

Science Strand 2: Properties and Principles of Force and Motion

CLE: 2.2 Forces affect motion

Health Profession: Physical Therapy

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Reference(s)

Konin, Jeff G. Practical Kinesiology for the Physical Therapist Assistant. Thorofare: John H. Bond, 1999.

Lippert, Lynn S. Clinical Kinesiology for Physical Therapist Assistants. 3rd ed. Philadelphia: F.A. Davis Company, 2000.

Objectives:

At the completion of this presentation the high school student will be able to:

1. Explain how different types of resistive forces influence therapeutic exercise. Explain how these forces may be changed or manipulated to increase or decrease the difficulty of these exercises.
2. Demonstrate mechanical advantage with the activity below.
3. Identify the importance of this information as it relates to Physical Therapy.

Background Summary of Information as Related to Physical Therapists (PT) and CLE

Kinesiology is the study of movement. It brings together anatomy, physiology, physics, and geometry, and relates them to human movement.

Biomechanics relates mechanical principles directly to the human body. In biomechanics forces are considered models by which movement are accomplished.

A force is a push or pull exerted by one object on another. In human movement these forces include gravity, muscles, externally applied resistances, and friction.

Total amount of push or pull is magnitude and it's course is direction.

Mechanical advantage refers to the efficiency of a lever. A lever is only considered efficient when only a small amount of effort is required to overcome a large resistance. In other words the force arm must be greater than the resistance arm. Many joints in the skeletal system work as a lever. For example the knee. When force is applied by the muscles of the upper leg (above the knee), this raises the lower leg (below the knee). The knee joint therefore acts as a fulcrum.

Resistive forces are always present. These range from weight of a limb (leg or arm), to any weight attached to the body (backpack, ankle weights, or even clothing).

For Physical Therapists it is important to know how forces act on the human body. Understanding of these (and more) principles allows the therapist to manipulate the patient's activities and exercises to allow them to perform at a higher success rate.

Set is a group of repetitions.

Repetition is a completion of a movement from a starting position to a midpoint and back to the starting position.

Seated knee extension refers to when a patient while sitting, raises the lower leg into an extended position aligning it with the upper leg.

Physical Therapist Education:

In Missouri, PT Education is found at Missouri State University, University of Missouri, Columbia, St. Louis University, Washington University, Maryville University, Rockhurst University, Southwest Baptist University. PTA programs: Missouri Western State University, Penn Valley Community College, Ozark Technical Community College, Linn State Technical College, St. Louis Community College

Scenario

Mr. McDonald is a Physical Therapist. Mr. King is a 48 year old male who is recovering from knee surgery. As part of his therapy, Mr. McDonald has instructed Mr. King to do 