabulary</th>
<th>Simple (common) vocabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion</td>
<td>bending</td>
</tr>
<tr>
<td>Extension</td>
<td>straightening</td>
</tr>
<tr>
<td>Rotation</td>
<td>turning</td>
</tr>
<tr>
<td>Internal Rotation (IR)</td>
<td>turning the limbs to the inside</td>
</tr>
<tr>
<td>External Rotation (ER)</td>
<td>turning the limbs to the outside</td>
</tr>
<tr>
<td>Abduction</td>
<td>bringing the limbs away from the midline of the body</td>
</tr>
<tr>
<td>Adduction</td>
<td>bringing the limb towards the midline of the body</td>
</tr>
<tr>
<td>Pronation</td>
<td>Palm down (hand)</td>
</tr>
<tr>
<td>Supination</td>
<td>Palm up (hand)</td>
</tr>
<tr>
<td>Prone</td>
<td>lying on stomach</td>
</tr>
<tr>
<td>Supine</td>
<td>lying on back</td>
</tr>
<tr>
<td>Inversion</td>
<td>internal side of foot up</td>
</tr>
<tr>
<td>Eversion</td>
<td>external side of foot up</td>
</tr>
<tr>
<td>Opposition</td>
<td>thumb contacts fingers of same hand</td>
</tr>
</tbody>
</table>
Activity:

Below are pictures used to show some body positions/movements. The student will draw the position/movements that are opposite to these.

FLEXION

shoulder

elbow

wrist

hip

EXTENSION

shoulder

elbow

wrist

hip
Activity: (continued)

FLEXION

knee

ankle (dorsiflexion)

EXTENSION

knee

ankle (plantar flexion)

ABDUCTION

shoulder

ADDUCTION

shoulder

hip

PRONE

SUPINE
Activity:
Put your right wrist on your left shoulder.
Describe the position of your:

RIGHT SHOULDER

RIGHT ELBOW

RIGHT FOREARM

Activity:
In sitting, put the external side of your left ankle on top of your right knee.
Describe the position of your:

LEFT HIP

LEFT KNEE
Activity:

1. Draw a picture of a man in standing position with his right shoulder abducted and externally rotated.

2. Draw a picture of a person in supine position that has both hips and knees flexed.

3. Draw a picture of a person that has both upper limbs abducted and both lower limbs abducted. Both elbows and knees are extended.

Questions:

1. A man would like to drink water from the palm of his hand. What hand position is best for this (pronation or supination)?

2. A boy walks on the external side of his foot. What is the position of the foot when he walks (inversion or eversion)?

3. What is the opposite movement of plantar flexion?
Activity:

As a review of this chapter, for the pictures given below, please name all the body parts that you know.

(Anterior View)

(lateral view)
E. CHAPTER SUMMARY

Pictures and names of the following body parts are given:

- SHOULDER
- ELBOW
- WRIST
- FINGERS
- THUMB
- CHEST
- BUTT
- HEAD
- PALM
- HIP
- KNEE
- ANKLE
- TOES
- FOOT
- ABDOMEN
- CALF
- NECK
- ARM
- FOREARM
- HAND
- THIGH
- LEG
- BACK
- HEEL
- TRUNK
- UPPER LIMB
- LOWER LIMB
- FOREFOOT

ANATOMICAL POSITION is:
* standing position with the back straight
* head and feet facing forward
* palms facing forward
* elbows and knees straight

Medical vocabulary is used so that all health professionals can understand each other. Medical vocabulary is not used with patients.

Language for patients must be simple and clear.

Medical vocabulary for locations includes:

- Anterior (Ventral)
- Superior
- Proximal
- Posterior (Dorsal)
- Inferior
- Distal
- Medial (Internal)
- Lateral (External)

Medical vocabulary for body positions and directions of movement includes:

- Flexion
- ABduction
- Pronation
- Prone
- Extension
- ADDuction
- Supination
- Supine
- Inversion
- Eversion
- Opposition
- Rotation
- Internal Rotation (IR)
- External Rotation (ER)
CHAPTER 3

GENERAL BODY SYSTEMS
GENERAL BODY SYSTEMS are the parts of our body that work together to keep us alive.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. identify three important functions of the skin.
2. describe what happens to the food we eat (to include used and unused parts).
3. describe how air is pulled into the body.
4. describe how blood moves through the body and how waste is removed from the blood.
5. identify three systems directly responsible for movement of the body.

CHAPTER CONTENTS

A. INTRODUCTION
B. THE SKIN
C. THE DIGESTIVE SYSTEM
D. THE RESPIRATORY SYSTEM
E. THE CIRCULATORY SYSTEM
F. THE URINARY SYSTEM
G. THE SKELETAL SYSTEM
H. THE MUSCULAR SYSTEM
I. THE NERVOUS SYSTEM
J. CHAPTER SUMMARY
A. INTRODUCTION

In the first two chapters the PTA learned specific information about Physical Therapy (what it is, and the vocabulary needed to work with others).

The PTA must now begin to learn about the human body.

It is important that the PTA understand the normal body before trying to work with a body that has a problem.

**Question:**

Why is it important for the PTA to understand a normal body before trying to work with a body that has a problem?

This chapter gives general information about the main systems in the body that help to keep us alive.

If one system has a problem, then other systems will also have a problem.
B. THE SKIN

Although skin may look and feel different in the different parts of the body, all skin has three main functions.

1. Protection
2. Temperature regulation
3. Sensation

1. Protection

The skin is like a bag that covers our body. It can let some water out but it prevents dirt, bacteria and harmful things from going into our body.

A hole or opening in the skin is called a WOUND.

A wound is like a doorway for bacteria (small trouble makers) to enter our body.

When bacteria come in, they attack the body parts under the skin and cause an infection.
An infection is like a war between the normal parts of our body and the unwelcome harmful things.

The skin also protects the body by acting as a cushion for different parts (thick skin on the heel).

It can also prevent too much water from leaving our body (it will release water only when it needs to ... see next section).

2. Temperature regulation

Normally the temperature on the inside of our body should always be around 37 C.

The body can become hot from exercise, hot weather or disease. When this happens, normally we sweat.

SWEAT is the body releasing water through the skin. As the sweat dries, it makes the skin more cool.

Activity:

Wet the back of your right hand. Then move both hands through the air. Which hand feels more cool?
When there is an infection or disease in the body, the temperature may increase to more than 37°C. An increase in the body temperature is called a FEVER.

A fever is the result of the body trying to fight infection or disease. The body becomes hot in trying to kill the bacteria or trouble makers.

If a person's fever is too high (over 40°C) for too long, he may die.

Questions:

1. A person has a fever. What will keep him more cool - a wet towel or a dry towel?

2. Water that has been boiled is more safe to drink than water that has not been boiled. Why?

3. Sensation

The skin provides us with information from our environment. It can tell us if something is hot, cold, sharp, soft or smooth.

It helps us to know better what we are touching and helps us to know if something is touching us.

Question:

What are three problems that could occur if you have severe damage to the skin?
C. THE DIGESTIVE SYSTEM

The digestive system is actually one long tube that begins at the mouth and ends at the anus.

The function of each main part will be given in the same order as it travels through the digestive system.

1. MOUTH - the place where we chew food to make it more soft and break it into smaller parts.

2. ESOPHAGUS - carries food from the mouth to the stomach.

3. STOMACH - like a box that holds the food. The food is mixed with stomach liquids (acid) that turn almost all food into thick liquid.

4. SMALL INTESTINE - the "decision maker". This part of the digestive system decides what part of food the body can use, and what parts are not useful (waste). The small intestine will give important parts of food to the blood that passes by. The less useful parts of food will continue through the tube to the large intestine.

5. LARGE INTESTINE - in this area some water is removed so that the unused food becomes more solid.

6. ANUS - place where waste (stool, shit) leaves the body.
Questions:

1. Where does food enter the digestive system?

2. Where does food exit the digestive system?

3. Why is the small intestine called the "decision maker"?

4. If there is too much water in your stool (diarrhea), do you expect a problem in the small intestine or the large intestine?

D. THE RESPIRATORY SYSTEM

The respiratory system brings good air (oxygen) into the body and carries used air (carbon dioxide) out of our body.

In this chapter, the PTA will receive an introduction to the respiratory system. The respiratory system will be discussed in more detail in the RESPIRATORY CHAPTER in Volume 2.

This section includes:

1. Anatomy of the respiratory system
2. How food is prevented from entering the respiratory system
3. Air exchange in the respiratory system
4. How we breathe.
1. Anatomy of the respiratory system

The respiratory system is many tubes that carry air to and from small air sacs.

The main parts of the respiratory system are given below. The parts are given in the order that air passes as it goes into the body.

1. NOSE and MOUTH - the places where air enters and leaves the body.

2. TRACHEA - big air tube that travels through the neck.
   (You can feel this tube on the front of the neck.)

3. BRONCHII - two smaller air tubes that connect the trachea to the lungs.

4. LUNGS - each person has two lungs. One on the left side and one on the right side.

   The lungs are made of:

   BRONCHIOLES - small air tubes inside the lungs that connect the bronchii and alveoli.

   ALVEOLI - small air sacs where good air is exchanged for used air.
2. How food is prevented from entering the respiratory system

If you remember, the mouth is the place where food, water, and air enter the body.

After the mouth, there are two different tubes that pass through the neck.

One tube (esophagus) carries food and water to the stomach, and the other tube (trachea) carries air to and from the lungs.

If air enters the food tube, we can burp and it will come back up.

If food or water enters the air tube, we cough to try to remove it.

**Question:**
A man swallowed a piece of meat and it went down his trachea. What problems will this man have if the meat is not removed?
Our body has a special protective door that prevents food or water from entering the air tube (trachea).

When we breathe, normally both tubes (esophagus and trachea) are open. (A)

When we eat or drink (swallow), there is a special piece of skin that covers the trachea to prevent food or water from entering the air tube. (B)

Activity:
Take a deep breath in (fill your lungs with air). As you slowly let the air out (exhale), swallow.

What happens to your breathing as you swallow?

Why?
3. Air exchange in the respiratory system

Air exchange is the reason why we breathe.

We want to bring good air (oxygen) into the body, and remove used air (carbon dioxide) from the body.

It is important for the PTA to know:

a. where air exchange happens
b. how air exchange happens
c. why air exchange happens

a. where air exchange happens

Air exchange happens in the alveoli.

The alveoli are the smallest parts of the lungs. Alveoli look like small balloons.
b. how air exchange happens

The walls of the alveoli are so thin that air can pass through them. Very small blood tubes pass each alveoli and can collect oxygen (O2) and release carbon dioxide (CO2).

![Diagram of lungs and blood flow](image)

c. why air exchange happens

The body needs oxygen to live. Oxygen is a type of food for the body. If there is no oxygen, we will die.

After the body uses oxygen, it releases carbon dioxide (CO2). CO2 is waste. CO2 must be removed from the body.

If there is too much CO2, there is no space for oxygen.

If there is too much waste (CO2) and not enough food (O2) we can have severe problems or die.
3. How we breathe

Air is pulled into our lungs and pushed out of our lungs. This coming and going of air is called BREATHING or RESPIRATION.

Activity:
Sit with your mouth open. Do not move any part of your body. Are your breathing?

Yes [ ] No [ ]

From the above activity the PTA should understand that:

TO TAKE AIR INTO OUR LUNGS, THE BODY MUST DO SOME WORK!!

The part that works the most to bring air into the lungs is called the DIAPHRAGM.

The diaphragm is a muscle located below the lungs and above the stomach.

It is like a long wide piece of elastic; it is like a movable floor that the lungs are attached to.
WHEN THE DIAPHRAGM WORKS  
IT GOES DOWN

Diaphragm works, pulls lungs down, and this pulls air IN.

WHEN THE DIAPHRAGM RELAXES  
IT GOES UP

Diaphragm relaxes, pushes lungs up, and this pushes air OUT.

There are other parts of the body that can help with breathing. They will be discussed in RESPIRATORY CHAPTER in Volume 2.

For now, the PTA should understand that:

* when the diaphragm works it pulls air in
* when the diaphragm relaxes, it pushes air out
Activity:

You have just finished eating a very big meal and your stomach is full of food and water.

Because your stomach is so full, you have difficulty breathing air into your lungs.

Draw a picture to show why a full stomach may limit the amount of air you can take into your lungs.

E. THE CIRCULATORY SYSTEM

The circulatory system gives food to all living parts of the body.

It also removes waste from these working body parts.
The circulatory system is made up of the following parts:

1. BLOOD
2. HEART
3. BLOOD TUBES

1. BLOOD

BLOOD IS VERY IMPORTANT!

The function of the blood is to transport food and waste to and from all living parts of the body.

Blood is made up of two things:

* very small blood cells which carry the food, oxygen and waste
* clear liquid that acts as a river for the blood cells to travel in
2. HEART

Activity:
Bend all your fingers and keep them close together; this is about the same size as your heart.

The heart is a muscle. The strong muscle is found near the middle of your chest.

The heart has a left side and a right side.

Each side has space to hold blood.

When the heart muscle is relaxed, these spaces fill with blood.

When the heart muscle contracts, blood is pushed out of these spaces.

The heart has two functions:

a. receive blood
b. send blood

Each side receives and sends blood.
* THE RIGHT SIDE OF THE HEART RECEIVES USED BLOOD FROM THE BODY AND SENDS IT TO THE LUNGS.

* THE LEFT SIDE OF THE HEART RECEIVES FRESHENED BLOOD (lots of oxygen) FROM THE LUNGS AND SENDS IT TO THE BODY.

REMEMBER!

To receive blood, the heart must relax; to send blood, the heart must contract.
Activity:

Bend your fingers together so that your hand forms a type of cup. Pour water into this "cup". Now squeeze your fingers and bend them as much as you can.

What happens?

This filling action and squeezing action is similar to how the heart receives and sends blood.

A heart contraction is called a heart BEAT. Every time your heart contracts (beats), you can be sure it is pushing blood.

In summary:

* A blood cell hungry for oxygen and full of waste (carbon dioxide) arrives at the heart.

* It is received by the right side of the heart and sent to the lungs.

* In the lungs it releases waste (carbon dioxide) and picks up oxygen.

* The blood cell leaves the lungs and goes back to the heart.

* It is received by the left side of the heart and then sent back to the body.
3. **BLOOD TUBES**

Blood tubes carry oxygen, food and waste to and from all parts of the body.

There are three types of tubes that all blood travels in when it is pushed around the body.

These tubes are:

a. **ARTERIES**
b. **CAPILLARIES**
c. **VEINS**

**ARTERIES**

When the blood leaves the heart, it is pushed directly into tubes called **arteries**.

Arteries are thick and elastic and they help the heart to push the blood to the places that it needs to go.

In some places of the body, the arteries are near the surface of the skin; in these places you can feel every time the heart contracts and pushes more blood through them.

The number of beats that you count is called your **PULSE**.
Activity:

Your heart rate (pulse) is the number of heart beats in one minute. Count your heart rate.

What is it?

CAPILLARIES

We have said that arteries carry blood from the heart to the different body parts that need food.

When arteries arrive at the body part, they divide into millions of very tiny tubes called capillaries.

The capillaries are so small that only one blood cell can fit through at a time.

It is through the capillaries that the blood can give the food and oxygen (O2) to the tissues and pick up waste, carbon dioxide (CO2) from the tissues.
Activity:

You can sometimes see capillaries in the white part of the eye. They will look like very small red lines. Get into groups of two and look for capillaries in the eyes of your partner.

VEINS

After going through the capillaries (to give food and oxygen and pick up waste), the blood again enters bigger tubes called veins.

Veins return blood to the heart.

Veins are not thick and strong like arteries.

Blood that travels in veins moves more slowly than the blood in the arteries.

Because veins cannot push the blood well by themselves, active body movement helps them return the blood to the heart.

Most often, veins carry "used blood" and so look more blue in color.

You can see veins easily on the back of the hand, front of the wrist, and under the tongue.
In summary:

* The heart contracts and pushes blood into strong arteries.
* Arteries continue to push blood to specific body parts.
* At these parts the arteries divide into small tubes called capillaries.
* Blood cells travel one by one through capillaries. Here they give food and oxygen and pick up waste.
* Capillaries enter into bigger tubes called veins.
* Veins return blood to the heart.

**F. THE URINARY SYSTEM**

The urinary system helps to remove waste (used food) from the blood.

We have said that the blood receives new air (oxygen) in the lungs. Blood also releases used air (carbon dioxide) in the lungs.

We said that blood picks up new food from the small intestine.

The blood releases food (waste) in a special place called the KIDNEY.

Each person has two kidneys.

The kidneys remove waste from the blood.

The water-like waste travels down two tubes that empty into the BLADDER.

The bladder is a bag that holds this waste (URINE).

When we pee, the urine leaves the bladder and passes through another tube that carries urine to the outside of the body.
Questions:

1. The body needs oxygen and food to live. What 2 systems help bring this oxygen and food into the body?

   

2. The blood carries the oxygen and food to all body parts. What system helps to move the blood through the body?

   

3. The blood also carries waste (CO2 and used food) away from all body parts. What two systems help to remove used air and used food from the blood?

   

4. What system removes unused food from the body?

   

G. THE SKELETAL SYSTEM

The skeletal system is made of the BONES is the body.

Bones are strong and hard.

They protect the body, support the body, and help the body in movement.

Bones will be discussed in detail in the chapter on Osteology.
H. THE MUSCULAR SYSTEM

The muscular system includes all the muscles in the body.

Muscles make movement.

Muscles make our bones move.

Muscles move blood through our body.

Muscles move food through our body.

Muscles will be discussed in the chapter on Myology.

I. THE NERVOUS SYSTEM

The nervous system includes the brain, spinal cord and nerves.

The nervous system can make messages, send messages, and receive messages for all parts of the body.

Many of these messages direct the movements that our muscles make.

The nerves and brain and spinal cord will be discussed in the chapter on Neurology.
J. CHAPTER SUMMARY

General body systems are the parts of our body that work together to keep us alive.

The PTA must understand the normal body so that he/she can help a patient when the body is not normal.

The following systems were discussed:
- SKIN SYSTEM (body covering)
- DIGESTIVE SYSTEM (moves food through our body)
- RESPIRATORY SYSTEM (moves air in and out of our body)
- CIRCULATORY SYSTEM (carries blood to and from all our body parts)
- URINARY SYSTEM (removes food waste from the blood)
- SKELETAL SYSTEM (bones)
- MUSCULAR SYSTEM (muscles)
- NERVOUS SYSTEM (nerves)

SKIN

The skin protects against infection, helps us to feel, and can help keep our temperature normal.

DIGESTIVE

Food enters our body through the mouth. Next it moves through the esophagus to the stomach to the large intestine and small intestine. Waste (used food) leaves the body through the anus.

RESPIRATORY

Air enters and leaves our body through our nose and mouth. Next it moves through the trachea and then to the lungs. In the lungs there are little air sacs called alveoli.
There are two parts of air: oxygen (O2) and carbon dioxide (CO2). Our body uses oxygen (like food) and releases carbon dioxide (like waste).

We take air in by the DIAPHRAGM pulling the lungs down and air going into the lungs. When the diaphragm relaxes, air is pushed out.

CIRCULATORY

Blood moves through our body in many small tubes called arteries, capillaries, and veins. The heart is the muscle that pushes blood through our body.

URINARY

The kidney helps to remove waste (used food) from the blood. The bladder is the bag that holds this waste (URINE). When we pee, urine is released from the bladder.

SKELETAL, MUSCULAR, NERVOUS

These three systems responsible are for movement. The skeletal, muscular, and nervous system will be discussed in more detail in future chapters.
CHAPTER 4

OSTEEOLOGY
OSTEOLOGY is the study of bones.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. describe (in own words) the three functions of bone.

2. explain (in own words) how normal bone grows longer and thicker.

3. apply bone growth principles to broken bones and amputations.

4. identify major bones of the body on paper, x-ray, and human models.

5. describe the normal curves of the vertebral column and how they were formed.

CHAPTER CONTENTS

A. INTRODUCTION
B. FUNCTION OF BONES
C. GENERAL BONE STRUCTURE
D. BONE GROWTH
E. HUMAN SKELETON
F. CHAPTER SUMMARY
A. INTRODUCTION

OSTEEOLOGY is the study of bones. From this study we should learn that bone is hard, bone is strong and bone cannot bend.

All of the bones of the body together are called the skeleton. The PTA should learn the bones presented in this chapter to be able to communicate with other members of the medical team.

B. FUNCTION OF BONES

Bones have many functions (or jobs) in our body.

Activity  In the space provided, draw a picture if you had no bones. Compare your picture with the other pictures in your class and discuss what you see.

The first important function of bone is to SUPPORT THE BODY (and give each of us the same general shape).

Another function of bone is for PROTECTION.

We have many important parts inside of us (our brain, heart, lungs); for these special parts there are bones that cover them to prevent injury.

The last main function of bone is to allow MOVEMENT.

The skeleton has many separate bones (206 of them!); this is what allows us to make the many movements that we do (bending, brushing our hair, walking, etc.).

If we have only one bone, we cannot bend or move in many directions. If we have more than one bone, it can meet with another bone and allow movement.
In summary, the three main functions of bone are to SUPPORT the body, PROTECT the special parts of the body, and allow us to make the MOVEMENTS that we normally do.

C. GENERAL BONE STRUCTURE

In the human body there are many different shapes and sizes of bones. They may be long, short, flat, or irregular in shape.

Generally, there are two parts of a bone.

There is an outer part that is compact which makes the bone very strong.

There is an inner part that is less compact (less close together) called spongy bone.

Some bones (like the arm or the leg) may even be hollow on the inside (like bamboo is hollow -- an empty space on the inside).
Questions:

Imagine you are a person with only 6 bones in your body.

1. Describe how you will brush your teeth.

2. Describe how you sit on a chair.

Remember! Many bones allow many movements.
Our bones are alive! They need food the same as other parts of the body, and they receive this food from the blood that is carried to them.

Bone is very busy. When we are young, our bones are very active and want to grow bigger. Our body is able to tell these bones how, to grow and how much to grow.

This is important so that we keep a normal shape as we change from a baby to an adult.

Activity: Draw a picture of your body with the bones of your right leg the same as a one year old baby. The other parts of your body are the same size and shape as they are now.

It is very special that our bones know how much to grow and also when to stop.
Bone growth is important for two reasons:

1) to grow larger from the size of a baby to an adult .... see explanation to follow

2) if a bone breaks, it can repair itself.

* Bones of a Baby *

The bones of a baby are softer than the bones of an adult.

They are smaller and more flexible. The very soft parts you cannot see on x-ray, and so the shape of the bones does not look exactly the same as the adult bones.

Below are pictures to help see these differences.
TYPES OF BONE GROWTH

There are two different ways a bone can grow; it can grow in length (to become longer) or in width (to become thicker).
1. **BONE GROWTH: LENGTH**

For a bone to grow longer, it must grow from the ends of the bone only.

The middle of this bone will not move; it is the ends of the bone that will grow longer.

There is one special place in the ends of bone that is the most active; it is the place that makes all the new bone for increased length.

As we have said before, PTAs will be working with doctors. It is important for the PTA to know some medical vocabulary about bones.

The ends of the bone are called **EPHYSES**

The middle of the bone (or the area between two ephyses) is called the **SHAFT** or **DIAPHYSIS**.

The place where all of the bone growth for length happens is called the **EPHYSEAL PLATE** or **EPHYSEAL LINE**.

The **epiphyseal line** is very active from birth until about age 18 years old because this is when most of our body growth occurs.

By age 25, the growth of the length of the bone is complete and the ephyses and diaphysis grow together, and there is no longer the active area of the epiphyseal plate.
Questions:

1. A boy (age 11) was boxing and broke the shaft of a bone in his leg, will this step the growth of his leg length?

   Yes ______  No ______

   Explain your answer.

2. A boy (age 7) broke the bone in his left leg and destroyed the epiphyseal line 15 years after (now age 22). This man has one leg shorter than the other. What leg is shorter, left leg or right leg?

   Explain your answer.

2. BONE GROWTH: WIDTH (THICKER)

To understand how a bone becomes more thick, it is important to learn about the PERIOSTEUM. The periosteum is much like bark on a tree.

The periosteum is a covering of the outside of the bone.
The periosteum has three very important functions:

* nutrition
* bone growth
* control of bone shape

**Nutrition:**

The outer part of the periosteum has many blood vessels that bring food and oxygen to keep the bone alive.

**Bone Growth**

The inner part of the periosteum is where new bone is made to increase the width of the bone.

**Control of Bone Shape:**

The periosteum covers the bone and controls how much and in what direction a bone grows.

If there was not this covering, then the bone could grow more and more in many directions.

If there is uncontrolled bone growth that escapes past the periosteum covering, it is called *exostosis*.

When a bone is broken, it is the periosteum that makes new bone and helps the two broken parts come together.

This coming together of parts is called CONSOLIDATION.

This periosteum will continue to make new bone until this consolidation is very strong.

More information about broken bones if given in FRACTURES CHAPTER.
Question:

After an "amputation" (the cutting and removal of part of the body), the bone that was cut may continue to grow. Where does this bone growth come from?


Normally it will grow in a downward fashion. Why in this direction?
E. HUMAN SKELETON

In this section, we will discuss the specific bones of the body. This will include their name, their general shape, and their location.

Activity:

The PTA may have some knowledge about bones before studying this chapter.

In the picture given below, the PTA should draw and name as many bones as he/she knows.
The bones of the body can be learned by studying each one separately or by dividing the skeleton into main areas.

In this manual we will divide the skeleton into the following parts:

I) Bones of the Head
II) Bones of the Back
III) Bones of the Chest
IV) Bones of the Upper Limb
V) Bones of the Lower Limb

I) Bones of the Head

There are many bones of the head—all are flat or irregular in shape.

Together they are called the Skull.

The skull forms a box that holds the brain (a special part of your body that controls everything) and keeps it safe. These bones do not move.

The only bone in the head that moves well is called the mandible (or jaw bone). Your lower teeth are attached to this bone and so it helps in chewing food. (This is the bone that moves when you open and close your mouth).

In addition to protecting the brain and holding the teeth, the skull is also responsible for the shape of a person's face.
Activity:

Feel your nose on your face. Is the whole nose made of bone?

Yes  No

Put your fingers on the place where the bone stops.

Feel your teeth. Find the place where your lower teeth attach to the mandible both in the anterior and posterior areas of your mouth.

Feel the area just superior and inferior to your eyes.

Can you feel the circle of bone that surrounds your eye? What is the function of this bony area?

II) Bones of the Back

Together all the bones of the back are called the VERTEBRAL COLUMN.

"Vertebra" is the name of the bone "(Vertebrae" is more than one)

"Column" are objects put one on top of another straight up and down.

The total number of bones in the vertebral column is 33.

Only the first 24 of these bones can move.

To better understand the organization of the vertebral column, it has been divided into five parts. (See diagram on next page).
CERVICAL VERTEBRAE

The bones that are in between the bottom of the head and the top of the shoulders are called the cervical vertebrae.

There are 7 cervical vertebrae.

The first one is called C1, the second one is C2, the third is C3 and so on.

The cervical vertebrae are the bones responsible for allowing neck movement.

Activity:

If you flex your neck and touch the dorsal surface of your neck, you will feel one bone that seems bigger than the others. This bone is C7.

THORACIC VERTEBRAE

Just below the cervical vertebrae are the thoracic vertebrae.

There are 12 thoracic vertebrae.

The bones of the chest (the ribs) are attached to the thoracic vertebrae.

The thoracic vertebrae are located from the level of the shoulders to the middle back.

The thoracic vertebrae help allow movement of the trunk.
LUMBAR VERTEBRAE

The bones of the lower back are called the lumbar vertebrae.

There are 5 lumbar vertebrae.

They are just inferior to the thoracic vertebrae.

The lumbar vertebrae are responsible for allowing movement of the trunk.

SACRUM

These 5 vertebrae are different because they have all grown together to form one big bone.

The sacrum is like a table that holds the other vertebrae on top of it.

The sacrum is located in the area just above the buttocks.

No bones in the sacrum can move apart from one another.

COCCYX

There are 3-4 very small vertebrae fused together called the coccyx.

They are attached to the end of the sacrum and have no real function.

They are sometimes called the "tail bone".
The DISC *****

As we said, the vertebral column is made of many bones.

It is important to know that between each individual bone (from C2 to L5) is a more flexible part called the disc.

The disc allows the bones to move more freely upon one another.

Example:

Picture A:
There are a stack of books on a desk; if you try to bend them in any direction they will not move because they are hard and flat.

Picture B:
There is a balloon filled with water between each book; the books are now able to bend more freely in many directions.

Picture C:
It is the same principle with the bones and the disc (the books are the vertebral bones, and the balloon is the disc).

The disc will be discussed in more detail in future chapters, but for now it is important to remember that the disc helps the vertebral column to bend more freely in many directions.
Vertebral Bones

In general, most all cervical, thoracic and lumbar vertebrae look like this:

![Diagram of vertebral bone structure](image)

The vertebral body is the part that holds the weight of the vertebrae stacked on top of each other. (Between each vertebral body is a disc). The vertebral body is anterior.

The transverse process and the spine help keep the vertebrae attached together; they are also places where muscles attach to make movement of the vertebral column.

(The spine is the most posterior part of the vertebral column; the small bumps that you can feel or see on the midline of your back are individual spines of each vertebrae.)

The vertebral foramen is a hole found on each of the vertebrae.

The spinal cord (like a rope that carries all information to and from the brain) passes through these holes; the vertebral bones help to protect this important structure.

Each of the five areas of the vertebral column has its own special job (or function).

The bone shape in each area may be a little different because of the different functions.
Vertebral Curves

The last important area to discuss about the vertebral column is its general shape when it is all together.

There are two directions that you can look at the vertebral column; posteriorly and laterally.

1. Posterior view / anatomical position

In this view, the vertebral column should be straight.

2. Lateral view / anatomical position

In this view, the vertebral column will have some curves that are easy to see and feel.
These posterior and anterior curves are called **KYPHOSIS** and **LORDOSIS**.

**KYPHOSIS**

Kyphosis is the vertebral column curving in a posterior direction.

Examples of kyphosis can be seen in the thoracic and sacral areas.

**LORDOSIS**

Lordosis is the vertebral column curving in an anterior direction.

Examples of lordosis can be seen in the cervical and lumbar areas.

**Activity:**

To better see real kyphosis and lordosis, form groups of two people each.

On one person draw or put tape over the *kyphosis* areas of the vertebral column.

On the other person draw or put tape over the *lordosis* areas of the vertebral column.
Development of Vertebral Curves

As a baby, we are shaped like this: our body is in a position of flexion.

If we never moved, we would be in a position of flexion always.

But, when we can, we begin to lift our head by ourself.

This will cause a change in the curve in the neck area (the cervical area).

As we later begin to stand and walk, there is another change in the curve of the vertebral column.

This change happens near the hips or low back area (lumbar area).

In summary, there are two changes that happen in our vertebral column when we are young.

One is in the cervical region and one is in the lumbar region.
Questions:

1. Does neck flexion increase or decrease cervical lordosis?

2. What movement will decrease lumbar lordosis?

3. Primary means happening first. Secondary means happening second. Think about the curves in your spine. What curves are the primary curves?

What curves are the secondary curves?

Activity:

Below is a picture of the vertebral column. Please write if the curve is normal, has increased lordosis or increased kyphosis.

CERVICAL:

THORACIC:

LUMBAR:

SACRAL:
Activity: (continued)

Below is a picture of the vertebral column. Please write if the curve is normal, has increased lordosis or increased kyphosis.

CERVICAL: ___________________________

THORACIC: _____________________________

LUMBAR: _____________________________

SACRAL: _______________________________

III) Bones of the Chest

The bones are the chest are the ribs and the sternum.

The ribs help to protect the heart and lungs from injury.

There are 12 pairs of ribs (12 on the left side of the chest and 12 on the right side of the chest).

Together they are called the rib cage or thoracic cage.
Posteriorly, each rib attaches to one thoracic vertebra.

Anteriorly, most of the ribs attach to a flat bone called the sternum.

The last two ribs do not attach to anything anteriorly.

Because the ribs attach both anteriorly and posteriorly, they limit anterior-posterior bending (trunk flexion) and also limit some side bending (lateral trunk flexion).

Movement of the ribs

Activity:

Inhale very deeply, and after, slowly let the air come out of your lungs. Bring the air in and out of your lungs again. Describe the movement you see and feel in your chest.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

For details about rib movement in breathing, see RESPIRATORY CHAPTER.
IV) **Bones of the Upper Limb**

When we think of the arm, we think of the area distal to the shoulder. This is true.

It is important to know that there are two other bones that help attach the arm to the trunk; these are the **Clavicle** and the **Scapula**.

On the anterior surface of the body is the **clavicle**.

There is one clavicle on the left side and one clavicle on the right side. It is attached to the sternum and ends at the shoulder.

On the posterior surface is a large triangular bone called the **scapula**. The scapula is very movable.
Activity:
Both bones are very easy to see and feel on your body. Place your right hand over your left shoulder close to the neck. Under your wrist you will feel the clavicle; under the ends of your fingers you will feel the scapula.

There are three bones between the shoulder and the wrist.

From the shoulder to the elbow is one bone called the HUMERUS. The proximal part is called the head, and it is shaped like a ball.

The shoulder is where the head of the humerus, the scapula, and the clavicle meet together.
From the elbow to the wrist there are two bones: the RADIUS and the ULNA.

In anatomical position, the ulna is on the internal side (fifth finger side) and the radius is on the external side (thumb side).

The elbow is where the humerus, radius and ulna meet together.

The radius, ulna, and the CARPAL BONES together form the wrist.

The HAND is made up of the CARPAL BONES, METACARPAL BONES, and PHALANAGES.

There are eight carpal bones.
Distal to the carpal bones are the 5 metacarpal bones; one for each finger and the thumb.

Distal to the metacarpal bones are the bones of the fingers and the thumb. These bones are called phalanges.

It is very good to have many small bones in the hand because this allows much more movement and flexibility.

Activities:

1. Put your right hand on your left clavicle. Lift your left arm. Describe what happens to the clavicle.

2. Put your left hand behind your back and put your left fingers on the inferior end of the right scapula. Push forward with your right arm. Describe what you feel with your left fingers.

3. We have said that bones cannot bend. We can see that our fingers bend in many places. How many phalanges are in each hand?

In summary, the bones of the upper limb include:

SCAPULA, CLAVICLE, HUMERUS, ULNA, RADIUS, CARPAL BONES, METACARPAL BONES, and PHALANAGES.

These bones allow us to greet one another, to eat, to write, and to do many activities with the arms.
V) Bones of the Lower Limbs

The body is very heavy, so the bones that support this weight must be very strong and very stable.

We had said that the sacrum supports the vertebral column and much body weight.

Activity:

Draw a picture of how you think the sacrum is attached to the two legs.
Between the sacrum and the thigh bone is a large and heavy bone on the left side and the right side.

These large flat bones are called the ILIAC BONES.

The top of the iliac bones is called the ILIAC CREST.

At the most anterior part of the iliac crest is the ANTERIOR SUPERIOR ILIAC SPINE (ASIS).

**Activity:**

To feel the iliac crests, get into a standing position. Place both hands on your hips the same as you would do in a relaxed position. The bones you feel just under your hands are the iliac bones. Move your hands to feel the superior part of them. These are the iliac crests. Then move your hands to feel anteriorly along the iliac crests until you feel the ends of them. Here you may feel a larger bump; this is the ASIS.
The iliac bones are attached to the sacrum posteriorly. Anteriorly they attach together in an area called the PUBIS.

The most inferior part of the iliac bone is called the ISCHIUM.

This is the bone that you can feel very well under your buttocks when you sit down.

Activity:
Take time to feel the ischium. It will be an important place to be able to find correctly when treating patients in the future.

In sitting position, put your left hand underneath your left buttock. Place your hand on the ischium. Now come to standing position and try to find the ischium again.
The PELVIS (the two iliac bones and the sacrum together) can be compared to a large bowl.

This bowl contains many important parts of the body (stomach, intestines, liver, etc), helps to hold the baby when a woman is pregnant, and connects the vertebral column to the lower limbs.

Different views of the pelvis can be seen in the pictures (above).
Between the hip and the ankle are 3 long bones and one small round one.

The bone between the hip and the knee is called the FEMUR.

The proximal part is round like a ball and is called the head.

Distal to the head is the neck. Distal to the neck is the greater trochanter.

Activity:

To feel the greater trochanter, stand up, place your right hand on the external side of your leg just distal to the hip joint. With the knee extended, internally and externally rotate the leg. The bump you feel moving forward and backward is the greater trochanter.
The hip is the connection of the head of the femur and the iliac bone of that side.

Distally, the femur meets the Tibia. This large bone of the lower leg holds all of the weight of the body.

Parallel to the tibia in the Fibula; it is external to the tibia.

Anterior to the connection of the tibia and the femur is a small round bone called the patella.

To feel the patella, sit with your left leg extended and relaxed. Take your left hand and feel the top of your knee joint -- this is the patella. Try to move this small bone with your fingers.

The knee is made of the patella, distal femur, and proximal tibia.
The distal tibia and fibula together with the first bone of the foot make the ANKLE.

Look at your ankle. You will see a bump on the internal and external side of the ankle.

The one on the internal side is called the **internal malleolus**; (it is part of the tibia).

The one on the external side is called the **external malleolus**; (it is part of the fibula).

**Activity:**

With your pen, draw a circle around the internal and external malleolus so you can better see their location.
There are many bones in the foot to allow flexibility and movement.

There are 7 TARSAL bones. The TALUS, CALCANEUS, and 5 smaller tarsal bones.

Just inferior to the tibia is the talus.

Just inferior to the talus is the calcaneus.

Anterior to the talus and calcaneus are the five smaller tarsal bones.
As in the hand, there are also many bones in the foot.

There are 5 METATARSAL BONES and the same number of PHALANGES as in the hand.

Questions:

1. In sitting position bring your knee to your chest. What bone is touching your chest?

2. Put your right ankle on top of your left knee. What bone is touching your left femur?

3. In walking, what bone of the foot normally touches first?

In summary, the bones of the lower limb include the

ILIAC BONE, FEMUR, TIBIA, FIBULA, PATELLA, TARSALS, METATARSALS and PHALANGES.
Activity:

From the individual lessons in this chapter, please name all the bones that you know.

** Is this skeleton in anatomical position? ________

Why or why not? ____________________________
Activity:

Below are pictures of X-RAYS (pictures able to see the bones of the body) for different parts of the body. Please name the joint, bone, or area for each picture.

1. JOINT
   name of bone
   specific part of bone
   name of bone
   name of bone

2. JOINT
   name of bone
   name of bone
3. AREA OF BODY

- name of bones
- name of bones
- name of bones

4. JOINT

- name of bone
- specific part of bone
- specific part of bone
- name of bone

5. JOINT

- name of bone
F. CHAPTER SUMMARY

OSTEOLOGY is the study of bones. All of the bones of the body together are called the skeleton.

Bone supports the body, protects special body parts, and allows us to make movement.

The bones of a baby are softer, smaller and more flexible than the bones of an adult.

Bone growth: The ends of bone are responsible for increasing the length of bone. The outer covering of bone (periosteum) is responsible for increasing the width of bone and for bone repair.

Main bones of the different body areas include:

<table>
<thead>
<tr>
<th>Area</th>
<th>Bones</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEAD</td>
<td>Skull, Mandible</td>
</tr>
<tr>
<td>BACK</td>
<td>33 vertebrae (7 Cervical, 12 Thoracic,</td>
</tr>
<tr>
<td></td>
<td>5 Lumbar, 5 Sacral, 4 Coccyx)</td>
</tr>
<tr>
<td>CHEST</td>
<td>12 pairs of ribs, sternum</td>
</tr>
<tr>
<td>UPPER LIMB</td>
<td>Scapula, Clavicle, Humerus, Ulna, Radius,</td>
</tr>
<tr>
<td></td>
<td>Carpals, Metacarpals, Phalanges</td>
</tr>
<tr>
<td>LOWER LIMB</td>
<td>Iliac bone, Femur, Tibia, Fibula, Patella,</td>
</tr>
<tr>
<td></td>
<td>Tarsals, Metatarsals, Phalanges</td>
</tr>
</tbody>
</table>

The vertebral column curves anteriorly in the cervical and lumbar areas; this is called LORDOSIS. It curves posteriorly in the thoracic and sacral areas; this is called KYPHSOSIS.

Our vertebral column is in complete kyphosis when we are born. As we lift our head and stand, lordosis develops in the cervical and lumbar areas.
CHAPTER 5

ARTHROLOGY
ARTHROLOGY is the study of joints.

OBJECTIVES

At the time of the exam and with 80% proficiency, the students will be able to correctly:

1. describe the main supporting structures of a joint (ligament, tendon, capsule, cartilage).
2. identify major joints of the body and the movements available at each joint.
3. state the amount of degrees for different angle measurements.
4. when shown a joint in a specific position, state the approximate (+/- 10) angle the joint is in.
5. given a patient problem, evaluate range of motion (ROM), identify the limitation, and give the approximate measurement of the joint (+/- 10).
6. given a patient problem, identify the area(s) of compensation for different movements.

CHAPTER CONTENTS

A. INTRODUCTION
B. FUNCTION OF JOINTS
C. STABLE JOINTS AND MOBILE JOINTS
D. DIFFERENT PARTS OF A MOBILE JOINT
E. DIRECTIONS OF JOINT MOVEMENT
F. AMOUNT OF JOINT MOVEMENT (RANGE OF MOTION)
G. SPECIFIC JOINTS OF THE BODY
H. CHAPTER SUMMARY
A. INTRODUCTION

ARTHROLOGY is the study of joints. A joint is the place where two or more bones come together. There are many joints in the body.

B. FUNCTION OF JOINTS

Joints have two functions:

1) to hold the bony skeleton together

2) to permit movement of the bones in specific directions.

C. STABLE JOINTS AND MOBILE JOINTS

In OSTEOLOGY chapter we learned that there are many different shapes of bones.

In the same way, there are also many different shapes of joints.

The SHAPE of the joint is what most often decides how much and what kind of movement is available there.

Some joints of the body have a shape that does not allow much movement between the bones; they fit together very tightly.

These joints are for STABILITY. For example, the joints between the bones of the skull are very stable.

They do not have much movement; their shape holds the bones together well.
Question: Why is it important that the joints holding the skull bones together are stable?

In other joints, the bones can move very well in many directions.

More movement means more mobility.

An example of a joint that is very mobile is the shoulder. The bones of the shoulder are shaped in such a way that their ends do not attach together closely and so can move more freely.

Not many joints have complete stability or complete mobility in them -- most joints have a little of both.

The bones of the joint will help decide how much stability or mobility there is.

Of most importance to the PTA are those joints that have a lot of movement (are the most mobile).

This is for two reasons.

1) the more movable joints are the ones that we most often use in our common daily activities

2) the more mobile joints are the joints most often injured.
Activity:

In the picture given below, please (a) draw all the bones that you know and (b) name all of the body parts and bones that you see in the picture.
Activity: The shoulder, elbow, wrist, hip, knee and ankle are all joints that have some mobility. Please name the bones that help to make each of these joints.

<table>
<thead>
<tr>
<th>Joint</th>
<th>Bones</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHOULDER</td>
<td>____________________</td>
</tr>
<tr>
<td>HIP</td>
<td>____________________</td>
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<tr>
<td>ELBOW</td>
<td>____________________</td>
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<tr>
<td>KNEE</td>
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<tr>
<td>WRIST</td>
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<tr>
<td>ANKLE</td>
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</tr>
</tbody>
</table>

Because the bones are not tightly attached to each other, the more mobile joints have other parts that help to keep the bones together.

D. DIFFERENT PARTS OF A MOBILE JOINT

We have said that bones are alive. The other parts of a joint are also alive! They need food, can become sick or damaged, and will grow and change with time and activity.

There are many different parts that help to keep the bones together. The parts that the PTA should know are:

1. ligament          2. tendon
3. cartilage         4. capsule
1. LIGAMENT

The ligament directly connects bone to bone.

The main function is to limit joint movement. It is very strong and is like the plastic (rope) that is used to hold packages together.

It helps to give the joint more stability.

Activity: Draw a picture of the right femur, tibia and fibula in anatomical position.

Draw a ligament attaching the external side of the femur with the external side of the fibula.

Draw a ligament attaching the internal side of the femur with the internal side of the tibia.

What are the functions of these ligaments?


What direction of movement do they limit?


2. TENDON

The tendon connects muscle to bone.

(Muscle is a very elastic part of the body that helps to make the bones move -- it will be discussed in the next chapter.)

A tendon is strong like a ligament and also gives stability to the joint.

Question: What area of the body do you find the patellar tendon (upper limb or lower limb)?

3. CARTILAGE

Cartilage is like very hard rubber; it covers the ends of bones to make movement easier.

It makes the surfaces smoother so the bones can move against each other without trouble.
Activity:

Cartilage is alive. Normally there is a special fluid that surrounds the cartilage that gives it food and keeps it wet. Explain the problem at a joint is this fluid did not exist.

The disc in the vertebral column is also made of cartilage.

As we said earlier, it helps for more movement in the vertebral column.

It also works to prevent damage to our vertebral bones as we walk, run or jump.

It does this by acting as a cushion placed between each of the hard bones.

This cushion decreases the hitting of hard bones together and so protects them from damaging each other.
4. CAPSULE

The capsule is like a plastic sac that surrounds the joint.

Inside of this sac is a water-like fluid that helps the bones to move on each other more easily.

This fluid keeps the cartilage healthy, wet and smooth.

The functions of the capsule are to keep this fluid in the joint and also provide some joint stability.

In summary, the five main parts of a movable joints are:

BONE, LIGAMENT, TENDON, CARTILAGE and CAPSULE.
Questions:

What three parts help to make a joint more stable? (Do not include bone).

______________________________________________________________

______________________________________________________________

What two things help to make the bones move more easily on one another? (Do not include bone.)

______________________________________________________________

______________________________________________________________

E. DIRECTIONS OF JOINT MOVEMENT

Bone shape can limit what direction a joint can move.

A tight muscle/tendon, tight ligament, or tight capsule could also decrease joint mobility.

Normally, each joint of the body has specific movements that it can do.

It is important for the PTA to know in what direction most normal joints move.

NOTE To be very clear, it must be well understood that you can say the direction that you move the limb AND the position the limb is in when it stops moving.
For example:

Start with your right shoulder in complete flexion (arm next to your head).

Next, slowly lower your arm until it is straight out in front of you.

You have started in a position of flexion (A)
You have moved in a direction of extension (B)
You have stopped in a position of flexion (C)

Anatomical position (BODY PARTS AND MEDICAL VOCABULARY CHAPTER) is the neutral position for all joints. *

This means that in anatomical position the joint has 0° flexion, 0° extension, 0° IR, 0° ER, 0° adduction, and 0° abduction.

* The area that is not in neutral position is the forearm which is in complete supination.

Naming joint positions and directions of movement is in reference to anatomical position.
Activity:

For each of the joints shown below, please write the name of the Starting Position (SP), Direction of Movement (DOM), and Ending Position (EP).

**HIP:**

<table>
<thead>
<tr>
<th>SP</th>
<th>DOM</th>
<th>EP</th>
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**ELBOW:**

<table>
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<tr>
<th>SP</th>
<th>DOM</th>
<th>EP</th>
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</table>

Questions:

In anatomical position, the forearm is in *supination*; why?

With the elbow extended and the forearm in neutral position, would the thumb be external, anterior, or posterior to the hand?
In Chapter 2 (pages 15 - 20) we discussed directions of movement. Review the different directions of movement and then apply them in the following activity.

**Activity:** For the joints listed below, write the types (directions) of movement that you can do at each joint.

<table>
<thead>
<tr>
<th>Joint</th>
<th>Types of Movement</th>
<th>Types of Movement</th>
<th>Types of Movement</th>
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<tbody>
<tr>
<td>SHOULDER</td>
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<td>Forearm *</td>
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<td>THUMB</td>
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<tr>
<td>Foot *</td>
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<tr>
<td>TOES</td>
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</tbody>
</table>

* Please note that the forearm and foot are NOT joints. They are areas where a movement can be seen most simply.
Question:
You can see that the types of movements you can do at different joints is not the same. Why?

F. AMOUNT OF JOINT MOVEMENT

The amount of movement at each joint is called the RANGE OF MOTION (ROM) of that joint.

Normally, each joint of the body has a specific amount of movement that it can do.

Bone shape can limit the amount of movement of a joint.

A tight muscle/tendon, tight ligament, or tight capsule could also decrease joint mobility.

If the amount of movement is not normal, then we must be able to write or say clearly how much movement there is at a joint.

To draw a picture of the joint position is one way to show how much a joint moves.

Another way to describe joint range of motion (ROM) is by using numbers.

Because numbers are the common method used in hospitals, it will be the method discussed in this manual.

To understand measurement of joint movement, we must first understand some basic mathematical words.

The words that are important to understand are angle, degree, perpendicular, and parallel.
ANGLE:
The picture shows two lines that join together. The space that is between the two lines is called an angle.

An ANGLE is the amount of space that is between two lines that are joined together.

The word used to describe how much space is between the two joined lines (angle) is degree.

Normally, the word "degree" is represented by a small circle (°).

For example: 10 degrees is written as 10° 73 degrees is written as 73° 24° means 24 degrees.

A DEGREE is a word used to describe how much space there is in an angle.

Activity:
Below are pictures of three angles.

1. What picture has the most space between the two joined lines?

2. What picture has the biggest angle?

3. What picture has the smallest angle?
Activity: (continued)

4. 40° is the measure of what?

5. What is the number of degrees of the angle in picture (C)?

The PTA should be able to say approximately how big an angle is just by looking at it with her eyes.

Three angles that are very easy to see are 360°, 180°, and 90°.

These are very important angles to remember; you can more easily identify other angles if you use these angles as your reference.

360°: If a line joins another line and is going in exactly the same direction, the space between them is 360°.

(Note that at the end point there is also no space between the two joined lines, so this angle can also be 0°.)
180°: If two lines join together in exactly opposite directions, then the space between them is 180°.

90°: If two lines join together and the space between them is 90°, (exactly one half of 180°), then the lines are PERPENDICULAR.

Activity: 90° angles are very common when building houses, chairs, and equipment. Give three examples of PERPENDICULAR lines (90° angles) that you can see in your classroom.

1. 
2. 
3. 

In summary, three angles that are easy to see are 360°, 180°, and 90°.

The last general word to know is PARALLEL.

Parallel lines do not join together.

For example:

With one line "A", there can be many, many lines that are parallel to "A".

These lines can be above "A" 
below "A"
beside "A"
on top of "A"
close to "A"
far from "A"
The one rule they must all follow is that to be parallel to "A", they must be placed in exactly the same direction as "A".

If you have two lines that are parallel, their ends will never meet (never join together)

**Question:** What does parallel bars mean?

**Activity:** On many maps you need to have the directions of North, South, East and West so you can find your way. Most often the directions look like the picture on the left.

1. How many degrees are between North and East?

2. What direction(s) is (are) perpendicular to West?

3. How many degrees between North and South?
Activity:

1. If head (x) turns 180°, what will be the end position(s)?

2. If head (x) turns 90°, what will be the end position(s)?

3. If head (x) turns 360°, what will be the end position(s)?

This is a picture of a head. Choose the correct head position (between A, B, C, D) to answer the following questions.

Activity: Match the picture with the number of degrees it describes correctly.

1. 45°
2. 100°
3. 300°
4. 90°
5. 160°
6. 20°

Draw an angle of 75°
Draw an angle of 90°
Draw an angle of 10°
Draw an angle of 270°
Activity: Below are pictures of five clocks. Please give the number of degrees (the amount of space) that is between the two hands on each clock.

A. _____ B. _____ C. _____ D. _____ E. _____

Now that you are familiar with angles and measurements, we will apply them to the human joints.

We had said that each joint of the body can move in specific directions.

The PTA should know that for every direction, the joint only moves in a specific space (number of degrees).

This amount of movement is called range of motion (ROM).

The Range of Motion (amount of movement) at each joint can be measured.

It is important to know if the range of motion is normal, or if the movement is limited (amount of movement is less than normal).

The guidelines, hand positions, and movements made to evaluate range of motion will be presented at the end of this chapter.
G. SPECIFIC JOINTS OF THE BODY

In the following joints, more complete anatomy, specific movements and range of motion will be discussed.

I. Shoulder *

II. Elbow

III. Forearm *

IV. Wrist *

V. Hand/Fingers *

VI. Hip

VII. Knee

VIII. Ankle

IX. Foot/Toes *

X. Vertebral column *

** Note that these areas may be a combination of many joints (hand, foot, shoulder, vertebral column); or may be an area and not a joint (forearm).

For each of the areas shown above, the following information will be given.

a. bones

b. function

c. other structures

d. movement

e. range of motion
I. THE SHOULDER

a) Bones of the shoulder

There is more than one joint in the shoulder area, but the joint most commonly identified as the "shoulder joint" is the one made by the joining of the HUMERUS with the SCAPULA.

The humerus is like a stick with a ball on its proximal end. The part of the scapula where the humerus attaches is shaped like a shallow half-circle.

Activity: With your left hand, flex the fingers tightly so the hand is in a fist. Flex the wrist slightly. Keep it in this position. With the right hand, adduct all fingers so that they are touching together. Now bend the palm and the fingers a small amount. Keep it in this position. Now put the left hand in the palm of your right hand. Your left hand is the head of the humerus and your right palm is a part of the scapula where the head of the humerus attaches.
b) Function of the shoulder

The function of the shoulder is to attach the upper limb to the trunk.

Because it is a very mobile joint, it allows the hand to be functional in many different positions around the body.

c) Other Structures of the shoulder

Because of the shape of the bones, the shoulder is not a very stable joint.

The capsule, muscles, and tendons provide the stability for this joint.

Observe that the cartilage helps to make the cup shape on the scapula a bit more deep.

d) Movement of the shoulder

It is important to know that to move the upper limb, the scapula and clavicle will move also.

**Question:** If the scapula could not move, would you expect the Range of Motion (ROM) at the shoulder to be increased or decreased?

__________________________

Why? ______________________

__________________________

__________________________

__________________________
e) Range of Motion of the shoulder

Activity: For the pictures given below, please write the name of the position and the number of degrees between starting and ending positions. The amount of space between them is a darker area.

Position: _______ Degrees: _______

Position: _______ Degrees: _______

Position: _______ Degrees: _______

Position: _______ Degrees: _______

Position: neutral Degrees: 0°
a) Bones of the elbow

The elbow is the attachment of the distal part of the HUMERUS with the proximal parts of the RADIUS and ULNA.

Note that the ulna has the most contact with the humerus and has a very special shape.

The proximal part of the ulna is shaped like the letter "c" and the distal humerus is shaped like the letter "o".
Activity: Feel the posterior elbow area; the bone that makes the point of the elbow is the proximal part of the ulna. This part is called the OLECRANON.

\[ U L N A \]

b) Function of the elbow

Activity: Normally you have three bones between the shoulder and the wrist. Your body has changed and now you have only one long bone in the upper limb; the length of your upper limb remains the same.

With this new upper limb, try to scratch the top of your head. Try to put something in your mouth. Try to write words in your book.

Describe what happened with these activities:

_________________________________________________________

Did you have difficulty?

_________________________________________________________

If yes, what?

_________________________________________________________

In your own words, write the function of the elbow joint:

_________________________________________________________

_________________________________________________________

_________________________________________________________
c) Other Structures of the elbow

Because the ulna fits closely with the humerus, the elbow is a very secure joint.

There are, however, many ligaments that connect the radius to the ulna, and the ulna and radius to the humerus.

The joint capsule surrounds the distal end of the humerus and the proximal parts of the radius and ulna.

---

d) Movement of the elbow

Observe that with elbow movement, the "c" (ulna) moves on the "o" (humerus).

The movement of extension stops when the top of the "c" contacts the humerus.

In flexion, it is more the skin and muscles that will stop the movement.
Activity: You are measuring the elbow ROM on two patients. One is a huge obese woman and the other is a very malnourished man.

Will elbow flexion be the same for these two patients? 

Why or why not?

If not the same, who will have more ROM for elbow flexion (the woman or the man)? 

* Note that the joints of each patient are normal.

e) Range of Motion of the elbow

Activity: For the pictures given below, please write the name of the position and the number of degrees between starting and ending positions. The amount of space between then is a darker area.

Position: 
Degrees: \(0^\circ\)

Position: 
Degrees: \(\)
III. THE FOREARM  (Note that this is an area and not a joint.)

a) Bones of the forearm

The bones of the forearm are the RADIUS and the ULNA.

b) Function of the forearm

The function of this area is to make the hand more functional in allowing pronation and supination.

Activity: Please list four activities that you could not do if you were unable to pronate and supinate the forearm.

1. __________________________________________
2. __________________________________________
3. __________________________________________
4. __________________________________________
c) Other Structures of the forearm

There are ligaments at the proximal and distal ends of these bones to help to provide stability.

There is also a strong membrane that helps to attach the two bones along the middle.

\[\text{LIGAMENT} \quad \text{ulna} \quad \text{MEMBRANE} \quad \text{LIGAMENT} \]

\[(\text{anterior view})\]

\[\text{radius} \quad \text{ulna} \quad \text{LIGAMENT} \quad \text{MEMBRANE} \]

\[(\text{posterior view})\]

d) Movement of the forearm

In supination, the radius and ulna are parallel to each other (A).

In pronation the radius crosses over the ulna (B).

The actual crossing of bones occurs in the forearm; thus we have decided to describe supination and pronation as happening in the forearm.

\[(\text{A}) \quad \text{(anterior view left forearm and hand)} \]

\[(\text{B})\]
e) Range of Motion of the forearm

Activity: For the pictures given below, please write the name of the position and the number of degrees between starting and ending positions. The amount of space between them is a darker area.

<table>
<thead>
<tr>
<th>Position</th>
<th>Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP</td>
<td>90°</td>
</tr>
<tr>
<td>EP</td>
<td>0°</td>
</tr>
</tbody>
</table>

IV. THE WRIST

(palmar view, left hand)
(dorsal view, left hand/wrist)
a) Bones of the wrist

The wrist is made of the joining of the distal RADIUS/ULNA and the CARPAL BONES.

b) Function of the wrist

Like the other joints in the upper limb, the wrist joint helps to make the hand more mobile and functional in everyday activities.

c) Other Structures of the wrist

There are many small ligaments that attach the bones of the forearm and the carpal bones together.

d) Movement of the wrist

Note that in the elbow, the proximal part of the ulna has the most contact and importance in movement. (A)

In the wrist, it is the distal part of the radius that plays the major role in contact and movement. (B)
e) Range of Motion

Activity: For the pictures given below, please write the name of the position and the number of degrees between starting and ending positions. The amount of space between them is a darker area.

- **Position:** neutral
  - **Degrees:** 0°

- **Position:** neutral
  - **Degrees:** 0°

- **Position:**
  - **Degrees:**

- **Position:**
  - **Degrees:**

- **Position:**
  - **Degrees:**
V. THE HAND/FINGERS

a) Bones of the hand/fingers

**Question:** There are many bones and many joints in the hand. What are the names of the bones in the hand?

_________________________  ___________________________  ___________________________

**Activity:** Look at the fingers and thumb; how many joints (total) are in these parts?

Fingers: __________       Thumb: __________
b) Function of the hand/fingers

Activity: Think about all the times you use your hands in one day. Please list five activities that you do with your hands.

1. 
2. 
3. 
4. 
5. 

Your hands are the tools that you have to grab and move all things (light, heavy, big, or small) in any way that you wish.
c) Other Structures of the hand/fingers

In the hand and fingers there are many, many ligaments that hold all of these small bones together.

Look at the shape of the palm; you can see that it is not flat, but looks more like the shape of a spoon.

This helps to make objects easier to hold. It is made by bone shape, ligaments, and small muscles of the hand.

There are also many tendons that attach to different bones in the hand.

These tendons are from muscles that work to extend or flex the hand; they can be seen on the dorsal and palmar side of the hand or wrist.
Activity:

Supinate your forearm and put your thumb and last finger together. Slightly flex your wrist. When you look at your wrist you should see one long tendon that comes from your forearm and passes your wrist.

Pronate your forearm. Flex all of your fingers together making a fist. In this position, gently move your index finger in abduction and adduction. You can see the tendon moving across the knuckle.

d) Movement of the hand/fingers

Because the hand has many small bones, it can easily change its shape to fit many different sizes and shapes of objects.

A special movement found only in humans in the movement made by the thumb.

This movement is called opposition. Opposition is the thumb's ability to touch the other fingers in the hand.

We use opposition every time we write (holding a pen between fingers and thumb), eat (holding a spoon or food between the fingers and thumb), in dressing, and many other activities during the day.

Opposition is very important!

e) Range of Motion of the hands/fingers

Because the movements of the hand are difficult to measure, sometimes it is better to describe the position of the fingers and thumb and say what they can do functionally.
Activity:

For each of the pictures below, write the name of the position only.

name of position of proximal finger joint:

name of position of the thumb:

name of position of distal finger joint:
VI. THE HIP

a) Bones of the hip

The hip is the joining of the FEMUR with the ILIAC BONE.

The way the two bones come together is similar to the shape of the place where the humerus and scapula meet in the shoulder.

Activity:
In your own words, describe the shape of the hip joint where the surfaces of the femur and iliac bone come together.
Although the hip joint and the shoulder joint are similar in their shape, there are some differences between the two joints:

* The place on the iliac bone where the femur attaches is deeper than the place where the humerus attaches to the scapula.

* Ligaments and tendons in the shoulder are very important for stability.

* The ligaments and tendons in the hip are not as important because the bone shape helps to make the hip joint more stable.

* The hip is a bigger and stronger joint made for weight bearing; the shoulder is not.

b) Function of the hip

The function of the hip is weight bearing and mobility.

It allows the leg and foot to be placed in many different positions; it also holds the weight of the upper body during standing and walking activities.

Activity:

Normally your hip joint can move in many directions. Imagine this has changed. Your hip joint is now fused and no movement can happen here. Your lower limbs are in a straight position only, and cannot move.

Describe how you put your pants on in the morning.
Activity: (continued)

Describe how you walk.

Describe how you sit.

(c) Other Structures of the Hip

There are many strong ligaments that help support the hip on all sides.
d) Movement of the hip

It is important to know that the hip joint is indirectly attached to the sacrum (i.e. the femur attaches to the iliac bone and the iliac bone attaches to the sacrum).

This means that movement at the hip can affect the vertebral column.

This is because of the many ligaments and tendons that are in these areas.

Activity:

Put your body in supine position with the lower limbs straight. Feel the lumbar area of your vertebral column.

In supine position, flex your hips and knees, and put your feet flat on the floor. Again feel the lumbar area of your spine.

In what position do you feel more lumbar lordosis?

What position decreases lumbar lordosis?
Activity:

For the pictures given below, please write the name of the position and the number of degrees between starting and ending positions. The amount of space between them is a darker area.

1. Position: ___________  Degrees: ________
2. Position: ___________  Degrees: ________
3. Position: ___________  Degrees: ________
4. Position: ___________  Degrees: ________
5. Position: ___________  Degrees: ________
VII. THE KNEE

a) Bones of the knee

The bones that make the knee joint are the distal part of FEMUR, proximal part of TIBIA, and the PATELLA.

Although the fibula is near the joint, it is not a part of the knee joint.

b) Function of the knee

The knee helps to support the weight of the body in standing and walking and helps in mobility (walking, sitting and squatting activities).

Knee flexion and extension also provide a functional shortening and lengthening of the lower limb.
c) Other Structures of the knee

The bones of the knee do not give it much stability; but the many strong ligaments that connect the bones, and the tendons that cross the joint help to make it a stable joint.

It is more stable in extension than in flexion because the ligaments are more tight in extension.

There is also special cartilage (called MENISCUS) that is between the femur and the tibia. Its function is for increased stability and to decrease hitting of the femur and tibia together.

The knee joint is one of the most complex because of the many tendons and many ligaments that attach in this area.

The joint capsule is also very big and is important in holding the fluid that helps the three bones easily move upon one another.

d) Movement of the knee

The patella changes its position with knee flexion and extension. In flexion it moves down, in extension it moves up.

A small amount of internal and external rotation can happen at the knee. These movements happen only when the knee is flexed at 90°.

It is not important for the PTA to measure this movement; just know that some rotation of the knee can occur when the knee is in a flexed position.
e) Range of Motion of the knee

**Activity:**

For the pictures given below, please write the name of the position and the number of degrees between starting and ending positions. The amount of space between them is a darker area.

- **Position 1:** degrees:
- **Position 2:** degrees:

**VIII. THE ANKLE**

- **Internal view:** talus and calcaneus
- **Posterior view:** ankle
- **External view:** calcaneus
a) Bones of the ankle

Many people will call the area where the foot and the leg meet the "ankle"; generally, this is true.

More specifically, the ankle joint is the connection between the TALUS, the distal part of TIBIA, and the distal part of FIBULA.

b) Function of the ankle

The ankle attaches the foot to the leg.

It works closely with the foot to support the body in standing, helps in contacting and leaving the ground when walking, can help make you taller in reaching high places, and allow you to tap your feet to music.

c) Other Structures of the ankle

Again, as in all of the joints, there are ligaments to help keep the bones together. The ligaments of the ankle joint help to give stability to the area.

**Question:**

Sometimes when you walk or run you turn your ankle and fall on the external side of the joint. The area below the distal fibula may have pain and swelling. What could be damaged?
e) Range of Motion of the ankle

Activity:

For the pictures given below, please write the name of the position and the number of degrees between starting and ending positions. The amount of space between them is a darker area.

position: NEUTRAL
degrees: 

position: 
degrees: 

position: 
degrees: 

IX. THE FOOT/TOES

a) Bones of the foot/toes

**Activity:**
As in the hand, there are many bones and joints in the foot and toes. Please write all of the bones that you know in the foot.

________________________
________________________
________________________

b) Function of the foot/toes

The foot functions as our only contact with the ground when walking. It carries all of the weight of our body and adapts its shape to adjust to the surfaces we walk on.

Think about this as you walk on rocks, over uneven surfaces, and up and down hills.
The foot will always try to have complete contact with the surface it is walking on.

**Question:**

One boy (A) walks with very hard bottoms (soles) on his shoes; they cannot bend much. One boy (B) walks with thin rubber on the bottom of his shoes. On uneven surfaces, which boy will have the most movement between the bones in his feet?

**Why?**

---

c) Other Structures of the foot/toes

As in the hand, there are many small ligaments that attach the bones together.

Just as the hand has a special shape, so does the sole (bottom of the foot).

The rounded part is called an arch. The arches help the foot adjust to the different surfaces that it moves on.
There are also many tendons that attach to the bones of the foot and toes.

These tendons are from muscles that will dorsiflex or plantarflex the foot.

**Activity:**

You can see many tendons on the dorsal side of the foot if you extend the toes.

Posteriorly, you can see and feel a big tendon just superior to the calcaneus.

There are also many small muscles located in the foot/toe area.

d) Movement of the foot/toes

**Inversion** and **eversion** are important movements that happen in the foot.

They are combinations of many movements.

Generally the result of these movements is:

**Inversion** -- when the bottom of the foot turns to the inside.

**Eversion** -- when the bottom of the foot turns to the outside.
Movement of the toes are flexion/extension and a little abduction and adduction.

e) Range of Motion of the foot/toes

Activity:

Because movement of the foot and toes is difficult to measure, sometimes it is better to describe the position of the foot and toes and what they can do functionally.

For each of the pictures below, write the name of the position only.
X. THE VERTEBRAL COLUMN

a) Bones of the vertebral column

Activity:
From your study in Osteology, please give the names of the areas of the vertebral column and the number of vertebrae in each area.

<table>
<thead>
<tr>
<th>Area</th>
<th>Number of vertebrae</th>
</tr>
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<tbody>
<tr>
<td></td>
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</tbody>
</table>
Generally, each vertebra joins together in two places.

One place is between the bodies of the vertebrae (with the discs between each one), and one place is posterior between the small parts of the vertebrae called articulating processes or facets.

b) Function of the vertebral column

**Activity:**

Again from your study in Osteology, what are the functions of the vertebral column?

1. 

2. 

3. 

The disc, ligaments and muscles help control each vertebral joint.

We have said that the disc helps the vertebral bones to move on each other for bending actions.
The outer part of the disc is strong and firmly attached to the vertebral bodies.

The inner part is like a thick liquid that moves as the vertebrae bend on each other.

Ligaments are found anterior to the vertebral body, posterior to the vertebral body, between spinous processes, and between transverse processes.

Each ligament gives the vertebral column more stability by limiting movement in specific directions.
Activity:

For the pictures below, please write what direction of movement each ligament (A, B, C, D, E, F) will limit.

Ligament A limits _______________________

Ligament B limits _______________________

Ligament C limits _______________________

Ligament D limits _______________________

Ligament E limits _______________________

Ligament F limits _______________________

What movement is most limited by ligaments?
vertebral bone shape does not limit flexion movements. Extension movements are limited by the shape of the vertebral bones (think of spinous processes).

This is the main reason why there are many ligaments that help to limit flexion, and few ligaments that limit extension.

There are also ligaments that help attach the sacrum to the iliac bone.

Muscles attach to each of the vertebrae to give them stability and help them move.

d) Movement of the vertebral column

Each vertebra does not move much by itself, but when all of the bones move together you can see a big change in the position of the vertebral column.

Activity:

One student will stand in front of the class and slowly make different movements of the trunk. The class should observe the movement of the vertebral column and discuss the following:

. The place(s) where you see the most rotation

. The places(s) where you see the most lateral bending

. The places(s) where you see the most flexion/extension

Discuss your observations with the entire class.
Remember that the ribs attach to each thoracic vertebrae.

In inspiration (taking air in) the ribs move up and out.

In expiration (pushing air out) the ribs move down and in.

e) Range of Motion of the vertebral column

As in the other areas that have many bones (hand, foot), the movements in the vertebral column are difficult to measure.

It is important that you can identify the different movements and positions so that you can describe them if they are not normal.

Activity:

For each of the pictures below, please write the name of the position only.

name of position

name of position
Activity: (continued)

For each of the pictures below, please write the name of the position only.

(name of position) (name of position)

(posterior view) (superior view)
Activity:

Below are pictures of different joints of the body.

For each picture, you must:

a) Put a circle around the joint.

b) Name the joint.

c) Write the view (what direction you are looking at the joint — anterior, posterior, lateral).

d) Name the bones that make the joint.

e) Label these bones on the picture.

Joint ____________________

View ____________________

Bones ____________________

Joint ____________________

View ____________________

Bones ____________________

Joint ____________________

View ____________________

Bones ____________________
Activity: (continued)

Joint _____________
View _____________
Bones _____________

Joint _____________
View _____________
Bones _____________

Joint _____________
View _____________
Bones _____________

Joint _____________
View _____________
Bones _____________
XI. SPECIAL VOCABULARY

In the beginning of this chapter we discussed major joints of the body, their general shape and the movements they can do.

Now that you are familiar with these, it is important to present some of the problems that can occur with a joint.

There are four medical words that you should be familiar with.

These are: **hypermobile**, **hypo**mobile, dislocation, and sprain.
HYPERMOBILE

The joint moves more that it normally should (more than complete ROM). An example is that in some people the elbow can bend more than 0°.

HYPOMOBILE (stiff)

The joint moves less than it normally should (less than complete ROM). An example is if a knee has not moved for 3 months, it will probably be stiff or hypomobile.

DISLOCATION

Normally two bones come together and move on each other in a specific way.

When one of these bones is pushed in a position where there is no longer normal contact between the bones, the joint is said to be dislocated.
SPRAIN

When the ligament holding the two bones together become overstretched or torn.

Posterior view of right ankle

A. Hands are feeling a NORMAL ligament that connects the fibula to the talus and calcaneus.

B. Hands are feeling the same ligament that connects the fibula to the talus and calcaneus. This picture shows a torn ligament; this is one type of ankle SPRAIN. A torn ligament results in more joint mobility and less joint stability.
RANGE OF MOTION EVALUATION GUIDELINES

To know how much movement (range of motion) a patient has at a joint, the PTA can observe the active movement, or can move the limb passively.

In this manual we will discuss methods for PASSIVE RANGE OF MOTION EVALUATION.

General guidelines for all passive range of motion evaluation techniques.

1. Put the patient in a comfortable position so that the individual joint can be easily moved through its range of motion. (Position similar to anatomical position.)

2. Instruct the patient as to what you are going to do and why (moving the limb to find the areas that may be stiff or painful).

3. For PASSIVE measurement, ask the patient to relax and the PTA will do all the work.

4. Hold the limb around the joints to support these parts and have better control of the movement.

5. Move the limb slowly through the range of motion; observe at what angle the patient has pain and at what angle you feel stiffness. *

* Note that when one area is stiff and cannot move, other parts of the body will try to help make this movement; this is called COMPENSATION.

It is important that during the evaluation, the PTA observes the patient carefully to be able to identify what movements are happening at the specific joint, and what movements are being held by other parts of the body.
Example:

When you are testing right shoulder abduction, the movement should be at the joint.

If the joint is stiff, the patient may begin to bend their body to the left so it would look like an abduction movement, but actually the joint angle would not change.

This would be compensation seen in the vertebral column.

6. The PTA should write what compensatory movement he observes in his evaluation.

7. After the PTA completes the evaluation of one joint, he should write the results down on paper in order to remember the details.

8. The PTA must always compare the two sides of the body. Often this will help the PTA identify the "normal" movement for the patient and what movement is limited.
The pictures on the following pages are to be used as general guidelines for hand positioning and patient positions.

**THE SHOULDER**

- Flexion
- Abduction
THE SHOULDER

EXTENSION *

(* May modify this position to see the patient.)

ADDITION

INTERNAL AND EXTERNAL ROTATION
**ELBOW**

FLEXION AND EXTENSION

**WRIST**

FLEXION
EXTENSION
ABDUCTION
ADDUCTION

**FOREARM**

PRONATION AND SUPINATION
THE HAND

FINGER FLEXION

STRETCHING THE ARCH

FINGER FLEXION AND EXTENSION
THE HIP

FLEXION

(* May modify this position to prevent the opposite leg from lifting.)

INTERNAL AND EXTERNAL ROTATION
THE HIP

EXTENSION

ABDUCTION AND ADDUCTION*

(* May modify this position to prevent the opposite leg from moving inward.)
ANKLE

DORSIFLEXION AND PLANTARFLEXION

THE FOOT

TOE FLEXION AND EXTENSION

FOOT INVERSION AND EVERSION
H. CHAPTER SUMMARY

ARTHROLOGY is the study of joints. A joint is where two or more bones come together.

Joints help to hold the bony skeleton together and allow movement of bones in specific directions.

Bone shape helps to decide what movement can happen at a joint.

The main parts of a movable joint are:

- **LIGAMENT** connects bone to bone
- **TENDON** connects muscle to bone
- **CARTILAGE** smooth covering on the ends of bone
- **CAPSULE** sac that surrounds a joint and holds fluid that helps keep cartilage wet and smooth

Range of motion is the amount of movement at a joint.

The movement is measured in degrees (°).

A summary of the general anatomy, types of movement, and amount of movement for main joints/body areas is given in the table on the following page.
<table>
<thead>
<tr>
<th>JOINT / BODY AREAS</th>
<th>BONES</th>
<th>TYPES OF MOVEMENTS</th>
<th>AMOUNT OF MOVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHOULDER</td>
<td>humerus/</td>
<td>Flexion</td>
<td>0 - 180</td>
</tr>
<tr>
<td></td>
<td>scapula</td>
<td>Extension</td>
<td>0 - 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ABDuction</td>
<td>0 - 180</td>
</tr>
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<td></td>
<td></td>
<td>ADDuction</td>
<td>0 - 40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Int. Rotation</td>
<td>0 - 90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ext. Rotation</td>
<td>0 - 90</td>
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<tr>
<td></td>
<td>(clavicle)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELBOW</td>
<td>humerus/</td>
<td>Flexion</td>
<td>0 - 135</td>
</tr>
<tr>
<td></td>
<td>radius</td>
<td>Extension</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>ulna</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FOREARM *</td>
<td>radius/</td>
<td>Supination</td>
<td>0 - 90</td>
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<tr>
<td></td>
<td>ulna</td>
<td>Pronation</td>
<td>0 - 80</td>
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<tr>
<td>WRIST</td>
<td>radius/ulna</td>
<td>Flexion</td>
<td>0 - 80</td>
</tr>
<tr>
<td></td>
<td>carpal bones</td>
<td>Extension</td>
<td>0 - 80</td>
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<td></td>
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<td>ABDuction</td>
<td>0 - 45</td>
</tr>
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<td></td>
<td>ADDuction</td>
<td>0 - 30</td>
</tr>
<tr>
<td>HAND/FINGERS *</td>
<td>carpals</td>
<td>Flexion</td>
<td>Describe</td>
</tr>
<tr>
<td></td>
<td>metacarpals</td>
<td>Extension</td>
<td>functional</td>
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<tr>
<td></td>
<td>phalanges</td>
<td>ADDuction</td>
<td>movement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thumb Opposition</td>
<td></td>
</tr>
<tr>
<td>HIP</td>
<td>femur/</td>
<td>Flexion</td>
<td>0 - 135</td>
</tr>
<tr>
<td></td>
<td>iliac bone</td>
<td>Extension</td>
<td>0 - 20</td>
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<tr>
<td></td>
<td></td>
<td>ABDuction</td>
<td>0 - 45</td>
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<td></td>
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<td>ADDuction</td>
<td>0 - 20</td>
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<td></td>
<td></td>
<td>Int. Rotation</td>
<td>0 - 30</td>
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<tr>
<td></td>
<td></td>
<td>Ext. Rotation</td>
<td>0 - 45</td>
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<td></td>
<td>(clavicle)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KNEE</td>
<td>femur</td>
<td>Flexion</td>
<td>0 - 135</td>
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<tr>
<td></td>
<td>patella</td>
<td>Extension</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>tibia</td>
<td>Int. Rotation</td>
<td>very</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ext. Rotation</td>
<td>small</td>
</tr>
</tbody>
</table>
A hypermobile joint is one that moves more than it normally should.

A hypomobile (stiff) joint is one that moves less than it normally should.

Dislocation is when the bones of a joint are pushed in an abnormal position where they lose contact with the other.

Sprain is when the ligament holding the 2 bones together becomes stretched or torn.

Guidelines for evaluating ROM at each joint are given in this chapter.

Compensation is the extra movement of a part of the body in trying to help another part move.

PTA must practice ROM techniques!!
CHAPTER 6

MYOLOGY
MYOLOGY is the study of muscles.

OBJECTIVES
At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. describe (in own words) how a muscle works; to include brain, nerve, muscle fiber.
2. write two reasons why you may have pain in a tired muscle.
3. identify if an action uses an isometric, eccentric, or concentric muscle contraction.
4. describe "gravity" and identify gravity and non-gravity position for different muscle groups.
5. identify specific muscle names, locations and actions.
6. demonstrate muscle testing techniques for specific areas and patient problems.

CHAPTER CONTENTS
A. INTRODUCTION
B. TYPES OF MUSCLES
C. GENERAL INFORMATION ABOUT SKELETAL MUSCLES
D. GRAVITY
E. TYPES OF MUSCLE CONTRACTIONS
F. ATTACHMENT OF MUSCLES TO BONE
G. WHERE MUSCLES CROSS A JOINT
H. MUSCLES THAT CROSS TWO JOINTS
I. SPECIFIC MUSCLE ATTACHMENTS IN THE BODY
J. LEVELS OF MUSCLE STRENGTH
K. MUSCLE TESTING
L. CHAPTER SUMMARY
A. INTRODUCTION

MYOLOGY is the study of muscles. MUSCLES MAKE MOVEMENT! If there are no muscles, then there is no active movement.

Activity:

We have learned about bones and joints. Are bones and joints useful if we have no muscles?

Why or why not?

B. TYPES OF MUSCLES

There are three different types of muscles in the body; cardiac muscle, smooth muscle, and skeletal muscle.

Each type is responsible to move different parts of our body.

* Cardiac muscle: This is a special muscle that is found only in the heart. (GENERAL BODY SYSTEMS, pages 17-19).

* Smooth muscle: This type of muscle is found in the walls of blood vessels, stomach/intestines/bladder, and in the colored part of the eye (see activity #2).

Smooth muscle and cardiac muscle work even when we don't tell them to.

They work while we talk, eat, study, and sleep. Even if we try to tell them to stop, these muscles will continue to work!
Activity:

Imagine your body has changed. You must now tell your heart to beat, tell the blood vessels to move blood, and tell the intestines and stomach to push and move food through them.

If you do not tell them, they will not work.

Try to direct all of these muscles and parts for one minute; do this now.

Is it difficult to remember to do everything?

Could you play volleyball and, at the same time, continue to tell of these muscles to work?

What happens when you go to sleep?

Activity #2

Form groups of two people each. Each student close their right eye and also cover it with their right hand. Stay in this position for 30 seconds.

When you remove the hand and open the eye, the student should quickly look at the colored part of the right eye of the other.

What movement did you see in the colored area?
Explanation

The colored part of your eye are muscles that control the amount of light that you need to be able to see.

If it is dark, they allow the hole (the black circle) to become bigger.

If it is too bright, they try to make the hole smaller.

They do this automatically -- without you telling them to do it.

BRIGHT LIGHT (hole is smaller because you don’t need too much light).

DARKNESS (hole is bigger because you need more light to be able to see).

Skeletal muscle: This is the muscle that is attached to the bones in our body.

Skeletal muscle moves our limbs, trunk, head, fingers and toes, and all movable joints.

These muscles move our body because we tell them to.

We decide to lift our arm .... the brain sends a message to the muscle, and then the muscle will work.

Normally, our arm will not lift unless we have asked it to.
Activity:

Voluntary means something happens because we want it to.

Involuntary means something happens even if we don’t want it to.

Apply these works to the three types of muscles.

1. What muscle type(s) are voluntary muscles?

2. What muscle type(s) are involuntary muscles?

Think of the tongue and the ability to move the eye in many directions.

Are these parts moved by voluntary or involuntary muscles?

Because skeletal muscle is the type that moves the limbs and body, it is the one that PTA's should study and know.

C. GENERAL INFORMATION ABOUT SKELETAL MUSCLES

There are many things to learn about the skeletal muscle; the following topics will be discussed in this section.

1. What a muscle is made of.
2. How a muscle becomes bigger and smaller.
3. How it works.
4. Nutrition/Wastes ... what happens when a muscle is tired.
5. How and when a muscle stops working.
6. Naming muscles.
7. Muscle opposites.
1. What a muscle is made of

A complete muscle is made of:

a. tendon

b. muscle fibers

a. tendon

The tendon is the non-contracting part of a muscle. It does not change its length.

The function of the tendon is to attach the muscle to bone (see page 30).

b. muscle fibers

The muscle fibers are the working parts of the muscle. (The fibres are often called the muscle belly. In this manual, the word muscle most often refers to the muscle belly.)

Muscle fibers can become shorter or longer - muscle fibers would always like to become shorter (like an elastic band).

Each muscle has thousands and thousands of muscle fibers.

The number of muscle fibers that we have in our body rarely changes.

We have a specific number when we are a baby. When we are an adult, we generally have that same number.
The fibers in a muscle are well organized. A simple comparison is with the organization of a school.

Below is a diagram to help show how individual parts (fibers) of a muscle are organized.

2. How muscles become bigger and smaller

As was said earlier, the number of muscle fibers generally does not change.

With training and exercise, the muscle fibers become more thick and thus more strong.

With no exercise or movement, the muscle fibers become more thin and weak.

A decrease in the size of muscle fibers is called ATROPHY.

Atrophy can be caused by decreased movement of a muscle, or decreased nerves telling the muscle to work (nerve injury).
3. **How muscles work**

Muscles can make only one movement -- **CONTRACT!**

When a muscle contracts, it tries to become shorter.

There are three basic steps for voluntary muscles to work.

a) The brain sends a messenger to tell the muscles to work.

b) The messenger travels along the **NERVES** (special roads that go from the brain to the muscle).

c) When it arrives at the muscle, the messenger orders the muscle fibers to contract!

**THREE BASIC STEPS FOR A VOLUNTARY MUSCLE TO WORK**

a. a.

b. c.

"Hey little messenger, go tell the elbow flexors to work!"

"Hey muscle fiber, CONTRACT!!!"

I was just relaxing

"Contract!"

"AARGH!!!"

"I pulled as much as I could!"

GOOD JOB!!
We had said before that the muscle is made of many individual parts called **fibers**.

*Each fiber is the same length as the muscle that it is in.*

One messenger will tell more than one muscle fiber to work.

When a messenger tells these muscle fibers to work, they will work as hard as they can or not at all.

The muscle fibers that a messenger is responsible for are not all in the same place; they are located in different areas of the muscle.

This is to allow equal movement in all of the muscle, and not just in one area.
A NERVE is a road from the brain that carries messages.

One nerve will divide into many smaller nerves (roads) to be able to contact many muscle fibers.

The nerve and the muscle fibers that it goes to are called a MOTOR UNIT. In one muscle, there are many motor units.

Because a muscle fiber is working as hard as it can, it cannot work for a very long time.

When a movement does not need all of the motor units in a muscle, the different motor units will take turns working and relaxing.

In this way, a movement that is very easy can be continued for a long time.

If a movement is difficult to do (if you need more strength to do it), most of the motor units will have to work.

If a movement requires maximum strength, perhaps all motor units must work.

For these actions, the muscle will be able to work for only a short time.

**Activity:**

A. You are sitting on a chair with knees flexed 90° and feet flat on the floor. Plantarflex your left ankle (your toes will remain on the ground and your heel will go up and down) 50 times without stopping. The speed should be two lifts for every second.

B. Come to a standing position. Repeat the same exercise as in "A" with your right ankle. (Plantarflex the right ankle 50 times - two times for each second - in standing position.) Your left foot should not touch the floor.
Activity: (continued)

* What exercise was more easy?

* Did you feel pain in either exercise?

* If yes, with what exercise did you feel the pain, and where did you feel the pain?

In activity "A", not many motor units were needed to plantarflex your left ankle.

In activity "B", you had to lift the weight of your body everytime you plantarflexed your foot and so more motor units had to work to help you do this.

They had to work very hard in the calf muscles ... in these areas you may have felt pain.

In the next section we will discuss what causes this pain.
4. Nutrition and Wastes — What happens when a muscle is tired?

Muscles are alive — just as bones and tendons and ligaments are alive.

The same as the others, muscles need food to live. They also need special air (oxygen) to work.

The blood brings food and oxygen to the muscles. The blood carries the food through small tubes called ARTERIES.

When you muscles are very active, they need more food and oxygen! They need more blood! Your heart is the muscle that helps to push blood through the arteries.

Your heart normally beats (works) faster during exercise so that it can push blood more quickly to the muscles that need it.

After they finish using the food, the muscles produce waste. (Just the same as after people eat food, they will produce waste.)

Normally, waste is carried away from the muscles soon after it is produced.

Small tubes called VEINS carry the "used blood" (not much food or oxygen and a lot of waste) away from the muscles.
When a muscle is working so hard or so quickly that the blood cannot bring food and oxygen fast enough, and the wastes cannot be taken away fast enough, then the muscle fibers will find it more and more difficult to work.

In summary, if the muscle does not have enough food, it will not work well (the same as people).

If the muscle has too much waste in it, the muscle will not work well (the same as people).
If there is too much waste in the muscle or the muscle does not have enough food, the muscle may begin to work more slowly or may become more jerky (movement less smooth and less coordinated).

You may also begin to feel pain in the working muscle; soon after this, the muscle may refuse to work at all.

All of the above are the muscle's way of saying that it needs more oxygen and food, and needs to have the wastes carried away.

Severe pain in working muscles from too much waste or not enough food and oxygen is called a CRAMP.

When you stop the activity, the muscles can relax while the blood continues to bring oxygen and food, and wastes are carried away.

Activity:

You are in sitting position. Your right arm is pronated and on the table in front of you. Your palm and fingers are flat on the table. Completely lift and lower your index finger as fast as you can and as many times as you can. All other fingers remain on the table.

After one minute, stop. Do this activity with your left index finger 2-3 times.

Compare the actions of the two fingers.

* What did you observe and feel?

__________________________________________________________________________

__________________________________________________________________________

* Why did this happen?

__________________________________________________________________________

__________________________________________________________________________
5. How and when a muscle stops working

Nerves from the brain can only tell the muscle to work. If these nerves don’t work, then normally the muscle will not work.

It is important to know that normally, the muscles never completely stop working. If they did, then we would be FLOPPY (like a doll).

Normally our muscles are always working a little bit. This small but continuous contraction is called muscle TONE. Muscle tone is the brain’s way of always having the muscles prepared to move.

When we are nervous or afraid, the tone increases so that we are able to move or respond very quickly if we need to.

When we are sleeping, our muscle tone decreases and all of the muscles are more relaxed.

If there is a problem in the brain or spinal cord, sometimes this tone may abnormally increase or decrease without our control.

6. Naming muscles

In this manual we will focus on the function and location of muscles more than remembering their specific names.

For muscles which have names that are used often, the specific name will be given in this chapter.

It is important that the PTA know that the muscles will have the same name as the movements that they make.

This is a general way to "name" the muscles.

Example:

a) Muscles that flex the elbow are called elbow flexors.

b) Muscles that extend the knee are called knee extensors.

c) "Knee extensors" are muscles that extend the knee.

d) "Elbow flexors" are muscles that flex the elbow.
Activity:

1. What is the general name for the muscles that dorsiflex the ankle? 

2. What do finger flexors do? 

3. When you bend the hip, what muscles are working? 

7. Muscle opposites

We have said that muscles can make only movement -- contract. Normally, muscle contraction is what causes joint movement.

For a joint to be able to flex and extend, it must have a flexor muscle on one side of the joint and an extensor muscle on the opposite side of the joint.

For every muscle that makes a movement, there must be at least one muscle that makes the opposite movement. (Example: Flex and Extend are OPPOSITE movements.)

Questions:

* What muscles make the movement opposite to the hip ADDUCTORS?
Questions: (continued)

* What muscles make the movement opposite to the shoulder INTERNAL ROTATORS?

* What muscles make the movement opposite to ankle DORSIFLEXORS?

* What muscles make the movement opposite to the forearm SUPINATORS?

Activity:

You are sitting and your neck is completely flexed with your chin on your chest. If you have no neck extensors, how will you lift your head up so that you are in a neutral position of the neck?

Will you be able to maintain this neutral position?

Why or why not?
It is also important to know that when one muscle contracts, the opposite muscle must slowly relax.

If both a muscle and its opposite muscle contract at the same time, then there will be difficulty in moving a joint at all.

In summary, when one muscle contracts, the muscle making the opposite movement slowly relaxes.

Activity:

You are in a supine and in anatomical position.

* You ABDUCT your right shoulder. What muscles must contract to do this?

[Blank]

What muscles must relax to do this?

[Blank]

* You ADDUCT your right shoulder. What muscles must contract to do this?

[Blank]

What muscles must relax to do this?

[Blank]
D. GRAVITY

Activity:

1. Hold a pen or pencil in the air in front of you. Release it. What happens?

2. Take a small object (rock, paper clip, wood) and hold it away from you. Release it. What happens?

3. Take a piece of paper and hold it near you. Release it. What happens?

4. Hold your arm out in front of you. Relax the muscles. What happens?

In the activity above, the answer to all the questions should be the same: the object or body part should have fallen in the direction of the ground.

It is very difficult to understand the details of WHY it happens, but the PTA should know that the ground would like to PULL everything close to it.

This pulling force is called GRAVITY.

We will now apply gravity to the different movements that we make in our joints.
Activity:

* You are in a standing position with your right shoulder in 160° of flexion. Relax your muscles. What is the end position of your shoulder?

* You are in a supine position with your right shoulder in 160° of flexion. Relax your muscles. What is the end position of your shoulder?

* You are lying on left side with the right shoulder in 160° of flexion. Relax your muscles. What is the end position of your shoulder?

* You are in prone position with your right shoulder off the side of the table. Your right shoulder is in 160° of flexion. Relax the muscles. What is the end position of your shoulder?

In the above activity you have observed that all of the end positions of the shoulder were different.

But, in the relaxed position, all of the arms fell (were pulled) toward the ground.

They were moved by gravity (in the same direction as gravity pulls) ... towards the ground.

Observe that it did not take any muscle power; gravity did all the work.
Activity:

You are in standing position. You begin to flex your right shoulder. The arm is moving in a direction against gravity ... moving away from the ground. To move against gravity, you need to have the muscles work.

Activity:

* In what position does your knee extend AGAINST gravity?

* In what position does your elbow flex WITH gravity?

* Is your forearm in pronation or supination to have your wrist flex AGAINST gravity?

* In what position do your dorsiflex your ankle AGAINST gravity?

* In what position do you flex your knee WITH gravity?

* In what position do you extend your elbow WITH gravity?

* Is your forearm in pronation or supination to have your wrist extend WITH gravity?
In summary, GRAVITY is the ground trying to pull everything close to it.

Gravity pulls everything in the same direction .. toward the ground.

To go against this pulling force, you need muscles to work.

If muscles are completely relaxed, gravity will try to pull all of the body toward the ground (you are moved with gravity .. in the same direction as the ground).

E. TYPES OF MUSCLE CONTRACTION

There are three basic types of muscle contractions: ISOMETRIC, CONCENTRIC, and ECCENTRIC.

We have said many times that a muscle can do only one thing ... CONTRACT.

When a muscle contracts, it would like to become shorter and so cause joint movement.

1. Isometric muscle contraction

Your muscles contract (try to become shorter) but do not change their length; this is called an ISOMETRIC muscle contraction.
Examples:

a) To lift something, normally the elbow flexors will contract and the elbow will bend.

You now try to lift a truck. Your elbow flexors are contracting very hard, but the elbow joint is not moving.

This is an ISOMETRIC contraction of the elbow flexors. (See picture).

```
I will try to lift this truck.
```

```
I cannot lift this truck at all.
```

b) You are standing with your back against a wall. Your try to extend your right arm; you make no movement at the joint because the wall prevents this.

You contract the shoulder extensors, they work but there is no joint movement. This is an ISOMETRIC contraction of the shoulder extensors. (See picture).

```
I can't extend my shoulders because the wall stops me.
```
c) Sit on the floor with your lower limbs extended and relaxed. Contract your knee extensor muscles by pushing your knee into the ground. There is no joint movement, but this muscle is working. This is an ISOMETRIC contraction of the knee extensors. (See picture).

2. Concentric muscle contraction

Your muscles contract and the muscle shortens; the two ends of the muscle come together causing joint movement. This is called a CONCENTRIC muscle contraction.
Examples:

a) You are standing in anatomical position. You contract your right elbow flexors so your right elbow bends.

Your elbow flexors have become more "short" and there is joint movement.

This is a CONCENTRIC muscle contraction of the elbow flexors.

Remember that gravity is trying to pull your forearm to the ground so the muscles must work against gravity. (See picture).

![Diagram of elbow flexion](image)

b) You are in sitting position with a small baby on your right knee. You contract your right hip flexors to lift the baby higher in the air.

The hip flexor muscles shorten (their ends become closer together) and the joint moves.

This is a CONCENTRIC muscle contraction of the hip flexor muscles. (See picture).

![Diagram of hip flexion](image)
3. Eccentric muscle contraction

Your muscles contract (work) but the ends of the muscle move away from each other; the muscle "lengthens" permitting joint movement; this is called an ECCENTRIC muscle contraction. (See picture).

c) You are in sitting position with both feet on the floor. You contract your right ankle dorsiflexors.

The muscles shorten and the joint moves. This is a CONCENTRIC muscle contraction of the ankle dorsiflexors.

(Remember that gravity is trying to pull your foot towards the ground so the dorsiflexors must work against gravity to lift your foot in an upward direction. (See picture).
**Examples:**

a) You are in sitting position with your right elbow in flexion. You slowly allow your elbow to extend (remember that gravity is trying to pull your forearm towards the ground very fast!)

Your elbow flexors are contracting (working) to **allow the extension of the elbow.** *The ends of the elbow flexor muscles are moving farther apart and there is joint movement.*

This is an **ECCENTRIC muscle contraction.**

(*If the elbow flexors did not work, the forearm would fall quickly because gravity is pulling it to the ground. If the elbow flexors did not become "longer", the elbow would remain in a flexed position.*) (See picture).
b) You are in standing position with your elbows flexed about 90°. A friend gives you a heavy box to hold. It is so heavy that you cannot continue to hold it, and you slowly lower it to the ground.

Your elbow flexors are contracting (working), but the weight of the box is too heavy and it slowly lowers toward the ground.

The end of the elbow flexor muscles are moving farther apart when the elbow flexors are contracting.

This is an ECCENTRIC muscle contraction of the elbow flexors. (See picture).

"Oh, good! A gift for me..."

"Thanks, friend..." "This is too heavy! My muscles are working, but my elbow is straightening, because the box is so heavy!"

c) You are in sitting position on a chair with your right knee extended. You slowly allow your knee to flex (remember that gravity will try to pull your leg quickly to the floor).

Your knee extensors are working to allow your knee to flex.* The ends of the knee extensor muscles are moving further apart and there is joint movement.

This is an ECCENTRIC contraction of the knee extensors.

(* If the knee extensors did not work, the leg would fall quickly towards the ground because gravity is pulling it in that direction. If the knee extensors did not become "longer", then the knee would remain in an extended position.)

(See picture).

"My muscle is working to control and permit my knee to bend"

GRAVITY PULL LEG DOWNWARD

GRVITY PULL LEG DOWNWARD
In summary, the three basic types of muscle contractions are:

* **ISOMETRIC MUSCLE CONTRACTION:**
  The muscle is contracting (working) but there is NO joint movement. The distance between the ends of the muscle does not change.

* **CONCENTRIC MUSCLE CONTRACTION:**
  The muscle is contracting (working) and there IS joint movement. The ends of the muscle come closer together causing joint movement.

* **ECCENTRIC MUSCLE CONTRACTION:**
  The muscle is contracting (working) and there IS joint movement. The ends of the muscle move farther apart allowing joint movement.

Questions:

1. You are sitting in class listening to a teacher. You have a question and raise your arm so the teacher will call on you. What type of muscle contraction have you made with your shoulder flexors?

2. You continue to hold your arm above your head. What type of muscle contraction are you making with the shoulder extensors?

3. The teacher has called on you and you lower your arm. What type of muscle contraction have you made with the shoulder flexors?
Questions: (continued)

4. You are in supine position. You move your right leg away from your left leg. What type of muscle contraction have you made in the right hip abductors?

________________________________________________________________________

Are the right hip adductors working when you do this?

Yes ____________  No _________________

Why or why not?

________________________________________________________________________

F. ATTACHMENT OF MUSCLES TO BONE

* Muscles are attached to bones by tendons. The tendon is part of the muscle, but it is not able to contract like the muscle fibers can.

* Movement happens at a joint (the place where two or more bones come together).

* Muscles must cross a joint to make it move.

* To cross a joint, every skeletal muscle must attach to at least two bones.
Question:
If a skeletal muscle is attached to one bone ONLY, would you have movement at a joint?  
Yes ______  No ______

Why or why not?
_____________________________________________________
_____________________________________________________
_____________________________________________________

* There are at least two tendons for every muscle; generally, there is one tendon on each end of the muscle.

The tendon that attaches to the bone more proximal to the trunk is called the PROXIMAL ATTACHMENT.

The tendon that attaches to the bone that is more distal from the trunk is called the DISTAL ATTACHMENT.
For the muscles that attach to the trunk only, the attachment more near the head is called the SUPERIOR ATTACHMENT.

The other attachment is called the INFERIOR ATTACHMENT.

A muscle crosses the knee joint. One tendon attaches to the femur, and one tendon attaches to the tibia. The PROXIMAL ATTACHMENT of this muscle is to the femur.

The DISTAL ATTACHMENT of this muscle is to the tibia.

Question:

A muscle crosses the hip joint. One tendon attaches to the pelvis, and one tendon attaches to the femur.

Where is the PROXIMAL ATTACHMENT of this muscle?

Where is the DISTALATTACHMENT of this muscle?
G. WHERE MUSCLES CROSS A JOINT

There can be many muscles that cross a joint.

There can also be more than one muscle that causes a specific movement. (Example: There is more than one muscle that flexes the knee.)

It is very important to know where the muscles crosses the joint (the LOCATION of the muscle).

If you know the location of the muscle, then you will know what movement the muscle will cause when it contracts (shortens).

The function of the muscle can be learned by knowing where the muscle crosses the specific joint.

There are many ways that muscles could cross joints and cause movement:

* ANTERIOR to the joint: Shortening causes movement in an ANTERIOR direction.

* POSTERIOR to the joint: Shortening causes movement in a POSTERIOR direction.

* SUPERIOR to the joint: Shortening causes movement in an UPWARD direction.

* INFERIOR to the joint: Shortening causes movement in a DOWNWARD direction.

* EXTERNAL side of joint: Shortening causes movement toward the OUTSIDE.

* INTERNAL side of the joint: Shortening causes movement toward the INSIDE.
Activity:

For each of the pictures given below, please write where the muscle crosses the joint and what movement it will cause when it contracts (shortens).

EXAMPLE

A. This muscle passes ____________ to the knee joint.

When it shortens, it causes ____________ of the knee.

B. This muscle passes ____________ to the hip joint.

When it shortens, it causes ____________ of the hip.
Activity: (continued)

C. This muscle passes

____________________

to the hip joint.

When it shortens, it causes

____________________ of the hip.

D. This muscle passes

____________________

to the wrist joint.

When it shortens, it causes

____________________ of the wrist.
H. MUSCLES THAT CROSS TWO JOINTS

We have said that every skeletal must cross at least one joint to be able to make movement.

Some muscles are special and cross two (or more!) joints.

For these "TWO JOINT MUSCLES", it is important to remember that when they contract, they may cause movement at TWO joints.

Example:

A muscle has its PROXIMAL ATTACHMENT on the posterior side of the femur, and the DISTAL ATTACHMENT on the posterior side of the calcaneus.

When this muscle contracts, it may cause movement in the knee joint AND the ankle joint.

Example:

A muscle has its PROXIMAL ATTACHMENT on the inferior part of the iliac bone, and the DISTAL ATTACHMENT on the proximal tibia (anterior side).

When this muscle contracts, it may cause movement in the hip joint AND the knee joint.
Example:

A muscle has its PROXIMAL ATTACHMENT on the ischium and the DISTAL ATTACHMENT on the proximal part of tibia and fibula on the posterior side.

When this muscle contracts, it may cause movement at the hip and knee.

Example:

A muscle has its PROXIMAL ATTACHMENT on the distal humerus on the external side and its DISTAL ATTACHMENT on the distal phalanges.

When this muscle contracts, it may cause movement at the wrist and fingers.

It will be important to learn the main "two joint muscles" to be able to apply good stretching techniques for different joints. (See STRETCHING chapter, Volume 2.)
I. SPECIFIC MUSCLE ATTACHMENTS IN THE BODY

In this section more detail will be given about where specific muscles pass different joints (or body areas) in the body.

The joints (or body areas) will be presented in the following order:

I. THE SHOULDER
II. THE ELBOW
III. THE FOREARM
IV. THE WRIST
V. THE FINGERS
VI. THE THUMB
VII. THE HIP
VIII. THE KNEE
IX. THE ANKLE
X. THE FOOT
XI. THE TOES
XII. THE TRUNK

For each movement in the joint (or body area) there is a description of the main muscle that is responsible for the movement.

There is a picture beside each muscle that is described.

The student is expected to DRAW the muscle on the picture from the location given in the description.

The student will also write the function of each muscle.

I. THE SHOULDER

A) Shoulder FLEXOR

**PROXIMAL ATTACHMENT:**
External part of clavicle.

**DISTAL ATTACHMENT:**
Anterior and middle part of humerus.

**LOCATION:**
Muscle passes anterior to shoulder joint.

**FUNCTION:**
B) Shoulder EXTENSOR

PROXIMAL ATTACHMENT:
Spines of lower thoracic vertebrae, lumbar and sacral vertebrae.

DISTAL ATTACHMENT:
Proximal part of humerus on the anterior side.

LOCATION:
Muscle passes posterior and inferior to the shoulder joint.

FUNCTION:

C) Shoulder ABDUCTOR

PROXIMAL ATTACHMENT:
Superior part of scapula and clavicle.

DISTAL ATTACHMENT:
Middle of external side of humerus.

LOCATION:
Superior and external to shoulder joint.

FUNCTION:
D) Shoulder ADDUCTORS

ANTERIOR PROXIMAL ATTACHMENT:
Sternum

POSTERIOR PROXIMAL ATTACHMENT:
Spines of lower thoracic, lumbar and sacral vertebrae

DISTAL ATTACHMENT:
Proximal part of humerus

ANTERIOR LOCATION:
Muscle passes anterior to the shoulder joint

POSTERIOR LOCATION:
Muscle passes posterior to the shoulder joint.

FUNCTION:

E) Shoulder INTERNAL ROTATOR

PROXIMAL ATTACHMENT:
Anterior side of scapula.

DISTAL ATTACHMENT:
Proximal part of humerus on the external side.

LOCATION:
Muscle passes anterior to the shoulder joint.

FUNCTION:
F) Shoulder EXTERNAL ROTATOR

PROXIMAL ATTACHMENT:
Posterior side of scapula.

DISTAL ATTACHMENT:
Proximal part of humerus on the external side.

LOCATION:
Muscle passes posterior to the shoulder joint.

FUNCTION:

II. THE ELBOW

A) Elbow FLEXOR (BICEPS)

PROXIMAL ATTACHMENT:
Superior and external side of the scapula.

DISTAL ATTACHMENT:
Proximal part of the radius, external side.

LOCATION:
Muscle passes anterior to elbow joint.

FUNCTION(S):
B) Elbow EXTENSOR (TRICEPS)

PROXIMAL ATTACHMENT:
External side of scapula, proximal and posterior side of humerus.

DISTAL ATTACHMENT:
Proximal part of the ulna on the posterior side.

LOCATION:
Muscle passes posterior to elbow joint.

FUNCTION(S):  

III. THE FOREARM (An area, not a joint)

A. Forearm SUPINATOR

PROXIMAL ATTACHMENT:
Distal humerus on the external side.

DISTAL ATTACHMENT:
Proximal part of the radius on the dorsal and external side.

LOCATION:
Muscle passes on the external side of the elbow joint.

FUNCTION:
B) Forearm PRONATOR

PROXIMAL ATTACHMENT:
Distal humerus on the internal side.

DISTAL ATTACHMENT:
Middle of radius on the external side.

LOCATION:
Muscle passes anterior to elbow joint.

FUNCTION:

IV. THE WRIST

A) Wrist FLEXOR

PROXIMAL ATTACHMENT:
Distal humerus on the internal side.

DISTAL ATTACHMENT:
Proximal part of the metacarpal bones.

LOCATION:
Tendon passes anterior to wrist joint.

FUNCTION:
B) Wrist EXTENSOR

PROXIMAL ATTACHMENT:
Distal humerus on the external side.

DISTAL ATTACHMENT:
Proximal part of the metacarpal bones.

LOCATION:
Tendon passes posterior to wrist joint.

FUNCTION:

C) Wrist ADDUCTOR

PROXIMAL ATTACHMENT:
Distal humerus on the internal side.

DISTAL ATTACHMENT:
Proximal part of the 5th metacarpal.

LOCATION:
Tendon passes wrist joint on the internal side.

FUNCTION:
D) Wrist ABDUCTOR

PROXIMAL ATTACHMENT:  
Distal humerus on the  
external side.

DISTAL ATTACHMENT:  
Proximal part of the  
1st metacarpal.

LOCATION:  
Tendon passes wrist joint on  
the posterior and external side.

FUNCTION:

V. THE FINGERS

A) Finger FLEXORS

PROXIMAL ATTACHMENT:  
Distal humerus on the  
internal side.

DISTAL ATTACHMENT:  
Distal phalanges.

LOCATION:  
Tendon passes anterior to  
wrist and fingers

FUNCTION(S):
B) Finger EXTENSORS

PROXIMAL ATTACHMENT:
Distal humerus on the external side.

DISTAL ATTACHMENT:
Distal phalanges.

LOCATION:
Tendon passes posterior to wrist and fingers

FUNCTION(S):

C) Finger ABDUCTORS (Reference is to middle of hand; 3rd phalange)

PROXIMAL ATTACHMENT:
Metacarpal bones.

DISTAL ATTACHMENT:
Proximal part of phalanges (2, 3, 4, 5)

LOCATION:
Muscles pass on the external side of the 2nd phalange, both sides of the 3rd phalange, and on the internal sides of the 4th and 5th phalanges.

FUNCTION:
D) Finger ADDUCTORS (Reference is to middle of hand; 3rd phalange)

**PROXIMAL ATTACHMENT:**
Metacarpal bones.

**DISTAL ATTACHMENT:**
Proximal part of phalanges (2, 4, 5)

**LOCATION:**
Muscles pass the internal side of the 2nd phalange, external sides of the 4th and 5th phalanges.

**FUNCTION:**

---

VI. THE THUMB

A) Thumb ABDUCTOR

**PROXIMAL ATTACHMENT:**
External carpal bone on external side.

**DISTAL ATTACHMENT:**
Proximal phalange of thumb.

**LOCATION:**
Muscle passes posterior to wrist and thumb.

**FUNCTION:**

---
B) Thumb OPPOSITION

PROXIMAL ATTACHMENT: Middle carpal bone on anterior side.

DISTAL ATTACHMENT: Length of 1st metacarpal bone on anterior side.

LOCATION: Muscle passes anterior to the proximal joint of thumb on external side.

FUNCTION: 

NOTE: The thumb can also make the movements of flexion, extension, and adduction. These are small movements and details of their proximal and distal attachments are not important for the PTA to learn.

VII. THE HIP

A) Hip FLEXOR

PROXIMAL ATTACHMENT: Transverse processes of the lumbar vertebrae, and on the inside of the iliac bone.

DISTAL ATTACHMENT: Proximal femur on the internal side.

LOCATION: Muscle passes anterior to hip joint.

FUNCTION: 

B) Hip EXTENSOR

PROXIMAL ATTACHMENT:
Posterior part of sacrum and iliac bone.

DISTAL ATTACHMENT:
Proximal part of femur on the posterior and lateral side.

LOCATION:
Muscle passes posterior to hip joint.

FUNCTION:

C) Hip ABDUCTOR

PROXIMAL ATTACHMENT:
External part of iliac bone.

DISTAL ATTACHMENT:
Greater trochanter

LOCATION:
Muscle passes on the external side of the hip joint.

FUNCTION:
D) Hip ADDUCTOR

PROXIMAL ATTACHMENT: Ischium

DISTAL ATTACHMENT: The length of the femur on the internal side.

LOCATION: Muscle passes on internal side of the hip joint.

FUNCTION:

E) Hip INTERNAL ROTATOR

PROXIMAL ATTACHMENT: External side of iliac bone

DISTAL ATTACHMENT: Greater trochanter on anterior side.

LOCATION: Muscle passes anterior to hip joint.

FUNCTION:

E) Hip EXTERNAL ROTATOR

PROXIMAL ATTACHMENT: Near ischium on posterior side.

DISTAL ATTACHMENT: Near neck of femur on posterior side.

LOCATION: Muscle passes posterior to hip joint.

FUNCTION:
VIII. THE KNEE

A) Knee FLEXOR (HAMSTRINGS)

PROXIMAL ATTACHMENT:
Ischium (ischial tuberosity)

DISTAL ATTACHMENT:
Proximal part of tibia and fibula on posterior side.

LOCATION:
Muscle passes posterior to hip and knee.

FUNCTION:

B) Knee EXTENSOR (QUADRICEPS)

PROXIMAL ATTACHMENT:
Inferior part of iliac bone.

DISTAL ATTACHMENT:
Patella, and proximal part of tibia on the anterior side.

LOCATION:
Muscle passes anterior to hip and knee.

FUNCTION:
IX. THE ANKLE

A) Ankle DORSIFLEXOR

PROXIMAL ATTACHMENT:
Proximal tibia on the anterior and external side.

DISTAL ATTACHMENT:
Proximal part of 1st metatarsal bone.

LOCATION:
Muscle passes anterior and internal to the ankle joint.

FUNCTION:

B) Ankle PLANTAR FLEXOR

(TRICEPS SURAE, GASTROCNEMIUS)

PROXIMAL ATTACHMENT:
Distal femur on posterior side.

DISTAL ATTACHMENT:
Posterior part of calcaneus.

LOCATION:
Tendon passes posterior to ankle joint.

FUNCTION:
X. THE FOOT

A) Foot EVERTOR

PROXIMAL ATTACHMENT:
Length of fibula on external side.

DISTAL ATTACHMENT:
Proximal part of 5th metatarsal bone.

LOCATION:
Muscle passes behind external malleolus on external side of ankle joint.

FUNCTION:

B) Foot INVERTOR

PROXIMAL ATTACHMENT:
Posterior side of tibia.

DISTAL ATTACHMENT:
Tarsal bones on internal side of foot.

LOCATION:
Tendon passes on internal side of the ankle joint.

FUNCTION:
XI. THE TOES

A) Toe EXTENSORS

PROXIMAL ATTACHMENT:
Length of fibula on the anterior side.

DISTAL ATTACHMENT:
Distal phalanges on dorsal side of the foot.

LOCATION:
Tendon passes anterior to ankle joint.

FUNCTION:

B) Toe FLEXORS

PROXIMAL ATTACHMENT:
Posterior tibia.

DISTAL ATTACHMENT:
Distal phalanges on plantar side of the foot.

LOCATION:
Tendon passes posterior to ankle.

FUNCTION:
XII. THE TRUNK

A) Trunk FLEXORS (ABDOMINAL MUSCLES)

INFERIOR ATTACHMENT:
Pubis (the anterior part of the pelvis where the two iliac bones meet).

SUPERIOR ATTACHMENT:
5th, 6th and 7th ribs.

LOCATION:
Muscle passes on anterior side of the trunk.

FUNCTION:

B) Trunk EXTENSORS

INFERIOR ATTACHMENT:
Near sacrum and pelvis on posterior side of the trunk.

SUPERIOR ATTACHMENT:
Posterior part of ribs and vertebrae.

LOCATION:
Muscles pass posterior to vertebral joints on the right and left sides of vertebral column.

FUNCTION:
C) Trunk LATERAL BENDER

INFERIOR ATTACHMENT:
Posterior iliac crest.

SUPERIOR ATTACHMENT:
Last rib, transverse.

LOCATION:
Muscle passes on external side
of lumbar vertebrae.

FUNCTION:

D) Trunk ROTATOR

INFERIOR ATTACHMENT:
Pubis (the anterior part of
the pelvis where the two iliac
bones meet).

SUPERIOR ATTACHMENT:
Inferior part of the lower
ribs.

LOCATION:
Muscle obliquely passes
anterior to the trunk.

FUNCTION:

It is interesting to be able to say the attachments of muscles and
even better to be able to draw them on a skelton.

Of most importance is to be able to work with the body and FEEL the
muscles as they work.

In this way, you can observe what the muscle does and even find that
there may be many muscles that could help make the same movement.
**Activity:**

Form groups of two people in each group. One student will be making different joint movements while the other student will be observing and feeling the muscles that work.

If the student cannot feel the muscle working, then he should add resistance (try to push the joint in the opposite direction to make the muscle work harder.

**Example:**
Student "A" demonstrates elbow flexion.
Student "B" cannot feel the elbow flexors work.
Student "B" tries to extend the elbow while student "A" tries to keep the elbow in flexion.
With this resistance, student "B" should be able to more clearly see and feel the elbow flexors.

Below are each of the joints and movements to be tested. For each joint movement, write the area where you feel and see the muscle working.

<table>
<thead>
<tr>
<th>JOINT/MOVEMENT</th>
<th>LOCATION OF WHERE MUSCLE IS SEEN AND FELT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elbow Flexion</td>
<td></td>
</tr>
<tr>
<td>Elbow Extension</td>
<td></td>
</tr>
<tr>
<td>Knee Extension</td>
<td></td>
</tr>
<tr>
<td>Knee Flexion</td>
<td></td>
</tr>
<tr>
<td>Ankle Plantarflexion</td>
<td></td>
</tr>
<tr>
<td>Ankle Dorsiflexion</td>
<td></td>
</tr>
<tr>
<td>Hip Extension</td>
<td></td>
</tr>
<tr>
<td>JOINT/MOVEMENT</td>
<td>LOCATION OF WHERE MUSCLE IS SEEN AND FELT</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Hip Flexion</td>
<td></td>
</tr>
<tr>
<td>Hip Adduction</td>
<td></td>
</tr>
<tr>
<td>Hip Abduction</td>
<td></td>
</tr>
<tr>
<td>Trunk Flexion</td>
<td></td>
</tr>
<tr>
<td>Trunk Extension</td>
<td></td>
</tr>
<tr>
<td>Foot Eversion</td>
<td></td>
</tr>
<tr>
<td>Shoulder Abduction</td>
<td></td>
</tr>
<tr>
<td>Shoulder Adduction</td>
<td></td>
</tr>
<tr>
<td>Shoulder Flexion</td>
<td></td>
</tr>
<tr>
<td>Shoulder Extension</td>
<td></td>
</tr>
</tbody>
</table>
**Activity: (continued)**

<table>
<thead>
<tr>
<th>JOINT/MOVEMENT</th>
<th>LOCATION OF WHERE MUSCLE IS SEEN AND FELT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrist Flexion *</td>
<td></td>
</tr>
<tr>
<td>Wrist Extension*</td>
<td></td>
</tr>
<tr>
<td>Finger Extension *</td>
<td></td>
</tr>
<tr>
<td>Finger Flexion *</td>
<td></td>
</tr>
<tr>
<td>Thumb Abduction</td>
<td></td>
</tr>
<tr>
<td>Thumb Opposition</td>
<td></td>
</tr>
</tbody>
</table>

* In the wrist and fingers you may feel the tendons easily, but try to locate the muscle itself.

**J. LEVELS OF MUSCLE STRENGTH**

We have learned about gravity.

We have learned where specific muscles are and the movement that they make.

We have practised to observe muscles and feel them as they work.

We must now be able to clearly and objectively say how strong a muscle is.
Question:
Why do you want to test or know how strong a muscle is?

If a PTA reports that a muscle is "strong" or a muscle is "weak", the listener will have a general idea of what the muscle is like.

Another PTA may describe the SAME muscle as being "strong" and "okay".

Because you want to give clear and precise information that will be the same for everyone who tests a muscle, a system was developed for testing and naming different muscle strengths.

This system is accepted in many areas of the world, and is used by Physical Therapists, Doctors, Nurses and other medical professionals.

THERE ARE SIX DIFFERENT LEVELS OF MUSCLE STRENGTH.

These levels begin at the point where there is no muscle contraction and continue to name the strength until the muscle is normal.

For all the muscle contractions that you test, you ask the patient to make the muscle work as much as he/she can.

It is useful for the PTA to look at both sides of the body to be able to compare the left and right sides.

The following descriptions are the SIX different ways to identify how strong or weak a muscle is.

**NO MUSCLE CONTRACTION AT ALL**
The patient tries to make the muscle work, but because of some nerve damage or other problem, the muscle does not contract.

This is often described as ZERO or "0" muscle strength.
CAN SEE OR FEEL THE MUSCLE CONTRACTING, BUT IS NOT STRONG ENOUGH TO MOVE THE JOINT

The patient tries to make the muscle work and the PTA can see or feel the muscle working, but no movement happens at the joint.

This is often described as TRACE or "1" muscle strength.

THE MUSCLE CAN MOVE THE JOINT, BUT ONLY IN A POSITION THAT IS NOT AGAINST GRAVITY.

The patient tries to make the muscle work, but against gravity it cannot make much joint movement.

When the joint is in a position where it does not move against gravity, then the muscle is able to contract and cause complete joint movement.

This is often described as POOR or "2" muscle strength.

THE MUSCLE CAN MOVE THE JOINT AGAINST GRAVITY

The patient tries to make the muscle work and it is able to make the full joint movement against gravity.

This is often described as FAIR or "3" muscle strength.

THE MUSCLE CAN MOVE THE JOINT AGAINST GRAVITY AND WITH SOME RESISTANCE

The patient tries to make the muscle work and it is able to make full joint movement against gravity.

The PTA will then add resistance to make the movement more difficult; the patient is able to make full joint movement even with this resistance.

This is often described as GOOD or "4" muscle strength.

THE MUSCLE IS NORMAL STRENGTH

The patient tries to make the muscle work and is able to make full joint movement against gravity and with resistance.

If you compare this muscle with the normal muscle on the opposite side of the patient, the two will be the same.

This is often described as GOOD or "5" muscle strength.
K. MUSCLE TESTING

In the beginning, muscle testing may seem difficult and confusing.

For practical muscle testing, the PTA should remember three types of information.

1. Where the muscle is and the movement that it makes.
2. What direction gravity is pulling the part being tested.
3. The six levels of muscle strength and what they mean.

If the PTA can apply this information, then muscle testing will seem more logical and easy.

Below are the general guidelines to follow when doing a muscle test.

a) Begin in the test position against gravity ("3" muscle strength), and change as needed.

b) Instruct your patient clearly so he/she knows what movement to make.

c) If resistance is needed, give it just distal to the joint being tested.

d) Stabilization may be needed to prevent unwanted parts from moving.

e) Comparing right and left side is very useful in determining levels of strength.

f) You do not muscle test hemiplegic or brain injured patients; (explanation will be given in future chapters).

For the larger body parts, gravity will have a big effect on the movement.

For the smaller parts (fingers/toes) gravity has less of an effect and so the testing position is not as important.

The next section will provide pictures of the big joints in the testing position against gravity ("3"). Next to each picture is a space open for COMMENTS. This area should be used to describe the test position without gravity and/or specific information about testing that particular joint movement.
SHOULDER FLEXOR
(against gravity position)

SHOULDER EXTENSOR
(against gravity position)

SHOULDER ABDUCTOR
(against gravity position)
SHOULDER ADDUCTOR
(against gravity position)

SHOULDER INTERNAL ROTATOR
(against gravity position)

SHOULDER EXTERNAL ROTATOR
(against gravity position)
ELBOW FLEXOR
(against gravity position)

ELBOW EXTENSOR
(against gravity position)

FOREARM SUPINATOR
FOREARM
PRONATOR

WRIST
EXTENSOR
(against gravity position)

WRIST
FLEXOR
(against gravity position)
No pictures are given for the following muscles; testing is similar to the movements made.

WRIST ABDUCTOR/ADDUCTOR
FINGER FLEXOR/EXTENSOR
FINGER ABDUCTOR/ADDUCTORS
THUMB ABDUCTION
THUMB OPPOSITION

*********************************

HIP
FLEXOR
(against gravity position)

HIP
EXTENSOR
(against gravity position)
HIP ABDUCTOR
(against gravity position)

HIP ADDUCTOR
(against gravity position)

HIP INTERNAL ROTATOR
(against gravity position)
HIP EXTERNAL ROTATOR
(against gravity position)

KNEE FLEXOR
(against gravity position)

KNEE EXTENSOR
(against gravity position)
No pictures are given for the following muscles; testing is similar to the movement made.

TOE EXTENSOR
TOE FLEXOR
TRUNK FLEXOR
(against gravity position)

TRUNK EXTENSOR
(against gravity position)

TRUNK LATERAL BENDER
(against gravity position)
L. CHAPTER SUMMARY

MYOLOGY is the study of muscles. Muscles make movement.

There are 3 different kinds of muscles.

- **CARDIAC**
  - found in the heart only

- **SMOOTH**
  - we cannot control these muscles, they work automatically
  - (involuntary)

- **SKELETAL**
  - muscles attached to bones so we can actively move our body parts
  - (voluntary)

A skeletal muscle is made of 2 parts

- **TENDON**
  - the non-contracting part that attaches muscle to bone

- **MUSCLE FIBERS**
  - the contracting parts of a muscle; together they are called the muscle belly

A muscle works by the brain sending a message to the muscle telling it to work (contract). This message travels along small roads called nerves.
A muscle needs food to work; it also needs to have waste removed. If there is not enough food and too much waste for the muscle, you may feel pain (cramp) and the muscle may stop working for a short time.

Normally, our muscles are always working a little bit. This small but continuous contraction is called muscle TONE.

Muscles are named by the movements that they make.

Gravity is the ground trying to pull everything in a downward direction.

3 types of muscle contractions:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO Lifetime</td>
<td>The muscle is contracting (working) but there is NO joint movement. The distance between the ends of a muscle does not change.</td>
</tr>
<tr>
<td>CONCENTRIC</td>
<td>The muscle is contracting (working) and there IS joint movement. The ends of the muscle come closer together causing joint movement.</td>
</tr>
<tr>
<td>ECCENTRIC</td>
<td>The muscle is contracting (working) and there IS joint movement. The ends of the muscle move farther apart allowing joint movement.</td>
</tr>
</tbody>
</table>

Specific muscle locations (places of attachment) are given for all main muscles.

Methods of testing how strong a muscle is are given in this chapter. The PTA should practice these muscle testing techniques.
CHAPTER 7

NEUROLOGY
NEUROLOGY is the study of nerves.

OBJECTIVES
At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. identify the differences between the central nervous system and the peripheral nervous system.
2. apply the fact that one side of the brain controls the opposite side of the body.
3. identify the differences between a sensory nerve and a motor nerve.
4. describe the difference between a reflex and a voluntary movement.
5. state the main functions of different spinal cord levels.

CHAPTER CONTENTS
A. INTRODUCTION
B. THREE MAIN NERVOUS SYSTEMS
C. CENTRAL NERVOUS SYSTEM
D. PERIPHERAL NERVOUS SYSTEM
E. CHAPTER SUMMARY
A. INTRODUCTION

NEUROLOGY is the study of nerves. Nerves are like small roads that carry messages to and from all parts of our body.

B. THREE MAIN NERVOUS SYSTEMS

Because this is such a big job, there are three main parts (or systems) that help send and receive messages.

These parts are the CENTRAL NERVOUS SYSTEM, the PERIPHERAL NERVOUS SYSTEM, and the AUTONOMIC NERVOUS SYSTEM.

1. CENTRAL NERVOUS SYSTEM (CNS)

This includes the BRAIN and SPINAL CORD.

The central nervous system can make messages and receive messages also.

2. PERIPHERAL NERVOUS SYSTEM (PNS)

This includes all of the "roads" that connect the parts of the body to the central nervous system.

The peripheral nervous system carries messages to and from the CNS.

Peripheral nerves and voluntary muscles work together.
3. AUTONOMIC NERVOUS SYSTEM (ANS)

This includes the "roads" that connect our internal organs (stomach, intestines, blood vessels, heart, etc) to the CNS.

This system works by itself without our telling it to.

Autonomic nerves and involuntary muscles work together.

Questions:

1. The biceps muscle has received a message to contract. Was this message carried by a peripheral nerve or an autonomic nerve?

2. You have finished eating. Your stomach muscles contract to mix the food and push it toward your intestines. Is this action controlled by the peripheral nervous system or the autonomic nervous system?

So that the PTA can better understand patients with neurological problems (problems with nerves), more details will be given about the central nervous system and the peripheral nervous system.

It will not be important for the PTA to know details of the autonomic nervous system.
C. CENTRAL NERVOUS SYSTEM (CNS)

The central nervous system is made of two main parts;

I. THE BRAIN
II. THE SPINAL CORD

Each of these areas have a special function in sending and receiving messages.

I. THE BRAIN

The topics given in this section include:
1. General Information
2. Function of the brain
3. Blood supply to the brain
4. Movement area of the brain

1. General Information

* The BRAIN is located in the head and protected by the bony skull.

* The BRAIN makes, sends, and receives messages to and from the body.

* The BRAIN is soft and is divided into right and left sides that are connected together. Each side has the shape similar to a small mango.

* It is important to know that one side of the brain controls the opposite side of the body.
THE RIGHT SIDE OF THE BRAIN IS RESPONSIBLE FOR THE LEFT SIDE OF THE BODY.

THE LEFT SIDE OF THE BRAIN IS RESPONSIBLE FOR THE RIGHT SIDE OF THE BODY.

Questions:

1. Your write with your right hand. What side of the brain is controlling this?

2. Your lift your left hip. What side of the brain is controlling this movement?

3. Your move your left toes. What side of the brain is controlling this movement?

4. You right knee feels hot. What side of the brain receives this message?

5. You have damage to the right side of the brain. What side of the body will you find a problem?
2. **Function of the Brain**

Our brain is for many things; thinking, remembering, controlling all parts of the body, receiving messages from all parts, coordination, speaking, emotions, and more.

Different parts of the brain are responsible for different functions.

Each area has a special job to do. Below are pictures to show the jobs of different areas.

The right and the left sides of the brain have the same parts except for the LANGUAGE (SPEAKING) AREA; this area is normally found only on the LEFT SIDE of the brain.

**Activity:**

Color the part of the brain that is responsible for language/speaking.

Color the part of the brain that is responsible for movement.

Color the part of the brain that is responsible for feeling (sensation).
3. **Blood supply to the brain**

The brain is ALIVE just like other parts of our body are alive.

It must have food and oxygen to be able to work.

As we have said, arteries bring food and oxygen to the brain.

There are two big arteries that bring food and oxygen to the brain; they are located on the anterior side of the neck.

**Activity:**

Put your fingers on your neck and try to find the arteries that carry blood to the brain.

When you gently press on them, you can feel the blood pushed toward your brain by the heart.

Each time more blood is pushed through the arteries, you can feel them expand (get bigger) and then contract (get smaller).

If no food and oxygen arrive at the brain it will die. If the brain dies, the body dies also.

There are many small arteries that feed many parts of the brain; if one of these arteries has a problem, then that area of the brain will also have a problem. Other parts of the brain may still be normal.

Please see pictures on the next page.
NORMAL BRAIN

Blood can travel to the brain - no problem.

ABNORMAL BRAIN

The artery bringing food is blocked. The brain receives no food and dies. The dark area is the dead area.

Question:

No food and oxygen arrive at the part of the brain that controls MEMORY (ability to remember) and this part of the brain is now unable to work.

List four problems or difficulties that you will have during a normal day.

1. 

2. 

3. 

4. 
4. Movement area of the brain

Of the different parts of the brain, the area responsible for movement will be the most important for the PTA to be familiar with.

The movement area is located near the front part of the brain on the left side and right side.

If there is damage in the movement area, it will have an effect on the movement of a body part on the opposite side of the body.

Remember, the left side of the body is controlled by the right side of the brain.
Just as specific parts of the brain control specific areas of the body, specific parts of the movement area control movement of specific parts.

EVERY PART OF THE BODY IS REPRESENTED IN THE MOVEMENT AREA OF THE BRAIN.

The amount of space that each part has will depend on the different movements that it makes.

The picture below gives a general idea of where the body parts are and how much space different parts will take in the movement area of the brain.

For example: The area for the trunk is very small while the area for the hand and face is very large.
Questions:
When there is a problem in the movement area of the brain, why does the hand often have a problem?

Why is the HAND area such a big area?

II. THE SPINAL CORD

The topics given in this section include:
1. General information
2. Organization of the spinal cord
3. Functions of the spinal cord

1. General information

* The SPINAL CORD is located along the dorsal side of the back and is protected by the vertebral column.

* The SPINAL CORD is like a long rope that is about the same thickness as your thumb.

* The SPINAL CORD begins at the bottom of the skull and ends at L2 (the second lumbar vertebra).
2. Organization of the spinal cord

The spinal cord is like a rope. If you cut this rope, the end would look like a cut banana with a dark gray "H" in the center.

The white part and the gray "H" each have specific functions that will be discussed in the next section.

The spinal cord is divided into parts just as the vertebral column is divided into parts.

There are cervical parts, thoracic parts, lumbar parts, and sacral parts.

Each part (or segment) has two main roads (nerves) that attach to the left side and two main roads (nerves) that attach to the right side.

These nerves are part of the PERIPHERAL NERVOUS SYSTEM and will be discussed in more detail in that section. (see page 20).

3. Functions of the spinal cord

The SPINAL CORD has two main functions:

a) Acts as the roadway for messages to travel to and from the brain. This is the most important function.

b) Can make fast decisions without the brain.
a) The spinal cord as a roadway

The white part of the spinal cord is the area that contains all roads to and from the brain.

Messages can travel in two directions.

*** There are messages sent FROM the brain TO the muscles to tell them what to do.

Nerves that carry these messages are called MOTOR NERVES.

*** There are messages that come FROM the muscles/skin TO the brain to tell the brain how we are feeling.

Nerve that carry these messages are called SENSORY NERVES.

The spinal cord is the roadway for all of these nerves.

There are always many messages that are travelling in the spinal cord.

These messages must travel in specific directions and to specific places.

Each type of message has a specific road that it travels on. The spinal cord is very well organized to carry all of these roads and messages.
As we have said before, each spinal cord segment has two nerves that attach to the left side and two nerves that attach to the right side.

One of the nerves is a MOTOR NERVE that will carry information from the brain to the muscles.

The other nerve is a SENSORY NERVE that will carry information from the muscles/skin to the brain.

The organization of these nerves is important for know so that the PTA can better understand reflexes.

It is important to understand how sensory and motor nerves (roads) travel in the spinal cord and brain.

REMEMBER!

* ONE SIDE OF THE BRAIN CONTROLS THE OPPOSITE SIDE OF THE BODY.

* ONE SIDE OF THE BRAIN RECEIVES MESSAGES FROM THE OPPOSITE SIDE OF THE BODY.

The nerves coming to and from the brain CROSS in the area where the brain and spinal cord meet.
Example: YOU WANT TO MOVE YOUR LEFT HAND

1. The message starts in the movement area of the right brain.

2. The message travels along a motor nerve (road).

3. The message arrives at the place where the brain and the spinal cord meet and CROSSES to the left side.

4. The message continues to travel along a motor nerve (road). This "road" is in the white part of the left spinal cord.

5. The motor nerve connects to a new motor nerve in the area where it leaves the spinal cord.

6. This new motor nerve leaves the spinal cord continuing toward the left hand.

7. The message continues to follow the motor nerve (road) until it arrives at the left hand.

8. Once at the hand, the message causes the hand to move.
Example: YOU FEEL COLD WATER WITH YOUR RIGHT TOE

1. Information is received in the sensory part of your right toe.

2. The message travels in a sensory nerve on the right side of the body until it arrives at the spinal cord.

3. At the spinal cord it connects to a new sensory nerve.

4. The new sensory nerve carries the message in the white part of the right spinal cord.

5. At the place where the brain and the spinal cord meet, the sensory nerve CROSSES to the left side.

6. The message continues to travel in the left side of the brain until it arrives in the sensation (feeling) area on the left side of the brain.

7. Once at the sensation area, the message informs the brain what the right toe is doing.

(ANTERIOR VIEW)
Note:

If there is damage in the brain ABOVE WHERE THE NERVES CROSS, the problem will be in the opposite side of the body. (A), (C).

If there is damage in an area BELOW WHERE THE NERVES CROSS, the problem will be on the same side of the body. (B), (D).

Activity:

The picture shows five different areas where there has been damage to the nervous system. For each of the areas given, please write what part of the body will be affected.

Example:

Damage at "A"

RIGHT SIDE OF THE BODY

Damage at "B"

Damage at "C"

Damage at "D"

Damage at "E"

(PERIOR VIEW)
b) The spinal cord as a decision maker

The dark "H" colored area in the spinal cord is where fast decisions are made without the brain.

A decision without the brain is called a REFLEX.

HOW REFLEXES HAPPEN:

1. All reflexes start with a sensory nerve message from the body (from muscle or skin).

2. This message arrives at the spinal cord.

3. Because a fast decision is necessary, it goes into the dark "H" area.

4. In the "H" area it connects to a motor nerve.

5. The message travels in the motor nerve and goes directly to the muscle causing a movement to happen.

Example:

If you hit a muscle quickly, the muscle will contract.

If you hit directly on the tendon of some muscles, you can see this REFLEX CONTRACTION.

Tendons that are easy to observe are the biceps tendon, triceps tendon, and quadriceps tendon.
Example:

The sensory nerves in the skin feel something hot. You quickly remove your hand before even thinking.

This is another type of REFLEX RESPONSE.
REFLEXES ARE IMPORTANT FOR TWO REASONS:

1. They can act more quickly than message going to and from the brain. This is good to protect the body from injury.

2. If the roadway to and from the brain is cut, then REFLEXES are responsible for any movement that can occur.

Activity:
In this activity you will try to test the REFLEX movement of the knee extensor (Quadriceps) muscle.

You are sitting on a chair. Cross your left leg over the right one so that the left knee is flexed and relaxed.

With the internal side of your right hand, hit the patellar tendon (it is just below the patella).

What did you observe?

________________________________________________________________________
________________________________________________________________________

Explain how this happened.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

D. PERIPHERAL NERVOUS SYSTEM

In this section the following topics will be discussed.

1. Sensory and motor nerves.

2. General function of nerves going to and from different spinal cord levels.

3. Specific sensory nerve information.

4. Specific motor nerve information.
1. **Sensory and motor nerves**

The peripheral nervous system is made of many nerves (roads) that carry messages to and from the spinal cord.

More specifically, it is made of two parts:

a) **MOTOR NERVES** - "roads" that carry information from the spinal cord to the muscles.

b) **SENSORY NERVES** - "roads" that carry information from the skin/muscles to the spinal cord.

There are sensory and motor nerves that work on the left and on the right side of the body.

The spinal cord is divided into different parts. Each part has two motor nerves and two sensory nerves that attach to it.

* One motor nerve goes to specific muscles on the right side; the other motor nerve goes to those same muscles that are on the left side.

* One sensory nerve comes from the skin and muscles on the left side, and the other sensory nerve comes from the same skin and muscles on the right side.

The nerve that is anterior is the one that carries the messages from the spinal cord to the muscles.

* THE ANTERIOR NERVE IS A MOTOR NERVE.

The nerve that is posterior is the one that carries the information from the muscles/skin to the spinal cord.

* THE POSTERIOR NERVE IS A SENSORY NERVE.
These anterior and posterior nerves come together in a bigger nerve (like two small roads joining one large road).

They do this only for a short time.

They join together so they can pass through the space where they enter and leave the protection of the vertebral column.

2. **General function of nerves going to and from different spinal cord levels**

The CERVICAL part of the spinal cord is where the nerves going to and from the upper limb are located.

The THORACIC part of the spinal cord is where the nerves going to and from abdominal and trunk muscles are located.

The LUMBAR and SACRAL parts of the spinal cord are where the nerves going to and from the lower limbs are located.
Different sensory nerves are responsible to give information about different areas from the muscles and skin.

It is NOT necessary to remember all of the skin areas and sensory nerves, but some are easy to remember.

SKIN AT THE TOP OF STERNUM LEVEL : T 3
* SKIN AT THE END OF STERNUM LEVEL : T 6
SKIN AT THE BELLY BUTTON LEVEL : T 9
SKIN AT THE PUBIC BONE LEVEL : T 12

* This means that the sensory nerve arriving at the spinal cord near the sixth thoracic vertebra will give information about the skin area at the level where the sternum ends.

3. Specific sensory nerve information

In this section, we will give information about:

a. different sensory areas of the body
b. sensory tests

a. different sensory areas of the body

The picture on the following page shows the different areas of skin that sensory nerves receive information from.

Note: Many skins areas have more than one sensory nerve that brings information to the central nervous system (CNS).

It is NOT important for the PTA to remember all of these areas, the picture is only a reminder.
This picture gives the PTA a general idea of in what areas different sensory nerves work.
b. **Sensory tests**

Sensory tests are ways of knowing if a sensory nerve is damaged.

It is important to know if a patient cannot feel an area so that future damage can be prevented (pressure sores, burns).

Two general tests are:

i) skin sensitivity

ii) joint sensitivity

i) skin sensitivity

This test is to identify the areas of skin that may have decreased feeling.

**Technique:**

* The PATIENT’S EYES MUST BE CLOSED

* The PTA will touch the patient lightly with his finger.

* Every time the patient feels a touch, the patient should say "yes" and tell where he feels a touch.

  (The PTA should **not** ask "do you feel?" after every touch.)

* The PTA should compare right and left sides of the patient.

* The PTA should write areas that have decreased feeling.
This test is to identify if the patient can feel different joint movements.

**Technique:**

* The patient's eyes must be closed

* The PTA will passively move different joints in different directions.

* When the PTA stops the movement, the patient must say the position of the joint.

* The PTA should compare right and left sides of the patient.

* The PTA should write areas that have decreased feeling.

**Questions:**

Use the skin sensory picture to answer the following questions.

1. What sensory nerves take information to the spinal cord about the skin around the thumb?

2. What sensory nerve takes information to the spinal cord about the posterior knee area?

3. What sensory nerve takes information to the spinal cord about the dorsal/internal side of the foot?
Questions: (continued)

4. The sensory nerve C3 has been damaged. In what area of the body will have have decreased feeling?

5. The sensory nerve L3 has been damaged. In what area of the body will have have decreased feeling?

4. Specific motor nerve information

Different motor nerves carry information from the spinal cord to different muscles.

A muscle test (see MYOLOGY and SPINAL CORD INJURIES chapters) can be used to help identify what motor nerves may be damaged.

The charts on the following pages tell the main motor nerves that are responsible for main muscle groups.

The PTA does NOT have to know the specific nerves, but may find it useful to use these charts to better understand patients who have spinal cord injuries or peripheral nerve injuries.
<table>
<thead>
<tr>
<th>Specific Muscles at Different Joints</th>
<th>Motor nerves that carry messages to tell muscle to work</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUSCLES</td>
<td>C5</td>
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<tr>
<td>SHOULDER</td>
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<tr>
<td>Flexor</td>
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<td>Extensor</td>
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<td>ABductor</td>
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<td>ADDuctor</td>
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<td>Int. Rot.</td>
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<td>Ext. Rot</td>
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<td>ELBOW</td>
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<td>Flexor</td>
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<td>Flexor</td>
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<td>FINGERS</td>
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<td>THUMB</td>
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<td>Extensor</td>
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<td>Opposition</td>
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<tr>
<td>Specific Muscles at Different Joints</td>
<td>Motor nerves that carry messages to tell muscle to work</td>
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<tr>
<td><strong>MUSCLES</strong></td>
<td><strong>L2</strong></td>
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<tr>
<td>Flexor</td>
<td>x</td>
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<tr>
<td>Extensor</td>
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<td>ABDuctor</td>
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<tr>
<td>Int. Rot.</td>
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<td>Ext. Rot.</td>
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<tr>
<td><strong>HIP</strong></td>
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<td>Flexor</td>
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<td>Extensor</td>
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<td><strong>KNEE</strong></td>
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<td>Flexor</td>
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<td>Extensor</td>
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<td><strong>ANKLE</strong></td>
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<tr>
<td>Dorsiflexor</td>
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<tr>
<td>Plantarflexor</td>
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<td><strong>FOOT</strong></td>
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<td>Invertor</td>
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<td>Evertor</td>
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<td><strong>TOES</strong></td>
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<td>Flexor</td>
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<td>Extensor</td>
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<table>
<thead>
<tr>
<th>Diaphragm and Trunk Muscles</th>
<th>Motor nerves that carry messages to tell muscle to work</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DIAPHRAGM</strong></td>
<td>C3, C4, C5</td>
</tr>
<tr>
<td>Flexor</td>
<td>T5 - T11</td>
</tr>
<tr>
<td>Extensor</td>
<td>T1 - T12, L1 - L5, S1 - S3</td>
</tr>
<tr>
<td>Rotator</td>
<td>T7 - T11</td>
</tr>
<tr>
<td>Lat. Bend.</td>
<td>T12, L1 - L4</td>
</tr>
</tbody>
</table>
Activity:

Using the charts shown on the two preceding pages, please answer the following questions.

1. What motor nerves carry messages to the HIP FLEXOR muscle to tell it to work?

2. What motor nerves carry messages to the ELBOW EXTENSOR muscle to tell it to work?

3. What motor nerves carry messages to the FINGER FLEXOR muscles to tell them to work?

4. What motor nerves carry messages to the ANKLE DORSIFLEXOR muscle to tell it to work?
E. CHAPTER SUMMARY

NEUROLOGY is the study of nerves. Nerves are like small roads that carry messages to and from all parts of our body.

The CENTRAL NERVOUS SYSTEM (CNS) is the brain and the spinal cord.

brain
Located in the head and protected by the skull. Makes, sends, and receives messages to and from the body.
ONE SIDE OF THE BRAIN is responsible FOR THE OPPOSITE SIDE OF THE BODY.

spinal cord
Located along the dorsal side of the back and protected by the vertebral column.
Spinal cord acts as a roadway for messages to travel to and from the brain.
Can make fast decisions without the brain (reflex).

The PERIPHERAL NERVOUS SYSTEM (pns) are nerves that connect the body parts to the central nervous system.

Two types of peripheral nerves are:

* SENSORY NERVES - take messages from the muscles/skin to the CNS giving information of how we are feeling.
* MOTOR NERVES - take messages from the CNS to the muscles telling them to work.

Because nerves (roads) CROSS in the area where the brain and spinal cord meet, ONE SIDE OF THE BRAIN IS RESPONSIBLE FOR THE OPPOSITE SIDE OF THE BODY.

A VOLUNTARY MOVEMENT occurs because of a message from the brain telling it to happen.
A REFLEX happens because of a sensory nerve carrying a message to the spinal cord and the SPINAL CORD sends the message to a motor nerve causing movement. The brain is not involved in causing reflex movements.

The spinal cord is divided into many different parts; each part is responsible for feeling and movement in different areas of the body.

- **CERVICAL**: upper limbs
- **THORACIC**: trunk and abdominal areas
- **LUMBAR**: lower limbs
- **SACRAL**: 

Sensory and motor nerve diagrams were given as general references.

Sensory tests are useful to help identify areas that could be easily injured (because the patient cannot feel these areas).
CHAPTER 8

MASSAGE
MASSAGE is moving the soft tissues of the body.

OBJECTIVES
At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. describe when and why you give a massage.
2. identify when not to give a massage.
3. describe 5 general guidelines in giving a massage
4. given a patient problem, demonstrate appropriate massage technique.

CHAPTER CONTENTS
A. WHAT IS MASSAGE?
B. WHAT MASSAGE CAN DO
C. WHAT MASSAGE CANNOT DO
D. WHEN TO GIVE A MASSAGE
E. WHEN NOT TO GIVE A MASSAGE
F. TYPES OF MASSAGE
G. GENERAL GUIDELINES FOR GIVING MASSAGE
H. CHAPTER SUMMARY
A. WHAT IS MASSAGE?

MASSAGE is moving soft tissues of the body. Generally, massage is given with the hands.

B. WHAT MASSAGE CAN DO

* Massage can relax tight muscles (decrease pain).
* Massage can soften scar tissue.
* Massage can increase blood circulation.
* Massage can calm a patient.
* Massage can help remove waste from the intestine and bladder.

C. WHAT MASSAGE CANNOT DO

* Massage will not prevent muscle atrophy.
* Massage will not increase muscle strength.
* Massage cannot maintain muscle length.
* Massage will not reduce fat areas.

Questions:

1. A patient would like to strengthen the muscles of his left thigh. Will a massage help this patient?

   Yes ______ No ______

   Explain your answer.
Questions: (continued)

2. An amputee has a scar that is very hard. Will a massage help this patient?

   Yes ___   No ___

   Explain your answer. ___________________________________________________________

D. WHEN TO GIVE A MASSAGE

Activity:

Below are patient problems. Check (✓) when you would give a massage. (If you need help, see page 2, "What massage can do").

   --- The patient has tight muscles.
   --- The patient has a soft and movable scar.
   --- The patient is nervous and tense.
   --- The patient has shortened muscles.
   --- The patient needs increased blood to an area.
   --- The patient needs help to remove urine and stool.
   --- The patient has pain because of muscle tightness.
   --- The patient has swelling and needs help to move blood.
   --- The patient has weak muscles.
   --- The patient has a scar that is tight and stiff.
E. WHEN NOT TO GIVE A MASSAGE

* Do not give massage over open areas or wounds.
* Do not give massage over scars that are not completely healed.
* Do not give massage when the patient has a fever.
* Do not give massage over broken bones.
* Do not give massage on joints that are hot, red, and swollen.
* Do not give massage over damaged or diseased blood vessels.

F. TYPES OF MASSAGE

There are four basic types of massage:

1. SUPERFICIAL MASSAGE
2. DEEP MASSAGE
3. FRICION MASSAGE
4. HACKING MASSAGE

1. SUPERFICIAL MASSAGE

Superficial massage is light pressure given on the body surface.

When given slowly, superficial massage will help to relax the patient.
2. DEEP MASSAGE

Deep massage is moderate pressure given into the body surface.

Two deep massage techniques are:

a) stroking
b) lifting and squeezing

a) Stroking

Stroking is giving moderate pressure moving toward the center of the body.

Stroking is given with two hands that surround a body part.

* Stroking can help decrease swelling.
  (The proximal part of the limb should be cleared before trying to decrease swelling in the distal part.)

* Stroking can increase relaxation.

* Stroking may cause a small stretch in soft tissues.
b) Lifting and squeezing

In this technique, the PTA tries to hold the muscle, lift - squeeze - release.

Lifting and squeezing can:

* relax tight muscles
* increase blood flow to and from tight muscles
* soften scar tissue
3. FRICTION MASSAGE

Friction massage is firm pressure given into the body surface.

Generally, friction massage is given to small areas of the body.

Friction can be made with the thumb or fingers.

The pressure can be circular or in a straight line.

Friction massage helps to:
* soften scar tissue.
* relax specific area of tight muscles.

Questions:

1. Do you think that friction massage is comfortable for a patient?  
   Yes ______  No ______
   Explain your answer.

2. Normally, would you start or finish a massage with friction?  
   Yes ______  No ______
   Explain your answer.
4. HACKING MASSAGE

Hacking massage is hitting the body surface with the ulnar side of the hands.

Hacking massage may:
* increase muscle tone
* stimulate the patient
* small stretching of muscle

G. GENERAL GUIDELINES FOR GIVING MASSAGE

1. If possible, massage should be given directly on the patient's skin (not over the top of clothes).

2. The patient should be positioned with the muscle in a relaxed position.

3. If massage is given to decrease swelling, the limb must be in an elevated position.

   This will help blood return to the heart.

4. Massage should generally be given for 15-30 minutes to have good results.

5. To help hands move more easily along the skin, the PTA can apply:
   - soap and water
   - coconut oil
   - vaseline
   - powder
Questions:

1. A patient arrives with a very hot and swollen ankle. She tells you that she fell about 3 hours before coming. Will you give her a massage to decrease the swelling?  
   Yes ______  No ______  
   Explain your answer.
Questions: (continued)

5. What is a "relaxed position" for a muscle?
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

6. Why should a massage be given with a muscle in a relaxed position?
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

7. A patient has swelling in the hand. The PTA gives a deep stroking massage to the arm, forearm and then hand. The patient is in sitting position with her arm on the table. What is the problem with this treatment?
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

How would you change the treatment to make it better?
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

8. A patient has a lot of hair on his skin. When the PTA gives a massage, the patient complains of pain because of the hair. What can the PTA do to solve this problem?
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
Questions: (continued)

9. A very large woman arrives and would like a massage to decrease the fat in her arms. What type of massage will you give?

Explain your answer.

H. CHAPTER SUMMARY

Massage is moving soft tissues of the body. Generally, massage is given with the hands.

Massage can be given to help

. relax tight muscles
. soften scar tissue
. increase blood circulation
. calm a patient
. help evacuate intestine and bladder.

Do not give massage:

. over open areas or wounds
. over scars that are not completely healed
. when the patient has a fever
. over broken bones
. over joints that are hot, red and swollen
. over damaged or diseased blood vessels
Four basic massage techniques are given:

- SUPERFICIAL MASSAGE
- DEEP MASSAGE (stroking, lifting and squeezing)
- FRICTION MASSAGE
- HACKING MASSAGE

Guidelines for giving a massage:

- directly on patient's skin
- muscle in relaxed position
- limb elevated if massage is to decrease swelling
- 15 - 30 minutes
- coconut oil, vaseline, soap and water, or powder may help the hands move more easily on the patient.
CHAPTER 9

RESPIRATORY TREATMENTS
RESPIRATORY TREATMENTS help to remove lung secretions and make breathing easier.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. describe how air is pulled into the lungs.
2. demonstrate 2 chest movements that happen with inspiration and expiration.
3. demonstrate 3 different breathing exercises and explain how these exercises will help a patient.
4. describe 4 different ways to remove secretions from the lungs.
5. explain why deep breathing is better than clapping for all respiratory patients.
6. demonstrate evaluation and treatment of a patient with a respiratory problem.

CHAPTER CONTENTS

A. INTRODUCTION
B. ANATOMY OF THE RESPIRATORY SYSTEM
C. MOVEMENTS THAT HAPPEN WHEN WE BREATHE
D. PHYSICAL THERAPY EVALUATION OF PATIENTS WITH RESPIRATORY PROBLEMS
E. PHYSICAL THERAPY TREATMENTS OF PATIENTS WITH RESPIRATORY PROBLEMS
F. EVALUATION AND TREATMENT OF CHILDREN WITH RESPIRATORY PROBLEMS
G. CHAPTER SUMMARY
A. INTRODUCTION

Respiratory treatments help to remove lung secretions and make breathing easier.

It is important to know some anatomy of the respiratory system and how we normally breathe to better understand respiratory treatments.

In GENERAL BODY SYSTEMS (Volume 1) the PTA received an introduction to the respiratory system.

This chapter will discuss more details of how we breathe and how to help people who have problems with breathing.

B. ANATOMY OF THE RESPIRATORY SYSTEM

Anatomy of the respiratory system was discussed in GENERAL BODY SYSTEMS chapter, Volume 1.

Activity:

As a review, please draw a picture of the complete respiratory system in the space provided. The picture should include:

- nose
- mouth
- alveoli
- trachea
- bronchii
- bronchioles
Questions:

1. What is the name of the air tube that you can feel in the front of your neck?

2. Where does AIR EXCHANGE happen?

In your own words, describe why air exchange is important.

Other parts that help with breathing are the:

* diaphragm

* ribs

* muscles between each rib

* abdominal muscles

* some muscles of the neck **

** Muscles of the neck are not used in relaxed breathing. Neck muscles are used when the patient has difficulty pulling enough air into the lungs.
Questions:

1. What is the function of the ribs?

2. What is the name of the most important muscle used in breathing?

C. MOVEMENTS THAT HAPPEN WHEN WE BREATHE

Breathing (respiration) is the movement of air going in and out of our body.

Three areas that move when we breathe are:

1. Diaphragm
2. Ribs
3. Abdominal muscles
* Diaphragm

The movement of the diaphragm is discussed in GENERAL BODY SYSTEMS, Volume 1.

Activity:
As a review, please draw how the diaphragm moves in breathing.

(inspiration)  (expiration)

* Ribs

Activity:
A. Put both hands on your chest. Inhale very deeply (take as much into your lungs as you can). Then exhale. Repeat these movements 3-4 times.

1. What movement did you feel when you inhaled?

2. What movement did you feel when you exhaled?
Activity: (continued)

B. Cross your arms in front of your placing each hand on the opposite side of your body. Your hands should be resting on the external rib area.

Inhale deeply and then exhale; do this 3-4 times.

3. What movement did you feel when you inhaled?

________________________________________________________________________

2. What movement did you feel when you exhaled?

________________________________________________________________________

From the activity the PTA should have identified the main rib and chest movement that occurs with respiration.

When we INHALE (air pulled in), the ribs move UPward and OUTward.

This increases the space inside the chest and lungs so that air is pulled in.

When we EXHALE (air pushed out), the ribs move DOWNward and INward.

This decreases the space inside the chest and lungs so that air in pushed out.

REMEMBER

INHALE = RIBS MOVING UP AND OUT
EXHALE = RIBS MOVING DOWN AND IN

The small muscles that are found between each rib are what cause this movement.
Abdominal muscles

Activity:
Place your right hand on your stomach and your left hand in front of your open mouth. Contract your abdominal muscles as hard and as fast as you can.

1. What did you feel with your left hand?

2. What did you feel with your right hand?

(X) During normal breathing, the abdominal muscles work very little.

(Y) To push air out of your lungs quickly and strongly (as in coughing or blowing out a candle), the abdominal muscles must work.

(Z) To take a big breath in (inhale deeply), the abdominal muscles must be relaxed.
<table>
<thead>
<tr>
<th>Activity:</th>
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<tbody>
<tr>
<td><strong>A.</strong> Contract your abdominal muscles as much as you can. Keeping your abdominal muscles contracted, inhale deeply. Exhale. Repeat this 3-4 times.</td>
</tr>
<tr>
<td><strong>B.</strong> Relax your abdominal muscles. Keeping abdominal muscles relaxed, inhale deeply. Exhale. Repeat this 3-4 times.</td>
</tr>
</tbody>
</table>

1. **Was it more easy to take air into your lungs with abdominal muscles contracted or relaxed?**

   **Why?**

   ____________________________________________

   ____________________________________________

   ____________________________________________

2. **Did you feel more air pulled into your lungs with abdominal muscles contracted or relaxed?**

   **Why?**

   ____________________________________________

   ____________________________________________

   ____________________________________________
RESPIRATORY TREATMENTS/ page 9

SUMMARY OF BREATHING

A. PULLING AIR INTO THE LUNGS (INHALE, INSPIRATION)

1. Diaphragm muscle contracts, moves downward, and pulls inferior part of the lungs downward.

2. Rib muscles contract helping to bring the ribs up and out.

3. Abdominal muscles relax, giving more room for the diaphragm to move downward.

ALL OF THESE MOVEMENTS HELP TO INCREASE THE SPACE INSIDE THE LUNGS TO PULL AIR IN.

B. PUSHING AIR OUT OF THE LUNGS (EXHALE, EXPIRATION)

1. Diaphragm muscle relaxes, moves upward, and the inferior part of the lungs moves upward also.

2. Rib muscles relax allowing the ribs to move down and in.

3. To push air out forcefully, the abdominal muscles will contract; this makes less space for the diaphragm.

ALL OF THESE MOVEMENTS HELP TO DECREASE THE SPACE INSIDE THE LUNGS TO PULL AIR IN.
D. PHYSICAL THERAPY EVALUATION OF PATIENTS WITH RESPIRATORY PROBLEMS

The PTA must carefully evaluate:

* movements used in breathing (diaphragm, upper chest, neck muscles)

* type of breathing (fast, slow, deep, shallow, difficult, easy)

* secretions? (location, amount, color, smell, can patient remove secretions independently?)

* fever?

* how long patient has had respiratory problems

* chest deformities

* other medical problems

* functional level of the patient (describe what the patient can do independently, what he needs help with)

E. PHYSICAL THERAPY TREATMENTS OF PATIENTS WITH RESPIRATORY PROBLEMS

The type of treatment given will depend on the result of the evaluation of the patient.
Below are 3 main treatments ideas that can be used with many different patients. These are:

1. Patient positioning for comfortable and effective breathing.
2. Breathing exercises.
3. Techniques to remove secretions.

1. **PATIENT POSITIONING FOR COMFORTABLE AND EFFECTIVE BREATHING**

Patients with respiratory problems may not know what positions are best to help bring more air into the lungs and help make them feel more comfortable.

The PTA must work closely with the patient to find different positions to help the patient breathe easier.

Guidelines for comfortable and effective breathing positions:

* Abdominal muscles are in a relaxed position
* Ribs have space to move up and out
* Diaphragm has space to move downward
* The upper body is supported so that the trunk muscles are relaxed. (It is a lot of work for the trunk muscles and respiratory muscles to both work at the same time.)
* Knees may be a little flexed (for comfort)
* Head and chest are above other body parts
Questions:

Guidelines for comfortable and effective breathing positions are given on page 11. Please answer the following questions.

1. Explain why abdominal muscles should be in a relaxed position.

2. Explain why ribs need space to move up and out.

3. Explain why the diaphragm needs space to move downward.

4. Explain why the head and chest should be positioned above other body parts.
Examples of comfortable and effective breathing positions can be seen in the following pages.

Remember that these are only examples and can be modified for different patients.

SUPINE POSITION

SIDELYING POSITION
SITTING POSITION

STANDING POSITION
Activity:

1. Sit on a chair. Lift your feet onto the chair and hold both knees tightly to your chest. Breathe deeply.

   Describe 2 reasons why this may not be an effective breathing position.

2. Lie in prone position with your upper body on your elbows. Breathe deeply.

   Describe 2 reasons why this may not be an effective breathing position.
2. **BREATHING EXERCISES**

Breathing exercises are given for three reasons.

a) to increase the amount of air going into the lungs

b) to keep air in the lungs for better air exchange

c) to help remove secretions (see page 26)

**BREATHING EXERCISES ARE THE MOST IMPORTANT TREATMENT FOR ALL PATIENTS WITH RESPIRATORY PROBLEMS**

The type of breathing exercise used will depend on the patient's problem.

a) Breathing exercises to increase the amount of air going into the lungs

Two different types of exercises to increase the amount of air going into the lungs are:

i) exercises to increase the downward movement of the diaphragm

ii) exercises to increase the upward and outward movement of the ribs.
1) exercises to increase the downward movement of the diaphragm

* patient learns to FEEL the movement

- patient is positioned with abdominal muscles relaxed

- patient puts hand over abdominal area to FEEL it move during breathing

- the abdominal area should feel "bigger" when inhaling

- the abdominal area should feel "smaller" when exhaling

- The PTA can also put his hand on top of the patient's hand to help give feedback for the movement
Question:

The diaphragm needs space to move downward. Is there more space with the abdominal muscles contracted or more space with the abdominal muscles relaxed?

Explain your answer.

ii) exercises to increase the upward and outward movement of the ribs

Exercises to increase upward and outward movement of the ribs include:

* patient instruction/demonstration
* pushing into hands
* trunk movements
* limb movements
* Patient instruction/demonstration

Position the patient appropriately.

Tell the patient (and demonstrate) how the ribs should normally move.

Have the patient practice this.
* Pushing into hands

PTA can put her hands on the anterior rib area of the patients.

Ask the patient to push the anterior ribs into the hands when inhaling.

PTA can put her hands on the external side of the patient's ribs.

Ask the patient to push the external rib area into the PTA's hands when inhaling.

PTA can put her hands in any combination on the patient's rib area.

Repeat the exercises as above.

Patient pushes ribs into the hand when inhaling.
* Trunk movements

Trunk extension is used with inhaling

Trunk flexion is used with exhaling

Lateral bending is used to increase air coming into one side of the lungs.
Questions:

1. Why is trunk extension recommended for inhaling and not exhaling?

2. The PTA instructs the patient to make lateral bending to the left when inhaling. What side of the lungs will have increased air flow, right or left?

   Explain your answer.
* Limb movements

Moving the upper limbs in a combination flexion-abduction direction is used with inhaling.

Moving the upper limb in a combination extension-adduction direction is used with exhaling.
b) **Keep air in the lungs for better air exchange**

If air moves in and out of the lungs very fast there may not be enough time to have a good exchange of oxygen and carbon dioxide.

**IMPORTANT RULE TO REMEMBER**

**EXPIRATION SHOULD BE LONGER THAN INSPIRATION**

Controlling what happens at the nose and mouth is very important in helping to keep air in the lungs.

**Questions:**

A. Take air in through your nose. Hold it, open your mouth very wide (big), now let the air out through your open mouth. Repeat this three times.

B. Take air in through your nose. Hold it, open your mouth so that your lips are close together, now let the air out through the space between your lips. Repeat this three times.

1. In what position did the air leave the lungs more slowly?

   

   Why? 

2. In what position did the air stay in the lungs longer?
Breathing technique to keep air in your lungs for better air exchange is as follows:

INHALE:  
- mouth closed
- air enters through nose

EXHALE:  
- lips close together
- air leaves slowly from the mouth only

RESISTED EXHALATION WITH TUBE AND WATER

Another exercise that can help keep air in the lungs is resisted breathing.

The patient blows air out of the mouth into a tube that empties into a jar with a small amount of water.

The resistance given by the water and tube help keep air in the lungs longer.

Questions:

1. A patient has a problem breathing with the diaphragm. Describe the breathing exercises you could do for this patient.
Questions: (continued)

2. A patient exhales very quickly. Describe the breathing exercises that you could give this patient to help air stay in the lungs longer.

3. A patient has no movement of the right rib area when breathing. Describe the exercise that you could give this patient to have more movement in this area when inhaling.

4. You would like the patient to try to bring more air into the posterior and inferior lung area. How will you do this?
RESPIRATORY TREATMENTS/page 26

c) Removing secretions from the airways

If secretions are in the airways (nose, trachea, bronchii, alveoli), breathing becomes very difficult and sometimes impossible.

Two ways to identify if a patient has secretions are to listen to the breathing, and feel over the lung areas for liquid movements.

It is important that all airways remain as clear as possible for good air travel and exchange.

3. TECHNIQUES TO REMOVE SECRETIONS

a) patient positioning

b) breathing exercises

c) use of steam

d) vibration/clapping

e) assist coughing

f) suction

a) Patient positioning

If there are secretions in the small air tubes and air sacs in the lungs, we can position the patient so that GRAVITY will help to pull these secretions into the large air tubes.

When secretions are in the large air tubes, they can more easily be removed from the body.
The following rules can help the PTA better decide what position is best for removing the patient's secretions.

<table>
<thead>
<tr>
<th>LOCATION OF SECRETIONS</th>
<th>PATIENT POSITION TO HELP REMOVE SECRETIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Superior parts of lungs</td>
<td>* Sitting</td>
</tr>
<tr>
<td>* External part of left lung</td>
<td>* Sidelying with left side up</td>
</tr>
<tr>
<td>* External part of right lung</td>
<td>* Sidelying with right side up</td>
</tr>
<tr>
<td>* Anterior parts of lungs</td>
<td>* Supine (back-lying)</td>
</tr>
<tr>
<td>* Posterior parts of lungs</td>
<td>* Prone (stomach-lying)</td>
</tr>
<tr>
<td>* Inferior parts of lungs</td>
<td>* Lying with upper body a little inferior to lower body</td>
</tr>
</tbody>
</table>

The above positions are general recommendations for positioning.

It is important that the PTA knows that changing the patient's position regularly (3-4 times each day) is the best for general removal of secretions.

Generally, the patient should remain in the specific position for 15-20 minutes.

Before putting the patient in different positions, the PTA must always check with the doctor.

The doctor will say what positions should be avoided for different patients.
Activity:
The PTA must learn different patient positions to help remove secretions from the lungs. For each picture given, please write where the secretions are, and draw them in the picture.

Example:

Location of secretions: SUPERIOR PARTS OF LUNGS

A. Location of secretions

B. Location of secretions

C. Location of secretions

D. Location of secretions

E. Location of secretions
b) **Breathing exercises**

Breathing exercises are very important and should be used in ALL respiratory treatments.

Deep breathing fills the alveoli with air. This air movement into the lungs can help keep alveoli open, and help movement of secretions out of the alveoli.

Deep breathing exercises are the most important treatment for removing secretions from the lungs.

Examples of deep breathing exercises are given on pages 16-24.
c) **Use of steam**

Steam is the small drops of water that lift in the air from hot water.

If a patient can inhale steam when deep breathing, it will help to make secretions in the lungs more liquid.

Secretions are more "water-like" and can move from the lungs easier.

d) **Vibration/Clapping**

Sometimes gravity and breathing exercises are not enough to help move the secretions out of the small air tubes and air sacs.

In this case, the PTA must manually try to help move the secretions.

The PTA can try to move secretions by:

* **Vibration**

  Vibration is very small and fast shaking movements.

  These small and fast shaking movements may help to make the secretions more loose (less attached to walls of air tubes and air sacs).
The PTA's hand will rest over the area of the lung that has secretions.

Vibration is given through the upper limb of the PTA. The arm, forearm, and hand all work together to give vibration.

Vibration is given at the same time the patient exhales.

Small pressure is also given to the patient with vibration.

This pressure is in the same direction as the movement of the ribs ... down and in.

Question:

Why are pressure and vibration given when the patient exhales and not when the patient inhales?
Clapping is a rounded hand contracting the surface of the body.

The hand is rounded to trap air in the space between the hand and body surface.

This trapped air will cause movement in the secretions that are under the hand.

If the hand is flat, it will be more painful for the patient and will not be effective in moving secretions.

The PTA gives clapping over the lung areas that have secretions.

**CAUTION**

Clapping may be effective in removing secretions, but may also hurt the patient.

* Clapping may help spread disease – do not use clapping on TB patients.

* Clapping may break small air sacs – use caution in applying clapping with pneumonia.

VIBRATION and CLAPPING are used together with patient positioning.
Questions:

1. Explain why vibration and clapping should be done in positions where gravity helps to move secretions.

2. A patient has secretions in the lower parts of his lungs. The PTA does clapping in sitting position. The patient does not get better. List 2 ways the treatment could be changed so that secretions can be more easily removed.

Note:

Clapping is a very overused technique. The use of clapping should be decreased and the use of deep breathing should replace it.

e) Assist coughing

A cough is when air is forced out of the lungs very fast.

A cough is the body's way to remove something from the respiratory system (water, food, smoke, etc).
The normal sequence for a cough:

1. A person takes a deep breath pulling air into the lungs.
2. After the air is in, the trachea closes at the top.
3. With the trachea closed, the air cannot leave.
4. Pressure increases in the lungs.
5. The abdominal muscles contract hard and fast.
6. The trachea is opened.
7. The air is quickly PUSHED OUT of the lungs.
8. Anything that is loose in the air tubes will be carried out by this rush of air.
Activity:

Review the eight main steps in a cough. Practice coughing and try to identify each of the eight steps as they happen.

Put your hand on the abdominal area. Try coughing without any abdominal muscles. Describe what happened.

Assisted coughing for weak patients

If the patient is not strong enough to remove secretions with his cough, the PTA can help the patient by pushing upward and inward on the ribs.

f) Suction

Suction is a very specialized technique that is done only in hospitals with the correct equipment.

In this technique, a tube is put into the airways for a very short time to try to pull the secretions out.

One end of the tube is attached to a suction machine; the other end is put into the airways of the patient.
F.  EVALUATION AND TREATMENT OF CHILDREN WITH RESPIRATORY PROBLEMS

The same principles of evaluation and treatment for adult respiratory problems can be applied to children.

Because a child is much smaller, and is not able to follow directions, modifications of techniques are needed.

1. EVALUATION OF CHILDREN WITH RESPIRATORY PROBLEMS

The same guidelines for adult evaluation applies to children. See page 10 for details.

2. TREATMENT OF CHILDREN WITH RESPIRATORY PROBLEMS

Children that need respiratory treatments are children with secretions.

Similar to adult treatment (pages 26-35), secretions can be removed by:

a) positioning
b) breathing steam
c) vibration/clapping
d) assisted expiration
e) cough reflex

a) Positioning

Different positions for the baby will help remove secretions from different parts of the lungs.

To help the baby remain in these positions it is recommended that the baby be held on the mother's lap or the PTA's lap.

On the next page are pictures demonstrating different positions to help remove secretions from a baby's lungs.
b) Breathing Steam

As with adults, breathing steam can help make secretions more liquid so they can move easier.

**CAUTION**

BE CAREFUL THAT THE STEAM IS NOT TOO HOT AND DOES NOT BURN THE CHILD

c) Vibration/Clapping

The same principle of vibration and clapping (pages 30-32) apply to children.

The application of these techniques will change because of the small size of the child.

* Vibration

Vibrations are given during expiration.

* One hand is on one side of the chest making the vibrations when the baby is exhaling.

* The other hand is on the opposite side of the chest - not moving. This hand is to support the baby and help the vibrations be more effective in staying inside the baby.
* Clapping

Because a child is so small, clapping must be gentle and clapping cannot be given with the whole hand.

Modifications can be:

a. to make gentle clapping with 3 fingers placed close together.

b. to remove the end of a stethoscope and use this to contact the baby's chest.
d) Assisted expiration

The PTA can help the baby remove air from the lungs so that expiration is deeper and more new air can enter into the lungs.

The PTA will place one hand on each side of the chest and when the baby exhales, the PTA will push downward and inward to help remove the air from the lungs.

Remember, the baby's bones are not strong and these movements must be gentle.

The PTA must follow the breathing rhythm of the baby and not go against the baby's breathing.

e) Cough reflex

Because we cannot ask the baby to cough, we must stimulate a reflex (page 41) to cause the baby to cough automatically.

If the child has secretions in the big air tubes, he can be able to remove them by coughing.
To stimulate the reflex, the PTA must put his finger over the top of the sternum and move it gently.

Moving this area gently with the finger will cause the baby to cough.

DO NOT PUSH VERY HARD ON THESE AREAS.

SUMMARY

- Respiratory techniques used for children must be adapted because:
  1. children are very small
  2. children cannot follow directions

- For best results, the child must be calm - not crying or upset.

- Respiratory treatments are best before feeding because of the chance that these movements may cause vomiting if it is too soon after eating.

- The baby should be put in all of the suggested positions to make sure all lung areas can be cleared of secretions. The baby should be in each position for about 5 minutes.

- If the baby has a big problem to breathe in any of these positions, stop it.

- Follow advice of the medic; he can tell you when treatments are dangerous for the baby.
G. CHAPTER SUMMARY

There are six main places that the air must pass to go in and out of the body. These are: the **nose** or **mouth**, **trachea**, **bronchii**, **bronchioles**, and **alveoli**.

Breathing (respiration) is air moving in and out of the body.

Air is pulled into the lungs by:

1. diaphragm contracts and pulls inferior part of lungs downward
2. rib muscles contract bringing ribs up and out
3. abdominal muscles relax to allow room for air in the lungs

Physical Therapy can help respiratory patients by:

1. positioning the patient for comfortable breathing
2. teaching the patient how to pull more air into the lungs
3. teaching the patient how to keep air in the lungs longer
4. helping the patient to remove secretions from the lungs

Specific techniques for patient positioning, breathing exercises, vibrations, clapping, and coughing are given in this chapter.

Breathing exercises should be used in the treatment of ALL respiratory problems.

Expiration should be longer than inspiration.

Change of position is good for moving secretions and preparing for them to come out.

Breathing NOT clapping is the most important.
CHAPTER 10

RANGE OF MOTION
RANGE OF MOTION (ROM) is moving a limb to help maintain the movement at a joint.

OBJECTIVES

At the time of the exam with 80% proficiency, the student will be able to correctly:

1. describe the difference between ROM and stretching techniques.
2. identify when to use passive ROM, active assistive ROM and active ROM.
3. demonstrate appropriate hand and body position when making ROM.

CHAPTER CONTENT

A. WHAT IS RANGE OF MOTION?
B. WHO NEEDS RANGE OF MOTION?
C. WHEN NOT TO MAKE RANGE OF MOTION
D. TYPES OF RANGE OF MOTION
E. GUIDELINES FOR MAKING RANGE OF MOTION
F. PICTURES OF PASSIVE ROM TECHNIQUES
G. CHAPTER SUMMARY
A. WHAT IS RANGE OF MOTION?

In ARTHROLOGY chapter, Volume 1, we described range of motion (ROM) as the amount of movement at a joint.

Range of motion is also moving the limb to help maintain the movement at a joint.

Questions:

1. A doctor asks, "What is the ROM at the shoulder?" In your own words, what is this doctor asking?

2. A doctor asks to "make ROM for the shoulder". What does this mean?

Range of motion is moving the limb to maintain the movement at a joint.

If a patient has tightness or stiffness at a joint, the PTA will use a STRETCHING technique to try to increase the amount of movement. (See STRETCHING chapter, Volume 2.)

Range of motion is moving the limb to prevent stiffness. After a joint is stiff, the PTA must make stretching to try to increase the movement.
Question:
In your own words, describe the difference between ROM and stretching.


B. WHO NEEDS RANGE OF MOTION?

People who need special care to maintain joint movement are:

* people who are unconscious
* people who cannot move their limbs without help
* people who are afraid of pain with joint movement
* people who are bedridden (see BEDRIDDEN PATIENTS chapter, Volume 3)

Questions:

1. A 10 year old boy is active and has no problem. Will your make range of motion for this boy?

   Yes _____   No _____

   Explain your answer.

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
Questions: (continued)

2. A bedridden patient needs special care to help maintain joint movement. Explain why.

The goal of ROM is to maintain normal joint movement. If a person is unable to make these movements or has little activity in a day, special care should be given to prevent joint stiffness.

C. WHEN NOT TO MAKE RANGE OF MOTION

Range of motion is not made when joint movement will injure a part of the body.

Examples:
- directly after a skin graft that crosses a joint
- directly after injury to a muscle, tendon, or ligament
- directly after surgery for tendons, ligaments, muscles, skin
- near a broken bone that is not immobilized
D. TYPES OF RANGE OF MOTION

Range of motion can be made 3 ways:

1. PASSIVE RANGE OF MOTION
2. ACTIVE RANGE OF MOTION
3. ACTIVE-ASSISTIVE RANGE OF MOTION

1. PASSIVE RANGE OF MOTION

Passive ROM means that the part of the body being moved does not help at all to complete the movement.

The part of the body being moved is passive (it makes no work).

Examples

Passive ROM of the left elbow means that the left elbow muscles make no work to complete the movement.

Passive ROM of the right hip means that the muscles of the right hip make no work to complete the movement.

Passive ROM of the left lower limb means that the muscles of the left hip, knee, ankle, foot and toes make no work to complete the movement.

There are 2 days to make passive ROM:

a. the PTA makes all the work
b. the patient makes all the work with another part of the body.
RANGE OF MOTION/page 6

a. **PTA makes ALL the work to move the joint**

For patients that are unable to move a limb at all and unable to help move this limb with another part of their body, the PTA or a family member must do all the work to move the joint.

**Examples**

* A patient is in a coma and cannot move any part of the body. The PTA must make Passive ROM for all joints because the patient cannot help at all.

* A patient cannot move his legs and has very weak arms. The PTA must make Passive ROM for both lower limbs because the patient cannot help at all.

b. **the patient makes ALL the work (with another part of the body) to move the joint**

For patients that are unable to move a limb, but are able to move this limb through complete ROM with another part of the body, the patient will make **self-ROM**.

**Examples**

* A patient cannot move his left hand at all. This patient can use his right hand to make passive ROM for his left hand.

* A patient cannot move her legs at all. Both of her arms are very strong. She is able to use her arms to make Passive ROM for her lower limbs.

**Summary of Passive ROM**

Passive ROM means that the part of the body being moved does not help at all.

- A PTA must make all of the movement for the patient.

  OR

- The patient must use a strong part of his body to make the movement for this part (Self-ROM).
2. **ACTIVE RANGE OF MOTION**

Active ROM means that the part of the body being moved is making all of the work to complete the movement. The part of the body is strong enough to make the complete ROM without help.

**Examples**

* Active ROM is the left elbow means that the left elbow muscles make all the work. The muscles are the left elbow are strong enough to make complete ROM without help.

* Active ROM is the right hip means that the muscles of the right hip make all the work. The muscles of the right hip are strong enough to make complete ROM without help.

* Active ROM of the left lower limb means that the muscles of the left hip, knee, ankle, foot and toes make all the work. The muscles of the left hip, knee, ankle, foot and toes are strong enough to make complete ROM without help.

**Summary of Active ROM**

Active ROM means that the part of the body being moved is making all of the work to complete the movement. The patient can make complete ROM of this joint without help. The PTA only supervises the patient and gives MOTIVATION for the patient to continue to make ROM by himself.
2. ACTIVE/ASSISTIVE RANGE OF MOTION

Active/Assistive ROM means that the part of the body being moved makes some work, but needs help to complete the movement.

Examples

* Active/Assistive ROM of the left elbow means that the left elbow muscles work, but need help to make the complete ROM.

* Active/Assistive ROM of the right hip means that the muscles of the right hip work, but need help to make the complete ROM.

* Active/Assistive ROM of the left lower limb means that the muscles of the left hip, knee, ankle, foot and toes make work, but they need help to make the complete ROM.

There are 2 ways to make Active/Assistive ROM.

a. the PTA gives some help to complete the movement
b. the patient helps to complete the movement by using another part of the body

For patients that are able to make a part of the ROM but unable to make the complete ROM, the PTA must give some help.

Example

* A patient is recovering from malnutrition. She can move all parts of the body a little. The PTA will ask the patient to make as much of the movement as she can and the PTA will give help to complete the movement when it is needed.
b. the patient helps to complete the movement by using another part of the body.

Example

* A patient has left elbow flexors that are very weak. The right arm is normal. The patient makes as much movement as possible with the left elbow flexors and, when needed, will complete the movement with the help of the right arm.

Summary of Active/Assistive ROM

Active/Assistive ROM means that the part of the body being moved makes some work, but needs help to make complete ROM

- A PTA can give help to make the complete movement.

OR

- The patient can use a strong part of his body to help make the movement for this part.

Questions:

1. The patient has very weak muscles of both upper limbs. What type of ROM exercises would you recommend for this patient (passive, active, or active/assistive)?

2. A patient has good strength in all muscles of the lower limbs. What type of ROM exercises would you recommend for this patient (passive, active, active/assistive)?

3. A patient has no movement in the left upper limb and severe weakness in the left lower limb. What type of ROM exercises would you recommend for this patient (passive, active, active assistive)?
Questions: (continued)

4. In your own words, describe self-ROM.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

5. Describe the difference between active ROM and active assistive ROM.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

E. GUIDELINES FOR MAKING RANGE OF MOTION

There are some general guidelines to remember about ROM that will help to make ROM exercises successful.

1. Encourage all patients to make as much active movement as possible; the PTA should help the patient when he needs help. Active movement (muscle contraction) will improve blood circulation much more than passive movement.

2. LOOK AT THE PATIENT when helping to make ROM!!! This helps to see if the patient has pain and helps to show the patient that you are interested in him/her.
3. The patient should be positioned so that he/she is comfortable and the part can be moved through the full ROM.

4. Move the part slowly through the complete pain-free ROM; 5 - 10 times.

5. When moving a limb, the joints should be supported. (Hold the patient's limb on or near the joints.)

6. The range of motion movement can be:
   - in one direction only
   - at one joint only
   - a combination of directions
   - at many joints at the same time.

F. PICTURES OF ROM TECHNIQUES

On the following pages are pictures of ROM techniques.

These are ideas of how to move a limb to help maintain the movement at a joint.

The PTA should practice these techniques and develop more ideas to help make ROM interesting and useful.
The Shoulder

Abduction

Flexion
**THE SHOULDER**

EXTRACTION

(* May modify this position to see the patient.)

ABDUCTION

INTERNAL AND EXTERNAL ROTATION
ELBOW

FLEXION AND EXTENSION

FOREARM

PRONATION AND SUPINATION
WRIST

FLEXION
EXTENSION
ABDUCTION
ADDUCTION

THE HAND

STRETCHING THE ARCH
THE HAND

FINGER FLEXION AND EXTENSION

FINGER FLEXION AND EXTENSION
THE HIP

FLEXION

(* May modify this position to prevent the opposite leg from lifting.)

INTERNAL AND EXTERNAL ROTATION
THE HIP

EXTENSION

ABDUCTION AND ADDUCTION *

(* May modify this position to prevent the opposite leg from moving inward.)
ANKLE

DORSIFLEXION AND PLANTARFLEXION

THE FOOT

FOOT INVERSION AND EVERSION

TOE FLEXION AND EXTENSION
G. CHAPTER SUMMARY

Range of motion is moving a limb to help maintain the movement at a joint.

There are 3 types of range of motion

PASSIVE ROM

The part of the body being moved does not help at all.

The PTA must make all the movement for the patient

OR

The patient makes all the movement using another part of the body (self-ROM).

ACTIVE ROM

The part of the body being moved makes all the work.

The part of the body is strong enough to make complete ROM without help.

ACTIVE/ASSISTIVE ROM

The part of the body being moved makes some work, but needs help to make complete ROM.

The PTA can help to complete the movement

OR

The patient can use a part of his body to complete the movement.
Guidelines for making ROM are:

- Encourage the patient to make as much active movement as possible.
- LOOK AT THE PATIENT when helping to make ROM.
- Support the distal joints, move slowly, and make sure the patient is positioned for comfort.
- Joint movement can be made at one joint only, or at many joints at the same time.
- Joint movement can be in one direction only, or using a combination of directions.
- Pictures are included for guidance and to stimulate thinking for making additional ROM activities.
STRETCHING is a technique to lengthen shortened soft tissues and increase range of motion.

OBJECTIVES
At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. compare active and passive stretching techniques.
2. describe at least 5 general rules of passive stretching techniques.
3. given a patient problem, demonstrate appropriate stretching techniques.

CHAPTER CONTENTS
A. WHAT IS STRETCHING?
B. WHEN AND WHY TO STRETCH
C. WHEN NOT TO DO STRETCHING
D. TYPES OF STRETCHING TECHNIQUES
E. STRETCHING MUSCLES THAT CROSS TWO JOINTS
F. GENERAL RULES FOR PASSIVE STRETCHING TECHNIQUES
G. PICTURES OF PASSIVE STRETCHING POSITIONS
H. CHAPTER SUMMARY
A. WHAT IS STRETCHING?

STRETCHING is a technique to lengthen shortened soft tissues and increase range of motion.

Soft tissues may be muscles, ligaments, joint capsules, or skin.

B. WHEN AND WHY TO DO STRETCHING

<table>
<thead>
<tr>
<th>STRETCHING (WHEN)</th>
<th>STRETCHING (WHY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. When ROM is limited because of contractures, scar tissue, or joint tightness.</td>
<td>1. To recover normal ROM of joints and soft tissue that surrounds the joint.</td>
</tr>
<tr>
<td>2. Before physical activities and sports.</td>
<td>2. To prevent muscle injuries.</td>
</tr>
<tr>
<td>3. Before strengthening weak muscles that have tight opposing muscles.</td>
<td>3. Lengthen tight muscles before strengthening weak muscles.</td>
</tr>
</tbody>
</table>

Example:

* finger flexors are tight
* finger extensors are weak

* stretch finger flexors before strengthening finger extensors

C. WHEN NOT TO DO STRETCHING

A PTA should not do stretching in the following cases:

a) when a bone limits joint movement
b) after a recent fracture
c) when a patient has hot, swollen, and painful joints
d) when contractures can be functional
Questions:

1. Why do you not give stretching after a recent fracture?

   ____________________________________________________________
   ____________________________________________________________

2. A patient fractured her ankle many years ago. On x-ray you can see that the bones of the ankle have grown together. The ankle has limited ROM and is very stiff. Will you try to stretch the ankle?

   Yes ______  No ______

   Explain your answer.

   ____________________________________________________________
   ____________________________________________________________

D. TYPES OF STRETCHING TECHNIQUES

There are two types of stretching techniques:

1. ACTIVE STRETCHING
2. PASSIVE STRETCHING

1. ACTIVE STRETCHING

When there is muscle tightness, the patient can participate by inhibiting the tight muscle.

Three methods to inhibit a tight muscle are:

i) contract - relax
ii) contract - relax - contract
iii) inhibition by contracting the opposite muscle
1) contract - relax

The guidelines for this stretching technique are as follows:

a. the tight muscle is put in a lengthened position.

b. patient *isometrically contracts the tight muscle* in this position against resistance for 5-10 seconds.

c. patient relaxes.

d. PTA passively moves the joint toward increased range of motion.

e. rest a few seconds and repeat.

**Activity:**

Form groups of 2 students in each group. One student will have muscle tightness and one student will be the PTA.

Review "contract - relax" stretching technique.

Apply this technique to a tight elbow flexor (biceps) muscle.

a. put the elbow flexor in a "lengthened" position (remember, this muscle has tightness!)

b. *isometrically contract the biceps against resistance* 5-10 seconds

c. relax

d. the "PTA" passively moves the joint toward extension

e. rest; and repeat

For more practice, apply contract - relax technique to tight elbow extensors, tight knee flexors, and tight knee extensors.
ii) contract - relax - contract

The guidelines for this stretching technique are as follows:

a. the tight muscle is put in a lengthened position.

b. patient *isometrically contracts the tight muscle* in this position against resistance for 5-10 seconds.

c. patient relaxes.

d. the patient contracts the muscle opposite to the tight muscle and *actively moves the joint* toward increased range of motion.

e. rest a few seconds and repeat.

**Activity:**

Form groups of 2 students in each group. One student will have muscle tightness and one student will be the PTA.

Review "contract - relax - contract" stretching technique.

Apply this technique to a tight elbow flexor (biceps) muscle.

a. put the elbow flexor in a "lengthened" position (remember, this muscle has tightness!)

b. *isometrically contract* the biceps against resistance 5-10 seconds

c. relax

d. contract the elbow extension (triceps) to move the joint toward extension

e. rest; and repeat

For more practice, apply contract - relax - contract technique to tight elbow extensors, tight knee flexors, and tight knee extensors.
iii) inhibition by contracting the opposite muscle

The guidelines for this stretching technique are as follows:

a. the tight muscle is put in a lengthened position.

b. patient **concentrically contracts the opposite muscle against some resistance.**

c. as the opposite muscle contracts, **the tight muscle is inhibited and stretched as the joint moves.**

d. rest a few seconds and repeat.

**Activity:**

Form groups of 2 students in each group. One student will have muscle tightness and one student will be the PTA.

Review "inhibition by contracting the opposite muscle" technique.

Apply this technique to a tight elbow flexor (biceps) muscle.

a. put the elbow flexor in a "lengthened" position (remember, this muscle has tightness!)

b. concentrically contract the biceps against some resistance

c. the elbow flexor may relax and allow more joint movement

d. rest; and repeat

For more practice, apply "inhibition by contracting the opposite muscle" technique to tight elbow extensors, tight knee flexors, and tight knee extensors.
2. PASSIVE STRETCHING

The patient is **relaxed**, and an external force is applied to lengthen soft tissues. Passive stretching technique can be used for any soft tissue tightness.

There are three methods to apply a passive stretch:

i) manual stretch

ii) mechanical stretch

iii) self stretch

**Questions:**

1. What is the difference between a **passive** stretching technique and an **active** stretching technique?

2. A patient has a joint limitation because of retracted skin. What type of stretch is better to use with this patient (active or passive)?

   Explain your answer.
1) manual stretch

This type of stretching technique is given by the PTA.

a. the PTA controls the direction, speed, intensity and duration of the stretch.

b. the stretch is applied for at least 15-30 seconds.

c. this is repeated several times.

d. patient and PTA positioning are seen at the end of the chapter.

EXAMPLES OF DIFFERENT MANUAL STRETCH METHODS
ii) Mechanical stretch

This type of stretching technique is given with equipment.

Weights, splints, and plaster are often used with this technique.

A mechanical stretch is a very long stretch.

The minimum is 15-30 minutes; this stretch can be hours, days, or weeks depending on the technique.

EXAMPLES OF DIFFERENT MECHANICAL STRETCH METHODS

- Cushion under thighs
  (Avoid pressure on knees)

- Weights here

STRETCHING TIGHT HIP FLEXORS

STRETCHING TIGHT KNEE FLEXORS
iii) self stretch

This type of stretching technique is given by the patient. The patient will put his body into a specific position. Next, the patient will put some body weight on this area. The weight of the patient's body will help to stretch soft tissues.

EXAMPLES OF DIFFERENT SELF STRETCH POSITIONS

STRETCHING LEFT PLANTAR FLEXORS

STRETCHING RIGHT HIP FLEXORS
E. STRETCHING MUSCLES THAT CROSS TWO JOINTS

In MYOLOGY chapter, Volume 1, we discussed muscles that cross two joints.

We have said that when these two joint muscles contract, they may cause movement at two joints.

If both joints are moved in the same direction that the muscle wants, the muscle is in the shortest position.

Questions:

1. A muscle attaches to the distal femur and the calcaneus. This muscle passes posterior to the knee and posterior to the ankle. When this muscle contracts, what 2 movements could happen?
   
   Knee: (flexion or extension) ___________________
   
   Ankle: (dorsiflexion or plantar flexion) ___________________
   
   This is the shortest position of this muscle.

2. A muscle attaches to the ischium and the proximal part of the tibia. This muscle passes posterior to the hip and posterior to the knee. When this muscle contracts, what 2 movements could happen?
   
   Hip: (flexion or extension) ___________________
   
   Knee: (flexion or extension) ___________________
   
   This is the shortest position of this muscle.

3. A muscle attaches to the anterior part of the iliac bone and superior part of the tibia. This muscle passes anterior to the hip and anterior to the knee. When this muscle contracts, what 2 movements could happen?
   
   Hip: (flexion or extension) ___________________
   
   Knee: (flexion or extension) ___________________
   
   This is the shortest position of this muscle.
Questions: (continued)

4. A muscle attaches to the distal part of the humerus and distal phalanges of the fingers. This muscle passes anterior to the wrist and anterior to the phalanges. When this muscle contracts, what 2 movements could happen?

   Wrist: (flexion or extension) ______
   Fingers: flexion or extension) ______

   This is the shortest position of this muscle.

5. A muscle attaches to the distal part of the humerus and distal phalanges of the fingers. This muscle passes posterior to the wrist and posterior to the phalanges. When this muscle contracts, what 2 movements could happen?

   Wrist: (flexion or extension) ______
   Fingers: flexion or extension) ______

   This is the shortest position of this muscle.

If ONE joint is moved in the opposite direction than what the muscle wants, there is a small stretch (lengthening) of the muscle.

If BOTH joints are moved in the opposite direction than what the muscle wants, there is a big stretch (lengthening of the muscles.)

Questions:

1. A muscle attaches to the distal femur and the calcaneus. This muscle passes posterior to the knee and posterior to the ankle. What joint movements together will put the biggest stretch on this muscle?

   Knee: (flexion or extension) ______
   Ankle: (dorsiflexion or plantar flexion) ______
Questions: (continued)

2. A muscle attaches to the ischium and the proximal part of the tibia. This muscle passes posterior to the hip and posterior to the knee. What joint movements together will put the biggest stretch on this muscle?
   Hip: (flexion or extension)
   Knee: (flexion or extension)

3. A muscle attaches to the anterior part of the iliac bone and superior part of the tibia. This muscle passes anterior to the hip and anterior to the knee. What joint movements together will put the biggest stretch on this muscle?
   Hip: (flexion or extension)
   Knee: (flexion or extension)

4. A muscle attaches to the distal part of the humerus and distal phalanges of the fingers. This muscle passes anterior to the wrist and anterior to the phalanges. What joint movements together will put the biggest stretch on this muscle?
   Wrist: (flexion or extension)
   Fingers: flexion or extension)

5. A muscle attaches to the distal part of the humerus and distal phalanges of the fingers. This muscle passes posterior to the wrist and posterior to the phalanges. What joint movements together will put the biggest stretch on this muscle?
   Wrist: (flexion or extension)
   Fingers: flexion or extension)
When applying a stretch to 2 joint muscles, it must be remembered to position BOTH joints so that the muscle can be in the longest position as possible.

Activity:

Review the muscles in questions #1-5. These are important 2 joint muscles to remember in the body.

Form groups of 2 people in each group. One student will apply a passive stretch with the muscle.

a) in its shortest position
   (both joints positioned as the muscle would like)

b) in a small lengthened position
   (one joint positioned opposite to what the muscle would like)

c) in its most lengthened position
   (both joints positioned opposite to what the muscle would like)

Compare the difference that you felt with each change in the joint position. Discuss this with your class.

In most patients, a maximal muscle stretch is what you would like. The exception to this would be for some specific patient problems where muscle tightness is useful. (See SPINAL CORD INJURIES chapter, Volume 3, for details.)
F. GENERAL RULES FOR PASSIVE STRETCHING TECHNIQUES

1. Patient needs to be as relaxed as possible.

2. Heat may be applied (10-20 minutes) to soft tissues before stretching.

3. Stabilize proximal parts of the area with belts or hands to prevent compensation (extra movements).

4. Hold proximal and distal to the joint where the motion should occur. (Only one joint between the PTA's hands.)

5. Slowly move the limb until the area of tightness and move a little more and hold in that position.

6. Do not bounce! This causes the muscle to contract, not relax!

7. In the stretched position the patient should feel a pulling tightness, not pain.

8. Hold in stretched position 15-30 seconds or longer.

9. Slowly release the stretch force.

10. Relax a few seconds and repeat the stretch.

IMPORTANT

Increasing range of motion is a slow process.

Do not expect full range of motion after two treatments!

It may take weeks of treatment before you reach your goal.

G. PICTURE OF PASSIVE STRETCHING POSITIONS

On the following pages are pictures of passive stretching techniques.

These are general suggestions for positioning of the PTA and patient. They may be modified to individual patient needs.
STRETCHING SHOULDER ADDUCTORS

Direction of movement:

STRETCHING SHOULDER EXTENSORS

Direction of movement:

STRETCHING SHOULDER FLEXORS

Direction of movement:
SHOULDER

STRETCHING SHOULDER EXTERNAL ROTATORS

Direction of movement:

STRETCHING SHOULDER INTERNAL ROTATORS

Direction of movement:
ELBOW

STRETCHING ELBOW FLEXORS

Direction of movement:

STRETCHING ELBOW EXTENSORS

Direction of movement:

FOREARM

STRETCHING FOREARM SUPINATORS

Direction of movement:
STRETCHING WRIST FLEXORS

Direction of movement:

---

STRETCHING WRIST EXTENSORS

Direction of movement:
STRETCHING/HAMSTRINGS

Direction of movement:

STRETCHING/HAMSTRINGS

Direction of movement:

STRETCHING/HIP EXTENDERS

Direction of movement:
STRETCHING HIP FLEXORS

Direction of movement:

STRETCHING HIP FLEXORS

Direction of movement:
STRETCHING HIP
ADDUCTORS
Direction of movement:

STRETCHING HIP
ABDUCTORS
Direction of movement:

STRETCHING HIP
INTERAL ROTATORS
Direction of movement:
KNEE

A

STRETCHING KNEE FLEXORS

Direction of movement:

B

STRETCHING KNEE FLEXORS

Direction of movement:

C

STRETCHING KNEE EXTENSORS

Direction of movement:
STRETCHING ANKLE PLANTAR FLEXORS
Direction of movement:

STRETCHING FOOT INVERTORS
Direction of movement:

STRETCHING FOOT EVERTORS
Direction of movement:
H. CHAPTER SUMMARY

Stretching is a technique to lengthen shortened soft tissues and increase range of motion.

Stretching should not be done:

- when a bone limits joint movement
- after a recent fracture
- when a patient has hot, swollen joints
- when contractures can be functional

There are two types of stretching techniques:

ACTIVE STRETCHING: patient participates
(good for stretching tight muscles)

PASSIVE STRETCHING: patient relaxes
(good for stretching any soft tissue)

General rules and pictures for passive stretching techniques are given.

The PTA must remember that increasing range of motion is a slow process.
CHAPTER 12

STRENGTHENING
STRENGTHENING is a technique used to make muscles stronger.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. identify patients that need strengthening and apply appropriate strengthening techniques.
2. describe 2 ways to progress a strengthening exercise.
3. demonstrate muscle strengthening using 3 different types of muscle contractions.

CHAPTER CONTENTS

A. INTRODUCTION
B. PATIENTS THAT NEED STRENGTHENING
C. WHAT MUSCLES TO STRENGTHEN
D. HOW TO STRENGTHEN MUSCLES
E. STRENGTHENING AND TYPES OF MUSCLE CONTRACTIONS
F. POINTS TO REMEMBER ABOUT STRENGTHENING
G. SPORTS
H. PICTURES OF DIFFERENT MUSCLE STRENGTHENING EXERCISES
I. CHAPTER SUMMARY
A. INTRODUCTION

Strengthening is a technique used to make muscles stronger.

For the PTA to better understand this chapter, please review MYOLOGY chapter, Volume 1.

The questions given below are to help with myology review.

Questions:

1. What is the function of a muscle?

2. A muscle fiber is the working part of a muscle. What happens to the muscle fibers when a muscle becomes stronger (muscle fibers increase in size, or muscle fibers increase in number)?

3. In your own words, please describe muscle atrophy.

4. A muscle passes anterior to the elbow joint. When this muscle contracts (gets shorter), what movement will happen at the elbow (elbow flexion or elbow extension)?

5. A muscle passes posterior to the knee joint. When this muscle contracts (gets shorter), what movement will happen at the knee (knee flexion or knee extension)?
To be independent in everyday activities (walking, standing, eating, brushing the teeth, dressing ...), a person needs to be able to move.

Muscles make movement! If muscles are weak a person cannot move their body as they would like and then everyday activities (walking, standing ...) may be limited.

Example:

A patient has very weak hip extensor and knee extensor muscles. This patient is unable to stand up without help. Standing is limited by weak muscles.

Strengthening is important to help prepare the person to move as independently as possible.

B. PATIENTS THAT NEED STRENGTHENING

Patients may have weak muscles for many different reasons.

Question:

Think about the different patients that you have seen that have muscle weakness. What are 3 main reasons why a patient may have weak muscles?

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
General reasons for muscle weakness include:

* not using the muscle

- patients with immobilization  
  (See FRACTURES chapter, Volume 3)
- patients who are in bed for a long time  
  (See BEDRIDDEN chapter, Volume 3)
- patients with painful joints  
  (See ARTHRITIS chapter, Volume 3)

* nerve damage from trauma

- patients with spinal cord injury  
  (See SPINAL CORD INJURIES chapter, Volume 3)
- patients with peripheral nerve injuries  
  (See PERIPHERAL NERVE INJURIES chapter, Volume 3)

* nerve damage from disease

- patients with Leprosy  
  (See LEPROSY chapter, Volume 3)
- patients with Polio  
  (See POLIO chapter, Volume 3)

* muscle injury

- patients with muscles cut  
  (See AMPUTATIONS chapter, Volume 3)

C. WHAT MUSCLES TO STRENGTHEN

In deciding what muscles to strengthen, the PTA must consider:

1. specific muscles that are weak
2. general functional muscles of the body
1. **SPECIFIC MUSCLES THAT ARE WEAK**

After the PTA evaluates a patient, he will have identified muscles or body areas that are weak and need special attention to increase their strength.

Question:
Describe how a PTA will evaluate what areas are weak or strong.

___________________________

___________________________

___________________________

2. **GENERAL FUNCTIONAL MUSCLES OF THE BODY**

The PTA must always remember to treat the whole patient.

Some patients may have weakness in one area, but the whole body needs to have good strength for the patient to be able to function well.

General functional muscles for standing/walking are:

* hip extensors
* knee extensors
* dorsiflexors/plantar flexors
* hip abductors
* elbow extensors (if patient uses walking aid)
Questions:

1. A patient has been in bed for 2 months. The PTA has been working on hip flexion and elbow flexion exercises with this patient. Do you agree with this treatment? 
   -Yes  
   -No

   Explain your answer.

   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

2. A patient wants to stand but his muscles are too weak to help him. What muscles need to be strengthened in the lower limbs?

   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

3. A patient has very weak knee extensor muscles of the right leg and needs crutches to walk. Describe the muscles that you will strengthen for this patient.

   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

Remember, specific muscles will need to be strengthened, but general muscles of the body (especially functional muscles) must not be forgotten.
D. HOW TO STRENGTHEN MUSCLES

If a muscle is weak, the PTA must work with the patient to help make the muscle strong. To strengthen a muscle, the muscle must work as much as it can.

The 2 ways to increase the strength of a working muscle are:

1. adjust the number of muscle contractions
2. adjust the resistance to the muscle contraction

Again, the PTA must carefully evaluate the patient to know how to adjust the number of contractions and the amount of resistance so that the patient can have the best result.

1. ADJUST THE NUMBER OF MUSCLE CONTRACTIONS

As a general guideline **, the number of muscle contractions used to increase the strength of a muscle is:

10 muscle contractions

REST

10 muscle contractions

REST

10 muscle contractions

**Note: These numbers are a general guideline and must be adjusted depending on the patient's strength.
2. **ADJUST THE RESISTANCE TO THE MUSCLE CONTRACTION**

Resistance is a force that tries to pull the joint in the opposite direction of the muscle contraction.

As we have said before, to strengthen a muscle, the muscle must work as much as it can.

Different patients have different muscle strengths and thus need different levels of resistance to strengthen the muscles.

Different levels of resistance include:

* no resistance
* gravity as resistance
* gravity plus another force (PTA or weights)

The level of resistance must be adjusted to fit the patient's needs.

The resistance should not be so much that the patient cannot do the exercise, but must be enough so that the muscle will work as much as it can.

In summary, the PTA can change the number of contractions, the amount of resistance, or a combination of these 2 ideas to have the muscle work as much as it can to become stronger.
Please answer the following questions and then discuss them with the entire class.

Questions:

1. A patient can flex his elbow against gravity but it is difficult. You would like to strengthen the elbow flexors. Please describe how many times you will make the exercises and with what type of resistance.

2. A patient has very weak hip extensors. You ask him to lay in prone position and extend his hip against gravity. If this is too difficult, please describe how you will adjust the level of resistance.

If this is too easy, describe how you will adjust the level of resistance.

3. A patient has very weak finger flexors and extensors. You make passive Range of Motion for this patient. Does this treatment help to strengthen the finger flexors and extensors? 

   __________ Yes    __________ No

   Explain your answer.
E. STRENGTHENING AND TYPES OF MUSCLE CONTRACTIONS

In MYOLOGY chapter (Volume 1) we learned about 3 different types of muscle contractions. As a review of this information, please answer the questions given below.

Questions:

1. In your own words, please describe an ISOMETRIC muscle contraction.

2. In an ECCENTRIC contraction is the muscle shortening or lengthening?

3. A man is sitting on a chair. Both hips and knees are flexed at 90°. The man lifts his leg upward until there is complete knee extension. What type of muscle contraction was made (concentric, eccentric or isometric)?

Explain your answer.

The 3 different types of muscle contractions we will discuss in this section include:

1. isometric contraction
2. concentric contraction
3. eccentric contraction
1. **ISOMETRIC CONTRACTIONS**

An isometric muscle contraction is the muscle working, but there is no joint movement.

Isometric muscle contraction is also called isometric exercise.

Generally, isometric exercises are used with patients with a joint that cannot move because of immobilization, contracture, or pain.

Isometric exercises can be done in any joint position, but are often limited by the position of the patient.

**Example:**

A patient has a plaster cast from his thigh to his ankle. The knee joint is immobilized by the plaster. The PTA can instruct the patient to make isometric exercises of the knee extensor and flexor muscles.

2. **CONCENTRIC CONTRACTIONS**

A concentric muscle contraction is the muscle working and the ends of the muscle are coming closer together causing the joint to move.

Concentric muscle contraction is also called concentric exercise.

Concentric exercises are the most common type of exercise.

Concentric muscles generally begin with the muscle in a lengthened position. The PTA must ask the patient to contract the muscle to move the joint through the range of motion.
3. **ECCENTRIC CONTRACTIONS**

An eccentric muscle contraction is the muscle working and the ends of the muscle are moving farther apart in the direction of the resistance. The muscle controls or allows the joint to move in the same direction as the resistance.

Eccentric muscle contraction is also called eccentric exercise.

Generally, eccentric exercises are good for muscles that are very weak. The muscle must work as much as it can to help control the movement of the joint.

In summary, the 3 different types of muscle contractions can also be included in a strengthening program. As was mentioned in Section D, the number of contractions and the amount of resistance to the muscle contractions can be modified to help progress the patient.

### F. POINTS TO REMEMBER ABOUT STRENGTHENING

The general points to remember about strengthening exercises for all patients include:

* evaluate the strength of the muscles to know the type and amount of strengthening that is needed

* **motivate** the patient to contract the muscle as much as he can (good eye contact, lots of verbal encouragement)

* support the body to avoid compensation when strengthening specific muscles

* whenever possible, use functional activities as part of the exercise

* progress the strengthening exercise (make the exercise more difficult) as the patient improves

* **NEVER MUSCLE TEST OR STRENGTHEN BODY PARTS THAT HAVE LOST CONTROL BECAUSE OF BRAIN DAMAGE.** These patients need practice on **controlling** movements, not on strengthening exercises.
As we mentioned earlier, it is important to strengthen weak muscles and work on improving or maintaining the general strength of the body.

Sports are a very good way to use the many muscles of the body and help to motivate the patient in a positive way.
H. PICTURES OF DIFFERENT MUSCLE STRENGTHENING EXERCISES

On the following pages are examples of different muscle strengthening ideas.

These pictures are given to help stimulate the PTA to develop other strengthening exercises.

The PTA and the patient must work together to find the strengthening program that best suits the patient.

Lie on your side and raise your leg as high as you can.

Keep your leg up until you get so tired that it falls by itself.

If the child can raise her leg easily, add weight with your hand, or with a little bag of sand.

Think of ways to make the exercises fun.
I. CHAPTER SUMMARY

Strengthening is a technique used to make muscles stronger.

The goal of strengthening is to help prepare the person to move and function as independently as possible.

General reasons for muscle weakness are:

- not using the muscle
- nerve damage from trauma or disease
- muscle injury

The PTA must understand that specific muscles and general functional muscles should both be included in all exercise programs.

Muscles can be strengthened by the muscle actively contracting as much as it can.

The patient can be progressed by adjusting the number of contractions and by adjusting the amount of resistance.

Isometric, concentric and eccentric exercises can all be used to help strengthen a muscle.

Points to remember about muscle strengthening:

- evaluate the patient's needs
- motivate the patient to work!
- support the body to avoid compensation
- progress the patient as he improves
- never "strengthen" muscles that have weakness or decreased control because of brain damage

Sports are a fun and creative way to encourage whole body strengthening.
CHAPTER 13

TRANSFERS
A TRANSFER is moving from one area to another.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. demonstrate a 3-person transfer.
2. demonstrate a 2-person transfer.
3. demonstrate a 1-person transfer.

CHAPTER CONTENTS

A. INTRODUCTION
B. GENERAL RULES FOR ALL TRANSFERS
C. TYPES OF TRANSFERS
D. WHEELCHAIR TRANSFERS
E. CHAPTER SUMMARY
A. INTRODUCTION

A transfer is moving from one area to another.

Some patients are able to do this without help, other patients may need some help or may need a lot of help to transfer.

There are many different types of transfers. The type of transfer that is used will depend on the patient's ability.

The PTA must evaluate the patient to know how much and what kind of assistance the patient will need.

Question:

You see a patient lying in bed. The nurse asks you to help this patient move from his bed to the chair.

What are 4 things you need to know about this patient before deciding how to best help this patient transfer?
The information that a PTA should know before deciding **how** to best help a patient with a transfer includes:

* patient's strength (lower limbs, trunk, upper limbs)
* balance
* any uncontrolled movements
* special medical conditions that will limit the patient's movement

In all transfers, the patient should be encouraged to participate as much as possible. If the patient can help with a transfer, let him help.

**AVOID MAKING THE PATIENT DEPENDENT!**

### B. GENERAL RULES FOR ALL TRANSFERS

There are general rules that a PTA should remember to apply with **ALL** transfers.

1. transfer to and from **stable** surfaces
2. tell the patient what is to be done
3. transfer toward the strong side of the patient
4. safety of the patient
5. safety of the PTA
1. **TRANSFER TO AND FROM STABLE SURFACES**

Stable surfaces are places that will not move when the patient transfers.

**Question:**

A PTA will help a patient move from his wheelchair to the bed. The PTA begins to help the patient stand. The wheelchair moves. The patient falls to the floor. How could this accident have been prevented?

The PTA is responsible to make sure that the areas where the patient is transferring from and transferring to are both stable.

2. **TELL THE PATIENT WHAT IS TO BE DONE**

Before the PTA helps a patient transfer, he must tell the patient:

* what the PTA will do
* what the patient is expected to do
* what will be the result
* when the transfer will begin

3. **TRANSFER TOWARD THE STRONG SIDE OF THE PATIENT**

If the patient has one side that is stronger than the other, it is safest if the patient transfers in the same direction as the strong side of the body.
4. **SAFETY OF THE PATIENT**

In all transfers the PTA must remember that the safety of the patient is very important.

The PTA can help make sure that a transfer is safe by doing the following:

* check to see that both transfer surfaces are stable
* prepare the area so that transfer surfaces are close and there are no obstacles to cause problems with the transfer
* correctly instruct the patient about what is to be done
* hold the patient securely so that he will not fall

5. **SAFETY OF THE PTA**

The main rule for the PTA to remember when helping a patient transfer is to use the muscles of the hip and thigh and not the muscles of the back.

Activity:

1. Sit as straight as possible and feel the trunk extensor muscles on the left side and right side of the vertebral column.

2. Now feel the muscles of the thigh (knee flexors and extensors) and hip (hip extensors).

What muscles feel bigger (back muscles, or muscles of the lower limb)?


Remember, the muscles of the back are smaller and weaker than the muscles of the hip or thigh. The PTA must remember to protect his back when lifting a patient.

General good lifting technique includes:

* bending the hips and knees (not the back!) and LIFT with the movements of knee extension and hip extension (NOT back extension)

* feet are positioned so that they are in the same direction as the transfer

C. TYPES OF TRANSFERS

As we have said in the beginning, the type of transfer used will depend on the patient's ability.

Question:

There are two patients that need help with a transfer. Patient "A" has weak legs, but all other parts are normal. Patient "B" cannot move his arms and legs at all and has no trunk control.

What patient will need more help to transfer (patient "A" or patient "B")?

Explain your answer.
The different transfers given in this section describe how many people are needed to help the patient transfer.

Transfers include:
1. 3 - person transfer
2. 2 - person transfer
3. 1 - person transfer
4. supervised transfer
5. patient alone (needs no help)

1. **3 - PERSON TRANSFER**

In a 3 person transfer all three "lifters" will be on one side of the patient's body with arms under the patient.

* one person will support the head and upper trunk
* one person will support the hip area
* one person will support the legs

These 3 lifters will lift the patient TOGETHER AT THE SAME TIME. The person at the head of the patient will check to see if the other lifters are ready and then direct all lifters to lift at the same time.
After the patient has been lifted, all lifters will flex their elbows a little which will cause the patient to be rolled toward them.

(This rolling brings the patient closer to the lifter's bodies .... this makes for easier carrying and helps prevent the patient from being dropped.)

The lifters will walk and move TOGETHER. When the lifters arrive at the other transfer surface, they will place the patient on this surface and then remove their arms.

PATIENTS NEEDING 3 PERSON TRANSFER

Patients that need the vertebral column immobilized - no movement of the vertebral column.

Activity:

Form groups of 4 people in each group and practice the 3 - person transfer technique.

Remember to use your hip and thigh muscles to help lift the patient ..... protect your back!

2. 2 - PERSON TRANSFER
In a 2 person transfer one person will support the trunk while the other will support the lower limbs.

The person lifting the trunk will be behind the patient. He will reach under the patient's arms and hold the opposite wrist of the patient. (Lifter's right hand will hold the wrist of the patient's left hand.)

The person holding the legs will hold the patient under the knees and ankles.

The lifter supporting the trunk will give the command so that both lifters work at the same time.

PATIENTS NEEDING 2 PERSON TRANSFER

Patients that have no movement in the arms, trunk, or legs.

Activity:

Form groups of 3 people in each group and practice the 2 - person transfer technique.

Remember to use your hip and thigh muscles to help lift the patient ..... protect your back!

3. **1 - PERSON TRANSFER**
For a 1 person transfer, the patient will have his feet flat on the floor, be positioned forward in the wheelchair, and have his arms around the PTA's upper back.

The PTA will put his feet and knees on the outside of the patient's feet and knees. The PTA's hands are put under the patient's buttocks.

The PTA will prepare the patient for the time when the transfer will begin by counting, "1", "2", "3", - "up".

The PTA must lean his body weight backward and straighten the hips and knees to help lift the patient.

When the patient is up high enough to transfer to a different surface, the PTA will turn the patient to the new area and slowly return the patient to a sitting position.

NOTE: This transfer is the maximum amount of help that one PTA can give to the patient. For patients that have increased strength or control, the PTA can decrease the amount of support needed for the transfer.

PATIENTS NEEDING 1 PERSON TRANSFER

Patients that can put weight on the legs, but are not able to transfer without some level of help.

Activity:

Form groups of 2 people in each group and practice the 1 - person transfer technique.

Practice this technique with different levels of patient ability and different levels of support from the PTA.

Remember to use your hip and thigh muscles to help lift the patient ..... protect your back!
4. SUPERVISED TRANSFER

In a supervised transfer the PTA does no work, but is there to give encouragement and advice and to prevent the patient from falling if he needs it.

PATIENTS NEEDING SUPERVISED TRANSFER

Patients that are able to transfer by themselves but are not completely safe, or they need psychological support to help make the transfer.

5. PATIENT ALONE (NEEDS NO HELP)

A patient transferring alone without help or supervision has made an independent transfer.

Independent transfers can be made by using different types of equipment or devices.

The patient uses these alone and is safe and independent in the transfer.
D. WHEELCHAIR TRANSFERS

On the following pages are pictures to help illustrate different wheelchair transfer techniques.

These are just ideas for transfers. The PTA must work closely with the patient to find the transfer technique that works best for him.

Transfer from floor to wheelchair — with help of a low seat

1. Sit with legs straight. Pull seat to your side opposite the wheelchair (a person's knee can also be used).
2. With hands on each chair, push up with your head forward over knees.
3. Swing onto the seat.
4. Now, with your head forward over your knees, swing body onto the wheelchair.

Transfer from wheelchair to floor — and back again — without help of a stool

1
2
3
4
5
6
7
8
9
Transfer from cot or bed to wheelchair without armrests

**CAUTION:** Make sure brakes are ‘on’ and footrests are ‘up’ out of the way.

To transfer from the wheelchair to the cot, follow the same steps in reverse.

1. Push yourself to a sitting position.
2. Reach under knees one at a time.
3. Move legs so that feet are on the floor.
4. Make sure brakes are locked. Then push up on arms while leaning forward with head facing down. Weight should be over knees.
5. Move body into wheelchair.

Transfer from cot or bed to wheelchair with armrests

1. Position your wheelchair so that you can swing body past armrests.
2. Place one hand on bed and one on the far armrest. Push yourself up while leaning forward with head down, weight over knees.
3. Swing body into wheelchair.

Transfer forward from wheelchair to cot or bed (often works well for children)

1. Lift feet onto bed and wheel the chair forward against bed. Put on brakes. Then bend forward and lift butt forward on chair.
2. With one hand on the cushion and one on the bed, lift the body sideways onto the bed.
3. Repeated lifts and lifting of legs may be needed.
Transfer with sliding board—without help

For getting into and out of bed, a car, etc.

1. Place board under hip by leaning to opposite side or by pulling up leg.
2. Lean forward, with your head and weight over knees.
3. Push yourself along the board.
4. When you are in the chair, remove the board and put it where you can easily get it.

Transfer with sliding board—with help

1. Lift leg and put board under hip.
2. Have person put arms around neck (if possible) while you put your hands under his butt, or grab his pants.
3. Slide the person along board to bed.
4. Lift legs onto bed.
E. CHAPTER SUMMARY

A transfer is moving from one area to another.

Different patients will need different kinds of help with a transfer depending on the patient's

- strength (lower limbs, trunk, upper limbs)
- balance
- uncontrolled movements
- special medical conditions that may limit the patient

In all transfers the patient should participate as much as possible

... do not make the patient more dependent than he is!

General rules for all transfers include:

- transfer to and from stable surfaces
- tell the patient what is to be done
- transfer toward the strong side of the patient
- always remember the safety of the patient
- PTA must use the muscles of the hip and thigh ...
  protect the back!

Examples of the following types of transfers are given in this chapter:

- 3 - person transfer
- 2 - person transfer
- 1 - person transfer
- a variety of wheelchair transfers
CHAPTER 14

STANDING UP
STANDING UP is the process of moving from chair or floor to an upright position.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. describe the sitting position of a person prepared to stand up.
2. identify 4 important body movements that help a person to stand up.
3. demonstrate how to physically and verbally help a patient to stand up.
4. identify good standing positions.
5. demonstrate floor $\rightarrow$ standing and standing $\rightarrow$ floor techniques.

CHAPTER CONTENTS

A. INTRODUCTION
B. NORMAL BODY POSITION TO PREPARE TO STAND UP
C. NORMAL BODY MOVEMENTS IN STANDING UP
D. PTA HELPING THE PATIENT TO STAND UP
E. GOOD STANDING POSITION
F. FLOOR $\rightarrow$ STANDING, AND STANDING $\rightarrow$ FLOOR TECHNIQUES
G. CHAPTER SUMMARY
A. INTRODUCTION

For a patient to walk, he must first be able to stand up.

The PTA must know the normal way to stand up for two reasons:

1. to identify specific problems a patient may have to stand up.

2. to correctly teach the patient how to stand up.

Activity:

Stand up and sit down three times. Think about the many small movements you make to help the body stand up. List at least two different movements that you made to prepare your body to stand up.

B. NORMAL BODY POSITION TO PREPARE TO STAND UP

Activity:

1. Sit with your back straight and your hands on your lap. Try to stand up without moving your shoulders forward. Describe what happened.
Activity: (continued)

2. Sit with your back in one position. After you are in this position do not move your back. Stand up. Describe what movements you made to stand up.

3. Sit with your left foot in front of you and your right foot under your chair. Stand up. Which foot did the work of holding the body - right or left?

4. You have pain in your right foot and can put no weight on it. Demonstrate how you will stand with this problem. What foot was under your body - right or left?
To prepare for sitting → standing, the body position will be:

* head looking forward

* back straight

* sitting near the edge of the chair

* shoulders forward

* feet under the body, a bit apart, and toes are forward.

Question:

1. Think about your experience from the activity on page 2. What two preparations are most important in helping the body to stand up? (Select from the list on page 3.)
Activity:

Look at the picture given below.

Is this person **prepared** to stand up?  

____ Yes  ____ No

Explain your answer.

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________
C. NORMAL BODY MOVEMENTS IN STANDING UP

After the body is in a good position, a person will:

1. MOVE THE SHOULDERS MORE FORWARD

   - the hips lift from the chair

   - the weight of the body is directly over the feet

2. EXTEND THE HIPS AND KNEES

3. TRUNK REMAINS STRAIGHT

4. HEAD REMAINS LOOKING FORWARD
### Questions:

1. What specific instructions will you give to a patient to prepare him to stand up?

2. The patient has a very weak and painful left leg. Describe how the patient should position her feet to stand up.

---

**There are three ways that a PTA can help a patient stand up:**

1. **teach the patient how to stand up**
2. **verbally instruct the patient**
3. **physically help the patient**

**1. TEACH THE PATIENT HOW TO STAND UP**

The PTA should teach the patient the important positions and movements that will help the patient stand up.

Next, the patient should practice different parts of standing up.
SIT → STAND

a. practice putting the feet in a good position under the body.

b. practice forward bending with the head forward and back straight.

c. practice half-standing (forward trunk movement until the butt is off the chair and body weight is over the legs; then slowly sit down).

d. practice complete standing.
STAND -> SIT

a. practice controlled movement; do not "fall into the chair".

b. patient must bend the hips and knees, head forward, trunk straight, and feet close to the chair.

c. some patients may reach back for the chair with their hand before sitting.

d. sitting down is the reverse movement of standing up.
2. VERBALLY INSTRUCT THE PATIENT

The PTA can help guide the patient’s movement by giving careful instruction and feedback.

The PTA can instruct the patient before the patient stands up.

The PTA can give feedback and instructions at the same time the patient stands up.

The PTA can give feedback and suggestions after the patient stands up.
Questions:
1. A patient prepares to stand. What will you tell her to help stand correctly?

2. What is feedback?

Why is feedback important for a patient?

3. A patient has just finished standing and the PTA gives feedback saying, "That was terrible". Give 2 reasons why this is NOT a good way to give feedback.
3. PHYSICALLY HELP THE PATIENT

The PTA can physically help the patient by:

a. supporting the patient's upper limbs
   * patient can rest arm on PTA's shoulders

b. lifting the patient's hips forward
   * so the body weight is over the legs

c. stabilizing the patient's legs
   * PTA holds patient's knee(s) between the PTA's knees

NOTE

never pull on a patient's arms to help him stand up!
E. GOOD STANDING POSITION

Standing positions should be evaluated from three views:

anterior view    posterior view    lateral view

GOOD STANDING IS:

* head looking forward

* trunk is straight
  (no lateral bending or
  forward/backward bending)

* normal curves of the
  vertebral column

* all limbs in neutral position

* equal weight bearing on
  both legs

* feet are flat on the floor
  and shoulder-width apart

* toes are pointing forward

Question:

Anatomical position and good standing position are almost the same. Please describe one difference between anatomical position and good standing position.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
F. FLOOR → STANDING, AND STANDING → FLOOR TECHNIQUES

Question:
Why is it important for patients to be able to go down to the floor and be able to get up from the floor?

Activity:
A. Start in a standing position. Slowly move from standing position to sit on the floor. Describe the movements that you made, and then compare with others in your class.

A. Start in sitting position. Slowly move from sitting position to a standing position. Describe the movements that you made, and then compare with others in your class.

Note: Every person may move from floor → standing differently. On the following pages are general floor → standing techniques that may work well for your patient. Experiment to find the ways that is safest and easiest for your patient.
STANDING \rightarrow FLOOR

1. strong leg holds body weight

2. weak leg bends and the knee is lowered to the floor

3. patient's arms can touch the floor for balance

4. both legs in kneeling

5. sit toward strong side
FLOOR -> STANDING

(Floor -> standing is the reverse movements of standing -> floor.)

1. both legs in kneeling

2. patient brings strong leg forward

3. patient puts weight over the strong leg and stands up

(* it is useful if a patient can hold a chair or stable object for better balance and safety)
G. CHAPTER SUMMARY

Standing up is the process of moving from chair or floor to an upright position.

Normal body position to prepare to stand up includes:
- head looking forward
- back straight
- sitting near edge of chair
- shoulders forward
- feet under body, a bit apart, toes forward

Normal body movements to stand up are:
- move the shoulders more forward
- extend the hips and knees
- trunk remains straight
- head remains look forward

The PTA can help a patient stand up by:
- teaching the patient how to stand
- verbally giving feedback
- physically helping the patient

Ways to physically help a patient:
- support the patient's upper limbs
- lift the patient's hips forward so the body weight is over the legs
- stabilize the patient's legs
- never pull on a patient's arms to help him stand up!
Good standing position is:

- head looking forward
- trunk straight
- normal curves of vertebral column
- all limbs in neutral position
- equal weight bearing on both legs
- feet are flat on the floor and shoulder width apart
- toes are pointing forward

Techniques for floor \rightarrow standing, and standing \rightarrow floor are given in this chapter.
CHAPTER 15

GAIT TRAINING
GAIT TRAINING is the process of teaching someone to walk as well as possible.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. describe normal gait (phases of gait, step information, weight shifting, trunk and upper limb movements).
2. identify the three most important muscles used in walking.
3. demonstrate three standing activities that prepare a patient for walking.
4. identify abnormal gait patterns and suggest how to correct them.

CHAPTER CONTENTS

A. WHAT IS GAIT TRAINING?
B. NORMAL GAIT
C. IMPORTANT MUSCLES USED IN GAIT
D. RANGE OF MOTION NEEDED FOR GAIT
E. GAIT PREPARATION
F. GAIT PRACTICE
G. ADVANCED GAIT ACTIVITIES
H. GAIT PROBLEMS AND HOW TO HELP THEM
I. CHAPTER SUMMARY
A. WHAT IS GAIT TRAINING?

Gait training is the process of teaching the patient to walk as well as possible.

Gait training is given for all patients that have problems with one or both legs, coordination, or balance.

This chapter can be used as a general guideline for evaluating gait and training all patients to walk.

Some patients have special problems that need special gait training. The PTA must first understand basic gait training; special cases will be discussed in detail in the specific pathology chapters.

B. NORMAL GAIT

Questions:

1. Why is it important for a person to walk normally?

2. List two reasons why the PTA must know about normal gait.

To describe normal gait, the following topics must be included:

1. gait cycle (phases of gait)
2. step information
3. weight shifting
4. trunk rotation
5. upper limb movement
1. gait cycle (phases of gait)

A gait cycle starts when one foot contacts the ground and ends when the same foot contacts the ground again.

There are two phases in a gait cycle:

a. STANCE PHASE = when the lower limb is contacting the ground.

b. SWING PHASE = when the lower limb is not contacting the ground.
Activity:

Walk around the room. When you walk, identify:
swing phase, stance phase and a gait cycle.

1. When your left leg is in swing phase, what phase is
the right leg in?

2. When is the lower limb weight bearing (during stance
phase or swing phase)?

STANCE PHASE and SWING PHASE each have specific parts.
These parts will be identified in the next section.

STANCE PHASE

There are three different parts of stance phase. These are:

a. HEEL STRIKE - when the heel contacts the floor
b. MIDSTANCE - when the patient has weight directly over the foot
c. HEEL OFF - when the heel lifts off the floor
SWING PHASE

There are three different parts of swing phase. These are:

a. BEGINNING SWING - when the leg is behind the body
b. MIDSWING - when the leg is equal with the other leg
c. END SWING - when the leg moves in front of the body.
Activity:
Look at the pictures below to answer the following questions.

1. In picture "C" what is the specific name of the phase for:
   the right foot
   __________________________
   the left foot
   __________________________

2. In what picture(s) do you see both legs in stance phase at the same time?
   __________________________

3. For the left leg, what part of swing phase is missing?
   __________________________

4. What picture shows the left leg in midstance?
   __________________________

5. When the right leg is in heel strike, what is the position of the left leg?
   __________________________
2. step information

One "step" is when the opposite foot contacts the ground.

**Question:**

How many steps are in one gait cycle?

The PTA must observe three things about steps:

a. step length
b. step width
c. step time

a. step length

Step length is the distance between the heel strike of one foot and the heel strike of the opposite foot.

**Activity:**

A. Practice walking with equal step lengths.

B. Now take a long step with the right foot and a short step with the left foot. Continue this for 30 seconds.

With the type of walk in activity "B", what leg would have the problem (right or left)?

Explain your answer.
b. step width

Step width is the distance between the feet.

Activity:
A. Practice walking with a very small step width (walking along a straight line).
B. Practice walking with a very big step width.

1. Many old people walk with a big step width. Why do you think old people walk like this?
   
   
   


c. step time

Step time is the amount of time it takes to complete one step.

Normally, the amount of time is equal for both sides.

Activity:
A. Practice walking normally (equal time for both sides).
B. Practice walking with short time for the right step and long time for the left step.

In activity "B", what leg has the problem, right or left?
   
   
   


Activity: (continued)

Explain your answer.

---

3. weight shifting

In the beginning of stance phase, the patient must shift his weight so the other leg can leave the ground.

At midstance all of the patient's body weight should be over the leg.

During weight shift, the upper body remains straight.

There is NO LATERAL BENDING of the trunk during normal weight shift.
Question:

You observe a patient walking. Every time his left leg is in stance phase, his trunk bends to the left. When his right leg is in stance phase, his trunk remains straight.

What side is normal (left or right)? ____________________________

Explain your answer. ________________________________________

4. trunk rotation

(A) When a person steps forward, the hip of the same side moves forward. Hip forward increases step length.

(B) When a person steps forward, the opposite shoulder also moves forward at the same time.
Activity:
Practice walking normally and think about trunk rotation.
Next, walk with NO TRUNK ROTATION. (The shoulder and hip of the same side move forward together.)
Which type of walking (with or without trunk rotation) uses more energy?

5. upper limb movement

Normally the opposite hand and foot will move together.
The arm follows the movement of the shoulder and also helps to balance body movements in walking.

Question:
A patient steps forward with her right foot. What hand should be moving forward at the same time, right or left?

C. IMPORTANT MUSCLES USED IN GAIT

The table (on the following page) is a summary of the important walking muscles and their main functions during the gait cycle.
<table>
<thead>
<tr>
<th>MUSCLE NAME</th>
<th>MAIN FUNCTION(S) DURING GAIT CYCLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIP EXTENSOR</td>
<td>* Keeps the hip moving forward during stance phase.</td>
</tr>
<tr>
<td>HIP ABDUCTOR</td>
<td>* Prevents the hip from moving outward during midstance.</td>
</tr>
<tr>
<td>HIP FLEXOR</td>
<td>* Used in beginning swing phase.</td>
</tr>
<tr>
<td>HIP ADDUCTOR</td>
<td>* Pulls body over weight-bearing leg in early stance phase.</td>
</tr>
<tr>
<td></td>
<td>* Keeps leg toward midline.</td>
</tr>
<tr>
<td>KNEE EXTENSOR</td>
<td>* Extends knee to prepare for heelstrike.</td>
</tr>
<tr>
<td></td>
<td>* Helps stabilize knee during stance phase.</td>
</tr>
<tr>
<td>KNEE FLEXOR</td>
<td>* Bends knee to start swing phase.</td>
</tr>
<tr>
<td>ANKLE DORSIFLEXOR</td>
<td>* Keeps foot up during swing phase.</td>
</tr>
<tr>
<td></td>
<td>* Keeps foot up so heel contacts the ground first.</td>
</tr>
<tr>
<td>ANKLE PLANTAR FLEXOR</td>
<td>* Helps to push body forward at heel off.</td>
</tr>
<tr>
<td>TRUNK MUSCLES</td>
<td>* Keep upper body in erect position and control rotation during gait.</td>
</tr>
</tbody>
</table>

Remember: This table is a very general summary of muscles in gait.
Questions:

To answer these questions, please look at the table on the previous page.

1. A patient has no dorsiflexors in the right ankle. Describe what you will see during:
   a) right swing phase
   b) right heel strike

2. A patient has no knee extensor in the left knee. Describe what you will see during:
   a) left stance phase
   b) left swing phase

3. During right stance phase, the patient's right hip moves outward uncontrollably. What muscle is weak in this patient?

4. A patient has very little trunk strength or control. Describe how this patient walks:

5. A patient has very weak hip abductors on the left side. Describe the gait problem that you will see when this patient walks.
D. RANGE OF MOTION NEEDED FOR GAIT

For a person to be able to walk normally, he must have enough range of motion in the lower limbs.

The table below gives a summary of the ROM needed for walking.

<table>
<thead>
<tr>
<th>JOINT</th>
<th>MINIMUM ROM NEEDED FOR NORMAL WALKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIP</td>
<td>10 extension</td>
</tr>
<tr>
<td></td>
<td>30 flexion</td>
</tr>
<tr>
<td>KNEE</td>
<td>0 extension</td>
</tr>
<tr>
<td></td>
<td>60 flexion</td>
</tr>
<tr>
<td>ANKLE</td>
<td>0 neutral</td>
</tr>
<tr>
<td></td>
<td>20 plantar flexion</td>
</tr>
</tbody>
</table>

Remember, these numbers are the minimum ROM needed for walking.

The patient will need more range of motion in the lower limbs for activities like running, sports, going up and down stairs, and sitting.
Activity:

Select one student to come to the front of the class. This student will demonstrate normal walking.

(It would be best if this student is wearing short pants to be able to see the lower limbs clearly.)

The class will observe this student’s gait carefully and answer the following questions.

1. When is the ankle in the most plantar flexion?

2. Is the knee completely extended during midstance?

   Yes _____    No _____

   If no, describe the position of the knee during midstance.

3. What is the position of the right hip during right swing phase, flexion or extension?

4. Why is it good to have the ankle in neutral position during swing stance?
E. GAIT PREPARATION

Before learning to walk, the patient must have:
* good standing balance
* appropriate ROM in the joints of the lower limb
* strength and control of the important muscles in gait
* devices (prosthesis, brace) if needed.

Questions:

1. A patient has ankle ROM of 10 - 20 plantar flexion only. Is this ROM enough for normal walking?  
   Yes _____  No _____  
   Explain your answer.

2. Explain why a patient needs good standing balance before learning to walk.

3. What are the five most important muscles used in walking?

   Describe the function of these three muscles.
There are three important steps that a PTA should follow when trying to teach a patient to walk. These steps are:

1. Keep the Patient Safe
2. Keep the Training Simple
3. Evaluate the Complete Gait

1. Keep the Patient Safe

The patient may need help to have safe and stable walking.

In the beginning, two ways to give help to the patient are:

a) parallel bars
b) manual support

a) parallel bars

Parallel bars are two very long poles that are strong enough to hold the patient's weight.

These poles are stabilized by other poles attached to the ground.

simple, non-adjustable bars (bamboo, wood, or metal)
Generally, parallel bars should be:

* as high as the patient’s hip
* wide enough to walk through
* long enough for the patient to make 5-7 gait cycles.

ALL gait training should begin in the parallel bars.

In the beginning, the patient may hold the bars for support. As the patient feels more stable, he should hold the bars less and less.

Some patients may need walking aids after the parallel bars for safe and stable walking. Please see WALKING AIDS chapter, Volume 2.
b) **manual support**

Manual support is hand contact from the PTA.

This support is to give the patient stability and prevent falling.

Manual support can be given **inside the parallel bars** and **outside of the parallel bars**.

Generally, manual support is given from **behind the patient** or on the patient's **weak or damaged side**.

Examples of different types of manual support are given on this page.
2. Keep the Training Simple

At first, the patient should practice the simple parts of gait.

In this way, the patient can feel the different parts of gait and the PTA can identify what parts the patient needs help with.

Below are the simple parts of gait and what the PTA must check.

<table>
<thead>
<tr>
<th>SIMPLE PART OF GAIT</th>
<th>WHAT THE PTA MUST CHECK</th>
</tr>
</thead>
<tbody>
<tr>
<td>weight - shifting (side to side)</td>
<td>* good knee control (no hyperextension)</td>
</tr>
<tr>
<td></td>
<td>* weight shifting with the hips ...</td>
</tr>
<tr>
<td></td>
<td>(no lateral trunk bending)</td>
</tr>
<tr>
<td></td>
<td>* complete weight shifting</td>
</tr>
<tr>
<td></td>
<td>* good patient posture (head up, back straight)</td>
</tr>
<tr>
<td>weight - shifting (forward and backward)</td>
<td>weight shift forward</td>
</tr>
<tr>
<td></td>
<td>* front foot flat</td>
</tr>
<tr>
<td></td>
<td>* posterior foot in heel off position</td>
</tr>
<tr>
<td></td>
<td>* posterior foot helps push body forward</td>
</tr>
<tr>
<td></td>
<td>* good posture, hips straight</td>
</tr>
</tbody>
</table>

weight shift backward

* posterior foot flat

* front foot in heel strike position

* good posture, hips straight
<table>
<thead>
<tr>
<th>SIMPLE PART OF GAIT</th>
<th>WHAT THE PTA MUST CHECK</th>
</tr>
</thead>
<tbody>
<tr>
<td>stepping (forward and backward)</td>
<td><strong>stepping forward</strong></td>
</tr>
<tr>
<td></td>
<td>* both feet equal</td>
</tr>
<tr>
<td></td>
<td>* weight shift with the hips to one leg</td>
</tr>
<tr>
<td></td>
<td>* step forward with the other leg</td>
</tr>
<tr>
<td></td>
<td>* good posture, hips straight</td>
</tr>
<tr>
<td></td>
<td>* good swing phase</td>
</tr>
<tr>
<td></td>
<td>* no lateral bending</td>
</tr>
<tr>
<td></td>
<td>* good heel strike and foot position</td>
</tr>
<tr>
<td></td>
<td>* begin to weight shift on the other leg</td>
</tr>
<tr>
<td>stepping backward</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* both feet equal</td>
</tr>
<tr>
<td></td>
<td>* weight shift with the hips to one leg</td>
</tr>
<tr>
<td></td>
<td>* step backward with the other leg</td>
</tr>
<tr>
<td></td>
<td>* good posture, hips straight</td>
</tr>
<tr>
<td></td>
<td>* no lateral bending</td>
</tr>
<tr>
<td></td>
<td>* <strong>toes contact the ground first followed by heel contact</strong></td>
</tr>
<tr>
<td></td>
<td>* weight shift to this leg</td>
</tr>
<tr>
<td></td>
<td>* heel off with the opposite foot</td>
</tr>
</tbody>
</table>

(then **combine** these two movements)
3. Evaluate the Complete Gait

After controlling the simple parts of gait, the patient must be able to put all of the parts together to walk normally.

A mirror can be put in front of the patient so that the patient can independently see and correct her posture as she walks.

The PTA must closely evaluate the patient’s gait. If there is a problem, the PTA can give verbal feedback to help correct this problem.

If the problem continues, the PTA can give physical help OR can again practice the simple parts of gait.

<table>
<thead>
<tr>
<th>DIFFERENT PARTS OF GAIT TO EVALUATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>* weight shifting</td>
</tr>
<tr>
<td>* arm swing</td>
</tr>
<tr>
<td>* posture (trunk straight)</td>
</tr>
<tr>
<td>* trunk rotation</td>
</tr>
<tr>
<td>* step width</td>
</tr>
<tr>
<td>* step length</td>
</tr>
<tr>
<td>* step duration</td>
</tr>
</tbody>
</table>
G. ADVANCED GAIT ACTIVITIES

After the patient can correctly demonstrate the basic gait cycle, there are many other walking activities to be practiced.

REMEMBER!!

All advanced gait activities should first be practiced in the parallel bars.

Suggestions for advanced gait activities include:

1. side - stepping to the left side
   side - stepping to the right side

2. walking with different speeds

3. walking backwards

4. walking toe to toe

5. walking in a straight line

6. cross - stepping anteriorly
   cross - stepping posteriorly

7. step over objects

8. stairs/ramps

9. pick something up from the floor

10. walking on uneven surfaces

11. obstacle course

On the following parges are pictures of different advanced gait activities.

These are only suggestions, The PTA and patient can work together to find other activities that are challenging and fun.
ADVANCED GAIT ACTIVITIES

Remember: Patients should have close supervision when doing these activities.
ADVANCED GAIT ACTIVITIES

Remember: Patients should have close supervision when doing these activities.

CROSS-STEPPING POSTERIORLY

CROSS-STEPPING ANTERIORLY

PICK SOMETHING UP FROM THE FLOOR

UNEVEN SURFACES
Questions:

1. A patient goes up the stairs. Is it more safe to go up with the good leg first or the weak leg first?

   Explain your answer.

2. When a patient goes down stairs, is it more safe to go down with the good leg first or the weak leg first?

   Explain your answer.

3. A patient walks well in the parallel bars. Why is it important for the patient to practice advanced gait activities?

4. Explain two reasons why the patient should practice simple parts of gait before walking normally.
H. GAIT PROBLEMS AND HOW TO HELP THEM

A person who walks abnormally has a "gait problem".

There are three main reasons for gait problems:

1. PHYSICAL CAUSES

2. POOR FIT OF DEVICE

3. PSYCHOLOGICAL CAUSES

1. PHYSICAL CAUSES

Physical causes of gait problems are from problems with the patient's body.

A patient can have muscle weakness, joint stiffness, pain, or other problems with the body that will change how the patient walks.

It is important for the PTA to be able to identify physical problems and give suggestions about how to correct these problems.

On the following pages are examples of common gait problems and possible physical causes.

PARALYSIS OR WEAKNESS OF HIP EXTENSORS

Patient will bend body posteriorly to help the hip stay in extension.

(picture: weakness of right hip extensor)
PARALYSIS OR WEAKNESS OF HIP ABDUCTORS

Patient will bend toward the weak side to help the hip stay in a straight position.

(picture: weakness of left hip abductor)

KNEE FLEXION IS LIMITED

Patient will bring the leg to the outside to help the foot lift off the floor.

(picture: stiffness of the right knee)
PARALYSIS OR WEAKNESS OF KNEE EXTENSORS

Patient will bend forward during stance phase to put body weight in front of the knee to keep it in extension/hyper-extension.

(picture: weakness of left knee extensor)

PARALYSIS OR WEAKNESS OF ANKLE DORSIFLEXORS

Patient will have high stepping gait to lift the foot off the floor.
Patient will have no heel strike; the foot will contact the ground all at the same time.

(picture: paralysis of left dorsiflexors)

For all physical gait problems, the PTA can try to strengthen the weak muscles. If the muscles are paralysed, a brace may be needed to help the patient walk as well as possible.
2. POOR FIT OF DEVICE

The PTA should know how to check the fitting for:
- crutches and other walking aids
- prostheses
- braces

(See WALKING AIDS chapter, Volume 2, and AMPUTATIONS chapter, Volume 3.)

If there is a problem with how a device fits the patient, a technician should be consulted to help solve this problem.

3. PSYCHOLOGICAL CAUSES

How a person feels can be seen in how he walks.

Remember: Psychology can sometimes direct how a patient walks.
I. CHAPTER SUMMARY

Gait training is the process of teaching someone to walk.

A normal gait cycle has 2 phases:

. STANCE PHASE (leg contacting the ground)
. SWING PHASE (leg moving through the air)

Important parts of normal gait are:

. complete weight shift on leg contacting the ground
. equal step length and step time
. small step width
. trunk straight (no lateral bending)
. trunk rotation
. upper limb movement (opposite hand and foot together)

Important muscles for walking are:

HIP ABDUCTOR    KNEE EXTENSOR    ANKLE DORSIFLEXOR

Before learning to walk, the patient must have:

. good standing balance
. appropriate ROM in the joints of the lower limb
. strength and control of the important gait muscles
. devices (prosthesis, brace) if needed

All gait training should begin in the parallel bars.

Simple parts of gait are:

. weight shifting (side to side)
. weight shifting (forward and backward)
. stepping (forward and backward)

Examples of common gait problems are given in this chapter.
CHAPTER 16

WALKING AIDS
WALKING AIDS are equipment used to help a person walk.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. given a patient problem, select the appropriate equipment needed to help a patient walk.

2. identify correct fitting for all walking aids.

3. given a patient problem, demonstrate the appropriate gait pattern that this patient should use.

4. describe four basic rules for going up and down stairs with walking aids.

CHAPTER CONTENTS

A. WHAT ARE WALKING AIDS?
B. PEOPLE THAT NEED WALKING AIDS
C. TYPES OF WALKING AIDS
D. MEASUREMENT AND FIT OF WALKING AIDS
E. GAIT PATTERNS USED WITH WALKING AIDS
F. STAIRS
G. CHAPTER SUMMARY
A. WHAT ARE WALKING AIDS?

Walking aids are equipment used to help a person walk.

B. PEOPLE THAT NEED WALKING AIDS

People that may need walking aids are people that:

* cannot control the joints/muscles of the lower limb.

* have poor balance.

* cannot or may not put all of their weight on the lower limbs.

C. TYPES OF WALKING AIDS

Walking aids are used by the upper limbs.

Walking aids used have two main functions:

* increase a patient's balance

* allow weight bearing on the arms
The most common walking aids are:

1. PARALLEL BARS (most stable)
   * immovable bars
   * very stable
   * all patients should begin any walking training in the parallel bars

2. WALKERS
   * stable but slow
   * contacts the ground in 3-4 places at the same time
   * good for balance and weight bearing on the upper limbs

3. CRUTCHES

4. CANES (WALKING STICKS) (least stable)
3. CRUTCHES
* less stable but more fast
* good for weight bearing through the upper limbs
* can begin to use crutches inside the parallel bars

4. CANES (WALKING STICKS)
* least stable
* normally canes are used to help with balance
* good for psychological support
* can begin to use a cane inside the parallel bars
* normally, canes are used on the opposite side of the weak leg

Questions:
1. Look at the pictures of the different walking aids. From these pictures describe the difference between a crutch and a cane.
Questions: (continued)

2. A 10 year old boy has a fractured femur. The doctor orders no weight bearing on the left leg. The PTA gives this boy a cane to help him walk. Do you agree with this choice of walking aid?  
   Yes  ______  No  ______

Explain your answer.


3. An 80 year old man has problems with balance when he walks. What type of walking aid could be useful to help this man?  

Explain your answer.


After the patient receives a walking aid, the PTA must:

a. check to see that it is the correct height for the patient.

b. teach the patient how to walk with the walking aid.

c. observe if the walking aid is appropriate for the patient (does it help?)

   AND AVOID THIS......
D. MEASUREMENT AND FIT OF WALKING AIDS

Below are general rules for checking the fit of walking aids.

* for all aids the elbow should be a little flexed when the hand is resting on the grip.

* when the patient is standing and the walking aid is on the ground the hand grip should be at wrist level.

* when the patient is in bed, the height of the hand grip is measured from the bottom of the foot to the wrist.

* for underarm crutches, the top of the crutch should be three fingers width below the arm pit.
E. GAIT PATTERNS USED WITH WALKING AIDS

Patients using walking aids can walk in many different ways.

The PTA can decide what type of gait pattern the patient should use.

To make a decision about gait, the PTA must know if the patient has:

1. two legs can weight bear and move independent of each other.

2. only one leg can weight bear OR two legs that move together.
1. Gait patterns for patients that have two legs that can hold weight and move separately.

There are three types of gait patterns than can be used:

a. 4 - point gait
b. 3 - point gait
c. 2 - point gait

a. 4 - point gait

1. one walking aid forward
2. opposite foot forward
3. other walking aid forward
4. opposite foot forward

* very stable gait
* very slow gait
* can only be used with parallel bars, two crutches, or two canes.
b. **3-point gait**

1. walking aid forward
2. weak leg forward
3. strong leg forward

* stable gait, slow
* good for partial weight bearing patients
* can be used with parallel bars, walker, two crutches
  (one cane be used if the patient can put a lot of weight on both legs)
c. 2-point gait

1. walking aid and weak leg go forward at the same time
2. strong leg forward

* stable gait
* faster than 3-point gait
* can be used with parallel bars, walker, two crutches, one crutch, or one cane.
2. Gait patterns for patients that have only one leg that can hold weight OR patients that have two legs that must move together.

There are two types of gait patterns that can be used:

a. swing-to gait
b. swing-through gait

a. swing-to gait
1. walking aid forward
2. leg(s) move to the area just behind walking aid

* very stable gait
* slow gait
* can be used with parallel bars, walker, or two crutches
b. swing-through gait

1. walking aid forward
2. leg(s) move to the area in front of walking aid

* less stable gait
* fast gait
* can be used only with parallel bars or two crutches
5 rules to follow when going up and down stairs with walking aids:

1. Patient should step up with the strong leg first.

2. Patient should step down with the weak leg first.

3. The PTA should always stay on the down-stair side of the patient. This will help protect the patient from falling.

4. Crutches always follow the bad leg

5. Walkers should never be used on stairs
Questions:

1. A patient has paralyzed knee extensors in the left leg. What leg will be first when this patient goes up stairs right or left?

2. A patient has a fractured left tibia. He uses two crutches to walk. When he goes up stairs, he steps up with his right leg first and then brings the left leg and crutches.

   Is this correct? Yes _____ No _____

   Describe how the patient will go down stairs.

3. The PTA is teaching the patient how to go up the stairs. The PTA is one step above the patient to help pull him up. Is this a good idea? Yes _____ No _____

   Explain your answer.
Questions: (continued)

4. Describe in your own words why walkers are not used on the stairs.


5. The patient is a 74 year old woman. She cannot put weight on her left leg. What type of walking aid will you give her?

What type of gait pattern will she use?

Why?


6. The patient is a 25 year old man. He is a right AK amputee. What walking aid will you give this man?

What type of gait pattern will he use?

Why?


G. CHAPTER SUMMARY

Walking aids are equipment used to help a person walk.

Walking aids are used by the upper limb to increase balance and allow weight bearing on the upper limbs.

Types of walking aids are:

- parallel bars (most stable)
- walkers
- crutches
- canes (least stable)

General rules for measuring walking aids:

- elbow a little flexed with hand on the grip
- hand grip is at wrist level when patient is standing
- underarm crutches should be three fingers width below the armpit

Gait patterns described in the chapter include:

- 4 - point gait
- 3 - point gait
- 2 - point gait
- swing-to gait
- swing-through gait

Rules to follow when going up and down stairs with walking aids

- patient step up with strong leg first
- patient step down with weak leg first
- crutches always in the same place as the weak leg
- walkers are never used on stairs
CHAPTER 17

BRACES
A BRACE helps to support or control a joint.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. describe the advantages and disadvantages of braces.
2. evaluate the fit of above knee and below knee braces.
3. given a patient problem, identify the type of brace that can best help the patient.

CHAPTER CONTENTS

A. INTRODUCTION
B. SPECIFIC INFORMATION ABOUT BRACES
C. PATIENTS THAT NEED BRACES
D. POINTS TO REMEMBER WHEN GIVING A BRACE
E. CHAPTER SUMMARY
A. INTRODUCTION

A brace helps to support or control a joint.

If a joint is unstable or if the patient cannot control the movement of a joint, a brace may be needed to help the patient use this joint as well as possible.

Questions:

1. What is the name of the body part that connects bone to bone?

2. If this part is stretched, will the joint be more stable or less stable?
   Explain your answer.

3. A motor nerve is destroyed. Will this cause a problem with joint movement?
   Yes  No
   Explain your answer.

There are different braces that can help support or control any joint in the body.

In this chapter we will discuss braces that help support or control the ankle and the knee.
B. SPECIFIC INFORMATION ABOUT BRACES

Information given in this section includes:

1. materials used in making braces
2. brace anatomy
3. fit of brace

1. MATERIALS USED IN MAKING BRACES

Because the lower limbs hold the weight of the body, the braces that support or control these parts must be strong.

The type of material used will depend on local materials, patient need, and the skill of the technician.

Braces can be made out of:

* metal (or strong bamboo)
* plastic
2. **BRACE ANATOMY**

Below is a picture of a metal above knee brace (long leg brace) and a picture of a plastic below knee brace (short leg brace).
Below are pictures of knee and ankle parts of a brace.

**KNEE**

- **KNEE PIECE**
  - Soft part of pad sits directly over kneecap.
  - Bending knee

- **KNEE PIECE**
  - Non-bending knee

**ANKLE**

- Metal braces:
  - Can have ankle joint
  - Side bars attached to the shoe

- Plastic braces:
  - No ankle joint
  - Worn on the inside of a shoe
3. FIT OF BRACE

Below are details of the correct fit for long leg brace and short leg brace.

Below-knee brace should reach almost to knee, yet allow knee to bend all the way.

Brace or clog should grip heel and ankle closely.

Above-knee brace should reach to about 2 cm. below groin.

Upper part of leather or plastic of brace should fit around the thigh closely.

Knee hinge (if used) should be at the middle of the knee, both in height and from front to back.

Side pieces should be close to knee but not touch or rub the child when he walks.
Below are details of the fit for knee pad, ankle joints, and plastic brace.

**KNEE PIECE**
- Soft part of pad sits directly over kneecap.

**HINGE AT ANKLE LEVEL**
- Ankle hinges, if used, should be at the level of the bony lumps of the ankle.
- Note: A brace with a hinge at ankle level is better than one with a hinge at foot level because it bends at the same height as the ankle joint (However, a metal brace with ankle hinge is more difficult to make.)

**HINGE AT FOOT LEVEL**
- Side rod should attach at a point directly below the midline of leg.

- The sole of the brace can end at the ends of the toes (or slightly beyond to allow for growth).
- Or the sole can end at the base of the toes.
- AVOID brace edges that stop at middle of toes.
- AVOID brace edges that pass across the middle of bony bumps. The edge should be either behind or in front of the bump.

**The side of the brace at the foot can extend to the toes if necessary for support.**
- For better comfort and shoe fit, the side can dip down around the base of the big toe.
- Avoid an edge that curves in (better to heat it and bend it out a little).

Soft padding inside the brace can make it more comfortable.
Places that may need to be padded are:
- edges over bony places or points of pressure
C. PATIENTS THAT NEED BRACES

The two main problems we will discuss in the section are:
1. patients that need help to support or control the ankle
2. patients that need help to support or control the knee

1. PATIENTS THAT NEED HELP TO SUPPORT OR CONTROL THE ANKLE

Patients that have problems at the ankle will need a short leg brace.

The type of short leg brace will depend on the patient's problem. (See information below.)

<table>
<thead>
<tr>
<th>Patient problem</th>
<th>Brace adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>* ankle bends outwards</td>
<td>For an ankle that bends out, use a strap that pulls the ankle in. A sole raised on the outer side may also help.</td>
</tr>
<tr>
<td>(inversion of the foot)</td>
<td></td>
</tr>
<tr>
<td>* ankle bends inward</td>
<td>For an ankle that bends in, use a strap that pulls the ankle out. A sole raised on the inner side may also help.</td>
</tr>
<tr>
<td>(eversion of the foot)</td>
<td></td>
</tr>
</tbody>
</table>
**Patient problem**

* Paralysis or weakness of dorsiflexors (patient cannot make active dorsiflexion)

A child with 'footdrop' or a floppy foot that hangs down so that she has to lift her leg high with each step.

**Brace adaptation**

- Needs a brace that holds the foot up. Use a plastic brace.
- Or a metal brace with a backstop that lets the foot bend up, but not down.

* Paralysis of dorsiflexors and plantar flexors

* Paralysis of plantar flexors only

**2. Patients that need help to support or control the knee**

Patients that have problems with movement or control of the knee will need a long leg brace.

The type of long leg brace will depend on the patient's problem. (See information on the following pages.)
**Patient problem**

* knee moves outward

* knee moves inward

* knee moves posteriorly (hyperextension)

**Brace adaptation**

needs a knee piece that pulls the knee inward.

and also one that pulls the knee back.

needs a knee piece that pulls the knee outward.

and also one that pulls the knee back (as shown above).

needs a firm strap behind the knee that lets the knee go back only a little.

(A front strap may also be needed.)

A child with a knee that bends backward.
**Patient problem**

* paralysis of knee extensors (knee flexors are working)

* paralysis of knee extensors and knee flexors.

**Questions:**

1. A patient has muscle paralysis of the foot evertors (the invertors continue to work). What will be the position of the foot (inversion or eversion)?

What direction will the ankle move (outward or inward)?

The PTA thinks that an ankle strap will help control the ankle. Where does this strap cross the ankle (on the internal or external side)?
Questions: (continued)

To what bar does this strap attach (internal bar or external bar)?

What is the function of this ankle strap?

2. A patient has paralyzed dorsiflexor muscle of the left ankle. The plantar flexors are working. The PTA gives the patient a plastic short leg brace. What are 2 functions of this brace?

3. A patient has paralyzed left knee extensors and normal strength left knee flexors. What type of brace will this patient need (a long leg brace or a short leg brace)? Explain your answer.

4. A patient has a long leg brace and a knee strap that passes on the medial side of the knee. Describe this patient's problem.
Questions: (continued)

5. A patient has paralysis of all the muscles of the knee and ankle. What type of brace will you give to this patient (long leg brace or short leg brace)?

Describe this brace.

D. SYSTEMS TO REMEMBER WHEN GIVING A BRACE

* Not all patients will want or need equipment! Carefully evaluate all patients before deciding on a brace.

* A brace should only be used if it helps the patient to move better and be more independent.

* Let the patient do what he can and support what he cannot do.

* Braces should be as light as possible so that the patient can function better.

* Evaluate a patient with his brace when he is doing functional activities (walking, going up and down stairs, dressing).

* Remember, braces are given to help increase a patient's function.
E. CHAPTER SUMMARY

A brace helps to support or control a joint.

Materials used to make braces will depend on local resources and the skill of the technician. (Metal, plastic, and strong bamboo are common.)

Specific parts of braces and their function are given in this chapter.

A PTA must evaluate the fit of the brace when the patient is sitting, standing, and doing functional activities.

Specific brace ideas were discussed for patients that need help to support the ankle and for patients that need help to support or control the knee.

The PTA must carefully evaluate IF a patient needs a brace, WHAT TYPE of brace is best for the patient, and how the brace FITS.

Remember: do not make the patient too dependent on equipment; let the patient do what he can and support what he cannot do.
CHAPTER 18

WHEELCHAIRS
WHEELCHAIRS are chairs with wheels that help a person move from one place to another.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. identify the types of patients that need wheelchairs.
2. measure a patient for correct fit of wheelchair.
3. select appropriate wheelchair adaptations for different patient problems.

CHAPTER CONTENTS

A. INTRODUCTION
B. PATIENTS THAT NEED WHEELCHAIRS
C. TYPES OF WHEELCHAIRS
D. WHEELCHAIR MEASUREMENT FOR CORRECT FIT
E. WHEELCHAIR ADAPTATIONS
F. INDEPENDENCE WITH A WHEELCHAIR
G. HOUSE ADAPTATIONS
H. CHAPTER SUMMARY
A. INTRODUCTION

Wheelchairs are chairs with wheels that help a person move from one place to another.

The PTA must know some basic information about wheelchairs so that the patient will receive a correct fitting wheelchair and be able to use this wheelchair as independently as possible.

B. PATIENTS THAT NEED WHEELCHAIRS

People that need wheelchairs are people that are unable to use their legs for walking, people that cannot walk for long distances, people that have severe balance problems and cannot walk safely, or people who have doctor's instructions to rest after surgery or illness.

Question:
Try to remember all of the patients that you have seen in a wheelchair. Describe what problems these people had that caused them to be in a wheelchair.

C. TYPES OF WHEELCHAIRS

There are many different types of wheelchairs!

The materials, shapes, and designs will change depending on the materials available in the country and the skill of the technician making the wheelchair.
Below are pictures of just some of the different wheelchairs that are made.
D. WHEELCHAIR MEASUREMENT

It is important that the chair is made to fit the patient.

If the chair is too big it will not support the patient, and the patient may not be able to move the chair.

If the chair is too small, it can put pressure on the patient's skin and cause wounds.

The parts of the chair that need to fit the patient are:

1. seat width
2. seat depth
3. leg rest length
4. arm rest height
5. back height (standard)

1. SEAT WIDTH

Measure across the patient's hips or thighs (whichever is wider). Add 1 cm to both sides for seat width.
2. **SEAT DEPTH**

Measure from the posterior knee to the posterior hip. May decrease this by 1 cm so that the chair seat does not press on the posterior knee area.

3. **LEG REST LENGTH**

Measure from the posterior knee to the inferior calcaneus. (Remember to include the space used by a cushion.)
4. **ARM REST LENGTH**

Measure with the patient in sitting position and elbow in 90° flexion.

The distance to measure is between the inferior elbow and the surface that the patient is sitting on.

(remember to include the space used by a cushion.)

5. **BACK HEIGHT (STANDARD)**

Measure with the patient in sitting position from armpit to inferior side of the hip.

(Note that the back height can be adjusted to help meet the needs of the patient.)
E. WHEELCHAIR ADAPTATIONS

We have discussed the standard fit of the wheelchair for different patients.

For some patients, a standard wheelchair is not enough to meet their needs. For these patients the wheelchair may need special changes or adaptations.

Different wheelchair adaptations are:

1. back height
2. lateral trunk support
3. wheel handles
4. seat cushion
5. arm rest
6. foot leg
7. leg rest

1. BACK HEIGHT/INCLINATION

According to the strength and control of the patient's trunk and neck, the seat back may be increased or slightly reclined to help support the patient.
Question:
A patient has trunk extensor muscles that do not work. What are two wheelchair adaptations that may help prevent this patient from falling forward?

2. LATERAL TRUNK SUPPORT

If the patient cannot control the trunk muscles at all and cannot sit straight without support, lateral trunk supporters may be needed.
3. **WHEEL HANDLES**

If a patient cannot use his hands to hold the wheel, special handles or sticks can be attached to help the patient push the wheelchair.

![Wheelchair with handles](image1)

4. **SEAT CUSHION**

If some wheelchairs are made of wood or bamboo, the seats may be very hard and cause pressure on the patient's skin.

For patients that have normal feeling, they will change their position when an area becomes painful. Patients that do not have feeling will not change their position and may develop pressure sores.

To help decrease the chance of pressure sores the seat can be adapted to have padding or be made out of canvas.

![Wheelchair with seat cushion](image2)
5. ARM REST

To help with transfers, it is best if the arm rest is removable so that the patient can slide from the wheelchair seat to another surface without problems.

If the arm rest cannot be removed, a cushion may be added to lift the patient a bit higher.

6. FOOT REST

For patients that are able to stand when transferring, it is useful to have removable foot rests to avoid problems when standing.
7. **LEG REST**

For patients that have no movement in the lower limbs, a leg rest is useful to prevent swelling in the feet. If the leg rests are up, the blood can more easily return to the heart.

![Wheelchair diagram](image)

**F. INDEPENDENCE WITH A WHEELCHAIR**

*Note: It is highly recommended that the students actively practice each of the activities listed in this chapter.*

The goal of giving a wheelchair to a patient is to help him move about as easily and as independently as possible.

To be as independent as possible, the patient must learn how to use his wheelchair.

The different activities that a patient needs to learn with the wheelchair are:

1. transfers to and from the wheelchair
2. pressure relief
3. pushing the wheelchair
4. turning the wheelchair
5. going over obstacles
1. **TRANSFERS TO AND FROM THE WHEELCHAIR**

For details on specific transfer techniques, please see TRANSFERS chapter, Volume 2, for details.

2. **PRESSURE RELIEF**

Every 15 minutes the patient should change his sitting position so that blood can come to all areas of the skin.

The different ways to help change positions include leaning left, right, forward or backward, or lifting the body off the chair.
3. **PUSHING THE WHEELCHAIR**

The patient can use 2 general techniques to push a wheelchair.

a) **elbow flexors and shoulder flexors** (for patients that do not have elbow extensor muscles that work).

b) **elbow extensors** (this is the most common method used)
4. TURNING THE WHEELCHAIR

To turn a wheelchair most easily, one arm will pull backward on a wheel while the other arm pushes forward on the opposite wheel.

Example:

To turn toward the right, the right arm pulls backward on the wheel and the left arm pushes forward on the wheel.

5. GOING OVER OBSTACLES

Obstacles are any uneven surfaces that make pushing a wheelchair very difficult.

To go over an obstacle, the patient should be able to lift the front wheels off the ground.
The method to lift the front wheel is:

a) patient pulls the wheel backward

b) the patient gives a QUICK push forward

c) patient will keep the chair balanced

d) the PTA should be behind the patient when the patient practices; this is to prevent the patient from falling backward
Up and down curbs

**UP:** the patient will put the front wheel up first, lean his body weight forward, and then pull the rear wheels forward on to the curb.

**DOWN:** the patient will put the rear wheels down first (leaning forward as much as possible) and then turn the wheelchair to bring the front wheels down off the curb.

---

**G. HOUSE ADAPTATIONS**

The PTA and the patient must remember that the patient's home may need some small changes so that the patient can use his wheelchair inside the house and continue to be independent.

Please see HOUSE ADAPTATIONS chapter, Volume 2.
H. CHAPTER SUMMARY

Wheelchairs are chairs with wheels that help a person move from one place to another.

The type of people that need wheelchairs are:

- people unable to use their legs for walking
- people that cannot walk long distances
- people that have severe balance problems and cannot walk safely
- people with doctor’s orders to use a wheelchair

Different wheelchair parts that need to be measured include:

- seat width
- seat depth
- leg rest length
- arm rest height
- back height

Some patients may need special wheelchair adaptations to help them function more independently and safely. Examples of different adaptations are given in the chapter.

The patient must also practice different activities to be able to control the wheelchair as well as possible.

House adaptations to fit a wheelchair into the home should not be forgotten.
CHAPTER 19

SLINGS
A SLING is a soft material used to support the upper limb.

OBJECTIVES
At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. describe the 3 main functions of slings.
2. make and apply the slings recommended in this section.

CHAPTER CONTENTS

A. WHAT IS A SLING?
B. FUNCTIONS OF A SLING
C. PATIENTS THAT NEED SLINGS
D. TYPES OF SLINGS
E. CHAPTER SUMMARY
A. WHAT IS A SLING?

A sling is a soft material that is put around a limb to hold it in a good position.

Slings are used to support the upper limbs only.

All PTA's should know how to make and use slings.

B. FUNCTIONS OF A SLING

The three main functions of a sling are:

1. SUPPORT A WEAK OR DAMAGED SHOULDER JOINT

(A sling will support the weight of the arm; this prevents the arm from pulling on the shoulder joint.)

2. PROVIDE SOME IMMOBILIZATION

(When a patient is in a sling, the upper limb will have decreased movement.)

3. DECREASE SWELLING IN THE DISTAL FOREARM AND HAND

(The blood can return to the heart more easily when the hand is higher than the elbow. Fluids can move with gravity.)
C.  PATIENTS THAT NEED SLINGS

Patients that may need slings are:

* Patients with flaccid hemiplegia
  (to help support the weak shoulder and decrease swelling in the hand)
  (See HEMIPLEGIA chapter, Volume 3.)

* Patients that have injured the shoulder
  (to help support the damaged area)

* Patients with a POP on the upper limb
  (to help support the shoulder and decrease swelling in the hand)
  (See FRACTURES chapter, Volume 3)

* Patients that have a fractured clavicle
  (to help immobilize the shoulder area)
  (See FRACTURES chapter, Volume 3)
D. TYPES OF SLINGS

Three types of slings will be presented in this manual:

1. simple sling (highly recommended for general use)
2. figure of 8 sling (for clavicle fractures)
3. common sling (common, but not the best)

1. Simple Sling

Question:
What are the 3 main functions of a sling?
Method to make and apply a simple sling:

a) Cut a piece of material
   (100 - 125 cm x 15 cm)

b) Attach each end so that it makes a loop.
   (Sew, pin, or tie it together)

c) Put one loop around the weakened forearm (just distal to the elbow).

d) Bring the material behind the back and over the opposite shoulder.

e) Put the other loop around the forearm.

f) Adjust the sling so that it's comfortable.

g) After adjustment, the hand should be higher than the elbow (at least the same level).

If the hand is below the elbow, the sling is too long.
Activity:

Different people may need different lengths of slings. Each student should take a long piece of material and measure how much material they need for a sling that fits well.

Describe how you find the measurement.

________________________________________________
________________________________________________
________________________________________________

2. Figure of 8 sling

This type of sling is used for clavicle fractures. (See FRACTURES chapter, Volume 3.)

An elastic bandage is good to use for this type of sling.
Method to apply a figure of 8 sling:

a) Put the bandage on the posterior side of the undamaged shoulder.

b) Wrap the bandage around the anterior part of the shoulder and then under the arm.

c) Cross the back and go over the opposite shoulder.

d) Wrap the bandage around the anterior part of this shoulder and then under the arm.

e) Cross the back and the begin step "b)" again.

f) Continue this wrapping until the bandage is finished.

NOTE
If the patient begins to have decreased feeling in the arms and hands, the bandage is too tight and must be removed.

(See BANDAGING chapter, Volume 2, for general guidelines.)
3. Common sling

The most common slings are attached around the neck and under the arm.

This method is not the best because the weight of the arm will pull on the patient's neck.

This pulling force may cause neck pain or damage to the neck.
A sling is a soft material wrapped around the upper limb to hold it in a good position.

The functions of a sling are to:

- support a weak or damaged shoulder joint
- provide some immobilization
- decrease swelling in the distal forearm and hand

Patients that may need slings:

- patients with flaccid hemiplegia
- patients that have injured the shoulder
- patients with a POP on the upper limb
- patients that have a fractured clavicle

Types of slings presented in this chapter:

- simple sling (highly recommended)
- figure of 8 sling (specific for clavicle fractures)
- common sling (not the best)
CHAPTER 20

BANDAGING
BANDAGING is the action of wrapping material (elastic) around a body part.

OBJECTIVES
At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. explain the function of bandaging.
2. describe general rules in bandaging.
3. demonstrate appropriate bandaging technique for a selected body part.

CHAPTER CONTENTS
A. WHAT IS BANDAGING?
B. THE GOALS OF BANDAGING
C. TYPES OF PATIENTS THAT NEED BANDAGING
D. GENERAL RULES IN BANDAGING
E. PICTURES AND EXAMPLES OF BANDAGING FOR DIFFERENT AREAS.
F. CHAPTER SUMMARY
A. WHAT IS BANDAGING?

Bandaging is the action of wrapping material around a body part.

Elastic material (elastic bandages) can stretch and recoil and are best for bandaging.

B. THE GOALS OF BANDAGING

When an elastic bandage is wrapped around a part, it will put inward pressure on this part.

Inward pressure from an elastic bandage can:

* decrease swelling

* give support to a joint

If this inward pressure is too much, the limb can be damaged!!

C. TYPES OF PATIENTS THAT NEED BANDAGING

Patients that may need bandaging are patients that have:

* amputations.

* swelling in distal joints.

* small instability or pain in a joint.

* a need for psychological support for joint protection.
D. GENERAL RULES IN BANDAGING

1. Bandaging should be made in figures of 8's.

Circular bandaging is bad because it will stop blood circulation.

2. Distal part of the bandage should be tighter than the proximal part of the bandage.

3. Immediately remove the bandage if the area distal to the bandage begins to have decreased feeling or turns blue!

E. PICTURES AND EXAMPLES OF BANDAGING FOR DIFFERENT AREAS

BELOW KNEE AMPUTEE

1 2 3 4 5 6 7 8 9 10

OR

1 2 3 4 5 6 7 8 9 10
ABOVE KNEE AMPUTEE

1 2 3

SWELLING OF THE FOOT/ANKLE

1 2 3 4 5 6 7 8
Questions:

1. Describe how a limb could be damaged if the bandaging is too tight.

2. Describe why circular bandaging will stop blood circulation and why figure of 8 bandaging will not stop blood circulation.

3. What are two ways to know if the bandaging is too tight.

4. An above knee amputee wraps a bandage very tight around his thigh and very loose around the end of the stump. Is this correct bandaging technique? Yes ____ No ____

   Explain 2 problems this patient could have because of this technique.
F. CHAPTER SUMMARY

Bandaging is the action of wrapping material around a body part. Elastic material is best for bandaging.

The goals of bandaging are to decrease swelling and give support to a joint.

General rules in bandaging are:

- bandaging should be made in figure of 8's.
- distal part of the bandage should be tighter than the proximal part of the bandage.
- if the area distal to the bandage begins to have decreased feeling or turns blue, immediately remove the bandage.
CHAPTER 21

PLASTER
PLASTER is a hard and fast drying material that helps to immobilize a joint.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. list 2 reasons why padding is used under plaster casts.
2. identify areas that need special padding in the upper limbs and lower limbs.
3. explain what you will teach the patient or family about a plaster cast and why this is important.
4. describe the common signs/symptoms that mean a cast should be removed immediately.

CHAPTER CONTENTS

A. INTRODUCTION
B. PLASTER AND PATIENTS THAT NEED IT
C. HOW TO MAKE PLASTER BANDAGES
D. STEPS TO APPLY PLASTER
E. FUNCTIONAL POSITIONS AND PLACES TO PAD
F. PLASTER REMOVAL
G. RULES TO REMEMBER ABOUT PLASTER
H. CHAPTER SUMMARY
A. INTRODUCTION

This chapter is written to provide guidelines about plaster use and application.

Plaster can be helpful if it is applied correctly; plaster can be harmful and cause serious injury to the patient if it is applied incorrectly.

If the PTA must use plaster with a patient, he must make sure to apply plaster correctly, teach the patient and family about possible problems and plaster care, and carefully monitor the patient with plaster.

REMEMBER

POORLY APPLIED PLASTER CAN CAUSE WOUNDS, JOINT DAMAGE, AND TISSUE DEATH.

B. PLASTER AND PATIENTS THAT NEED IT

We have said that plaster is a hard and fast drying material that helps to immobilize a joint.

In this section more details will be given about

1. plaster
2. patients that need plaster
1. plaster

The complete name for plaster is Plaster of Paris.

Plaster of Paris is a white powder.

When water is added to this plaster it makes a thick paste.

When this paste dries (very fast) it is very hard.

Plaster that is applied to a part of the body may be called a:  
* POP (Plaster of Paris)  
* cast  
* plaster cast

All of these names have the same meaning.
Questions:

1. A patient has a POP on his ankle. In your own words, explain what this means.

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

2. Is there a difference between a POP and a cast?
   Explain your answer.  Yes _____  No _____

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

2. Patients that need plaster

As we have said before, plaster is a hard and fast drying material that helps to immobilize a joint.

IMMобильIZE means to prevent movement. When a body part is immobilized, it cannot move.

Questions:

1A. A woman has both elbows immobilized in extension. What does this mean?

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
Questions: (continued)

18. Explain why this woman will have problems with eating, dressing, or brushing her hair.

Patients that may need immobilization with plaster are:

* patients with BROKEN BONES
  (see FRACTURES chapter, Volume 3)

- immobilization with plaster may prevent movement of the broken bone; with no movement, the bone can heal faster.

* patient with severe CLUB FOOT
  (see CLUB FOOT chapter, Volume 3)

- for babies with club foot that is very difficult to correct, immobilization with plaster can help to hold the foot in a specific position between each treatment.
C. HOW TO MAKE PLASTER BANDAGES

A plaster bandage is a type of gauze bandage that has plaster powder attached to it.

Bandages made by big companies are often the best, but they are also very expensive.

In this section we will suggest one method that can be used (and modified!) to make your own plaster bandages.

Materials needed

* Plaster of Paris powder
* gauze bandage
* scissors
* water
* storage container (air tight can or plastic bag)

Method to make plaster bandages

STEP 1 CUTTING THE GAUZE

If the gauze bandage is not the length or width that you want, you must cut it to be as you like and then roll it into a roll.
STEP 2 WETTING THE GAUZE

Put the roll of gauze bandage in water, remove it, and then squeeze it as dry as you can.

(A bandage that is a LITTLE wet will hold the plaster powder better than a dry bandage.)

STEP 3 APPLYING PLASTER POWDER

Unroll a part of the wet gauze bandage so that it is flat.

Sprinkle it with plaster powder until there is a thin layer of plaster over the gauze.

STEP 4 ROLLING THE BANDAGE

After plaster has been applied to a small area, roll this part into a roll (not too tight!)

Repeat Step 3 and Step 4 until the whole bandage has been "plastered" and "rolled".
STEP 5 STORAGE

After making a plaster bandage, it must be kept in a container that will help keep it dry.

A metal container with a good fitting lid, or a plastic bag can be used.

Questions:

1. A gauze bandage must be a little wet to help the plaster attach to it. Describe the problem if the gauze bandage is too wet.

2. After applying plaster powder to the bandage you must roll the bandage into a roll. Describe the problem if this bandage is rolled too tight.

3. After a PTA made a bandage he did not put it in a good container and the bandage became wet. Why is this a problem?
D. STEPS TO APPLY PLASTER

If plaster is NOT correctly applied, a POP can cause skin damage, tissue death and joint deformities.

Plaster application procedures are very important!

Below are steps that will help guide the PTA toward applying plaster correctly.

STEP 1 MATERIAL PREPARATION

Before starting, the PTA must prepare materials needed for plaster application.

Materials needed are:

- plaster bandages (as many as you will need)
- padding (to cover the limb and bony areas)
- a bucket of water (warm water causes fast drying plaster) (cool water allows plaster to dry more slowly)

It is also recommended that two people work to help apply the plaster.
STEP 2 PATIENT PREPARATION

a) joint positioning

put the patients joints in the position that you want them to be immobilized in. (See "Functional Positions", page 15.)

b) padding

* add thick padding over bony areas of the body to prevent the hard plaster from pressing on these areas. (See "Padding", page 15.)

* cover the entire area (including a little above and below where the plaster will end) with about 1 cm of padding; this will protect the body when plaster is removed.

Try to keep this padding as smooth as possible without folds or bumps.

* Do not put so much padding that the joint can move inside the plaster!
STEP 3 WET THE PLASTER BANDAGE

a) hold the plaster bandage in the pan of water for ~ 5 seconds (or until the bubbles have stopped rising).

This time allows the water to reach all areas of the bandage.

b) remove the plaster bandage by holding each end.

Gently twist the plaster bandage to remove excess water.

(Note: Do not squeeze the bandage because you will lose a lot of plaster with the water.)

(Do not remove too much water because the bandage will be too dry to make a good cast.)
STEP 4 APPLYING THE PLASTER BANDAGE

a) put the end of the wet bandage on the limb (the remaining part of the roll should be on top of this part to unroll easily.

b) unroll the bandage in a circular direction around the limb.

Do not lift the bandage or pull it tight...... just unroll it keeping and equal pressure on the bandage.

c) As you unroll the bandage the external side of your thumb should smooth over it - pushing out the air bubbles.

An assistant can also help to smooth the surface of the plaster so that it attaches well together.
d) continue bandaging in 
a circular direction 
from one end of the limb 
to the other end. When 
one bandage is finished, 
the next bandage should 
be ready to be applied. 
(Assistant can help with 
this.)

Continue applying plaster 
until you feel the thickness 
is enough to immobilize the 
part.

e) Always hold the POP 
with the palm of your 
hand to prevent pressure 
in one small area.

Never use your finger 
tips when holding the 
POP. This will make 
small pressure bumps 
inside the plaster.

f) At the ends of the 
cast you can fold the 
extra padding over 
the plaster and cover 
it with the last few 
turns of the bandage.
STEP 5 PATIENT/FAMILY TEACHING

* The patient or family must be told why the POP was applied and when it will be removed.

* The patient or family must be told to check regularly (especially the first 1-2 days) for WARNING SIGNS that mean that the patient should return immediately and have the plaster removed.

WARNING SIGNS indicating immediate plaster removal are:

- pain (in the area distal to the plaster or in an area under the plaster caused from too much pressure)
- decreased feeling or movement in the body parts distal to the plaster
- if the parts distal to the fracture become swollen, cold, or turn blue.

These warning signs mean that there is no enough padding under the plaster or that the plaster is too tight. The POP must be removed as soon as possible to prevent skin damage, nerve damage, or tissue death.

* The patient or family must be told how to take care of the cast. No weight bearing or pressure on the cast until it is hard and dry ("48 hours). Do not put water on the cast because it will become soft and start to smell bad. Use a plastic bag to cover the cast when bathing.

NO FOR 48 HOURS !!!!
E. FUNCTIONAL POSITIONS AND PLACES TO PAD

In the last section we discussed application of plaster. Important parts of "patient preparation" are joint positioning and padding bony areas.

* Functional positions are joint positions that are most useful if the joint is stiff. (See FRACTURES chapter, Volume 3).

* The diagram below shows the areas that need special padding.

F. PLASTER REMOVAL

Removal of a plaster cast can sometimes be painful. Explain to the patient and family what you are doing and, if appropriate, let the patient help you remove the plaster.

Plaster can be removed by:

1. cutting the plaster
2. soaking the plaster in water
1. cutting the plaster

Plaster can be cut with strong scissors. Start at one end of the cast and put the scissor blade on top of the padding and parallel to the skin. (Try to prevent the scissor blade from cutting into the skin!)

Avoid cutting the cast near bony areas.

For the upper limb, a good place to cut the cast is along the midline of the anterior surface of the arm.

For the lower limb, a good place to cut the cast is along the external side of the leg in the area between the heel and the external malleolus.

If scissors are not available or strong enough, a knife can be used to cut the plaster. (Be careful not to cut into the patient's skin!)

A technique to make the plaster softer in areas you want to cut is to put some drops of vinegar on the plaster area and wait a few minutes so it can become soft.
G. IMPORTANT RULES TO REMEMBER ABOUT PLASTER

Below is a summary of the guidelines that are important to remember about plaster.

WETTING PLASTER

- hold it in water for 5 seconds (or until the bubbles stop)
- remove it holding both ends, gently twist to remove extra water (do not squeeze it because you will lose a lot of plaster and the bandage will also be too dry)

APPLYING PLASTER

- carefully pad all bony areas well, and then pad the rest of the limb (1 cm thick)
- keep the bandage on the limb and never pull the bandage tight
- smooth over the plaster with your hand to help remove air bubbles and help the bandage be strong
- circular wraps with no folds or bends from one end of the limb to another.
- never put pressure on one small area of the plaster before it is dry - this may cause pressure over the skin and cause a wound.

PATIENT/FAMILY TEACHING

Warning signs to remove the POP as soon as possible are:

1. pain (in distal parts or under the plaster)
2. decreased feeling or movement in distal parts
3. distal parts becomes swollen, cold, or blue

REMOVAL OF THE CAST

Cutting - avoid bony areas (can cut on the anterior side of the arm and lateral side of the leg)
Soaking - may be good method for children
H. CHAPTER SUMMARY

Plaster is hard and fast drying material that helps immobilize a joint.

Other names for plaster are Plaster or Paris (POP), cast, or plaster cast.

Immobilization prevents movement.

A method to make plaster bandages was given in the chapter.

Steps in applying plaster are:

1. Preparing materials (water, plaster bandages, padding)
2. Preparing the patient (padding bony areas, good positioning)
3. Wetting the plaster bandage (don't squeeze it!)
4. Applying the plaster bandage (smooth surface, circular wrapping, no bubbles, don't pull tightly)
5. Patient/family teaching (warning signs to remove cast, cast care)

Warning signs that tell you there is not enough padding or the cast is too tight include:

- pain (in distal parts or under the plaster from pressure in one area)
- decreased feeling or movement in parts distal to the plaster
- parts distal to the plaster become swollen, cold, or blue

If the patient has any of these signs, the POP must be removed immediately!

Plaster can be removed by cutting it or soaking it in water and then unwrapping it.
REMEMBER: Some patients can be helped by good application of plaster and many patients can be hurt by poor application of plaster. Applying plaster is serious, and should be done correctly.
CHAPTER 22

DEVICES FOR AUTONOMY
DEVICES FOR AUTONOMY are equipment (and ideas) to help a person be more independent in eating, dressing, and bathing.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. given a patient problem recommend devices that may help the person to be more independent in eating, dressing, or bathing.

CHAPTER CONTENTS

A. INTRODUCTION
B. DEVICES FOR AUTONOMY IN EATING/DRINKING
C. DEVICES FOR AUTONOMY IN DRESSING
D. DEVICES FOR AUTONOMY IN BATHING
E. CHAPTER SUMMARY
A. INTRODUCTION

A person that has a physical limitation may need special equipment to help him to be more independent in taking care of himself.

Devices for autonomy are equipment (and ideas) to help a person be more independent in eating, dressing and bathing.

Question:

A person that has a physical limitation may need special equipment to help him to be more independent in taking care of himself.

A PTA teaches a patient how to use different devices for autonomy. What type of treatment is this (curative, preventative, or adaptive)?

Explain your answer.

Remember: As part of the REHABILITATION process, Physical Therapy treatment helps a person to have as much strength and movement as possible.

If the patient will always have a physical limitation (paralysis, limb loss, deformity), devices for autonomy can help him to have a more independent life.
Question:

Devices for autonomy can help a person be more independent in taking care of himself. Please list 2 reasons why it is important for a person to be as independent as possible in eating, dressing or bathing.

In the following sections, different devices will be presented. Remember that these are only examples.

Together with the patient and family, the PTA can make new and different devices that can help the patient in the same way.

B. DEVICES FOR AUTONOMY IN EATING

Ideas given in this section include:

1. devices to prevent plate/bowl movement
2. eating devices for patients with weak or deformed hands
3. eating devices for patients with weak arms
4. eating devices for patients with no arms
5. drinking devices
1. devices to prevent plate/bowl movements

a. covering the table surface with tire inner tube.

- A non-slip mat under the plate can be made from strips of tire tube woven over a stiff wire frame.

- The special plate can be made from a small plastic bucket.

- To prevent slipping, you can glue (with a waterproof glue) strips of tire tube on the bottom.

b. making a plaster mold that will hold the plate

- Put plate into wet plaster.

- When plaster becomes dry, remove the plate.

- Cover plaster with varnish to help protect it from water.
2. **eating devices for patients with weak or deformed hands**

   a. **methods to make a handle bigger for easier gripping**

   - rubber tube
   - rubber ball
   - strip of tire tube (wrapped)

   - old tool handle
   - cut off spoon
   - piece of wood
   - bend the handle to fit the child's grip

   b. **methods to attach the spoon, fork, knife to your hand**

   - Velcro

3. **eating devices for patients with weak arms**

   a **tipping board**

   that helps lift the patient's hand to his mouth.

   Or make it from the bottom of an old plastic (or metal) bucket.

   Heat the plastic along the lines with a hot strip of metal.

   And bend it like this.

   Straps may or may not be needed.
4. eating devices for patients without arms

a. prosthetic attachment with an end part made of rubber

3 holes in different directions to hold handles in different position.

b. Ways to eat using the mouth only

Pick up food holding spoon in mouth.

Slip spoon into clothespin.

With the lips, turn clothespin so that spoon enters mouth.

Put a rubber band or clip on the spoon handle to keep spoon from slipping in clothespin.
5. **drinking devices**

Below are pictures of many different ways to adapt cups or glasses for drinking.

![Diagram showing how to make a special cup from a plastic bottle]

You can make a special cup from a plastic bottle.

Cut it like this.

Gently heat the rim and gradually bend it out with a round smooth rod or stick.

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C. **DEVICES FOR AUTONOMY IN DRESSING**

Ideas given in this section include:

1. clothing suggestions
2. devices for closing buttons
1. clothing suggestions

For patients that have physical limitations, the following general suggestions are given to help patients put on and take off clothing.

a. shirts
b. pants and skirts
c. shoes

a. shirts

Large, loose fitting shirts without buttons or zippers are best.

b. pants and skirts

Pants or skirts with elastic are the easiest to put on and take off.

No heel

easier
harder
c. shoes

Sandal-like shoes or shoes with an open end at the toe are the easiest to put on and take off.

If available, velcro can be used to close the shoes.

If the patient must wear shoes with laces, an elastic band can be used to help "tie" the shoe.
2. **devices for closing buttons**

If buttons are used, the buttons should be large and the button holes big.

A device that can help pull the button through the button hole is seen below.

D. **DEVICES FOR AUTONOMY IN BATHING**

1. soap holders
2. body reacher
1. **soap holders**

There are many different ways of making soap easy to hold and use.

2. **body reacher**

A brush or cloth can be attached to the end of a stick to help patients wash areas that may be difficult to reach.
E. CHAPTER SUMMARY

Devices for autonomy are equipment (and ideas) to help a person be more independent in eating, dressing and bathing.

This chapter provided only a small introduction of what can be made to help a patient help himself.

The PTA can use these ideas, but must work closely with the patient and family to experiment and find ways that will help a patient be as independent as possible.
CHAPTER 23

HOUSE ADAPTATIONS
HOUSE ADAPTATIONS are changes made on the inside or outside of a house.

OBJECTIVES

At the time of the exam and with 80% proficiency, the student will be able to correctly:

1. given a patient problem identify house changes needed to help a patient be more independent in the home.

CHAPTER CONTENTS

A. INTRODUCTION

B. HOUSE ADAPTATIONS FOR PEOPLE IN WHEELCHAIRS

C. HOUSE ADAPTATIONS FOR PEOPLE WITH POOR BALANCE

D. OTHER HOUSE ADAPTATIONS

E. CHAPTER SUMMARY
A. INTRODUCTION

House adaptations are changes made on the inside or outside of the house.

In this chapter we will discuss specific house changes that can help a person with a limitation (a handicapped person) be more independent in the home.

At the home the PTA can work together with the patient and the family to help identify changes that can help the patient be more independent and ways to make these changes.

Remember, house adaptations and social integration are a part of the rehabilitation process.

Once the patient leaves the hospital he must NOT be forgotten!

B. HOUSE ADAPTATIONS FOR PEOPLE IN WHEELCHAIRS

Activity:

If possible, the PTA should experience life from a wheelchair for 2-3 hours.

During this time, the PTA should travel in the community and inside a house. The PTA does not leave the wheelchair during this time.

After many PTAs have made this activity, there should be a class discussion to include:

- problems with travelling in the community
- problems with moving in the home
- how the PTA felt (physically, emotionally)

Wheelchairs are given to help the patient move from one place to another. If areas are not adapted for wheelchairs, the patient will be more limited rather than more mobile.
Examples of problems for wheelchairs are stairs, doors that are too small, no place to turn, and tables that are too small. There are many other examples, but we will not mention them here.

In deciding house adaptations needed for wheelchairs, the PTA, patient, and family must consider the following areas:

1. outside of the home
2. doorways
3. space to move
4. transfer surfaces
5. tables to use
6. bathroom

Again, this chapter presents only SOME ideas for some adaptations. The PTA, patient and family must work together to identify what the patient needs and how to meet these needs through small changes in the house.

1. outside of the house

The question to ask and answer is, "How will the patient arrive at the door?"

For houses that are on the ground, arriving at the door may be no problem or a small ramp with handrails may be useful.
For houses that are off the ground, stairs with a handrail may be useful (a).

or a pulley system to help lift the patient into the house may be needed (b).
In these cases, the patient and family must decide if the patient needs the wheelchair in the house.

Sometimes the wheelchair can remain outside of the house and an adapted wheeled device can be made to help the patient move easily within the house.

2. doorways

For patients using a wheelchair inside the house, the doorway must be wide enough for the wheelchair to pass.
3. space to move

The wheelchair must have flat areas to roll on and enough space to turn and move.

Minimum space to turn with a wheelchair requires a circle of a diameter of 150 cm.

4. transfer surfaces

A general rule to remember is to adapt beds or toilets to be the same height as the seat of the wheelchair.
To make some transfers easier, a trapeze can be used to help the patient lift himself from one surface to another.

Points to remember are:

- can the wheelchair fit under the table? (arm rests, front wheel is not blocked)
- is table about at the elbow level of the patient?
- can a small edge be added round the table to prevent objects from falling off?
6. **toilets**

If the patient cannot wash himself or go to the toilet in his chair, there must be a seat in the bathroom to help with this.

A water jar must be placed close to this seat on the patient's strong side.
For patients that are able to walk but may have some problem with balance, HAND RAILS attached to the inside and outside of the house will help the patient to be safer and more independent.

If possible, a seat and side rails should be used when bathing so that the patient does not fall down.
D. OTHER HOUSE ADAPTATIONS

Again, the PTA working with the patient and the family must identify the patient's needs and find ways to help the patient function as independently as possible.

The answers will not be found in this chapter, the answers of how best to adapt a house will be found working together with the patient and family and EXPERIMENTING with different ideas.

Other suggestions for house adaptations are for the bed. Examples of some bed adaptations are given below. Again, these are only ideas ...
E. CHAPTER SUMMARY

House adaptations are changes made on the inside and outside of a house.

For a handicapped person (a person with a limitation), changes about the house can help increase their independence.

The PTA must work together with the patient and the patient's family to identify some house changes that could greatly help the patient.

This chapter gives some ideas for house adaptations. These ideas include suggestions for:

* doorways
* space in the house
* transfer surfaces
* table height
* bathroom
* rails in the house
* the bed

House adaptations and social integration are important parts of the rehabilitation process and must not be forgotten.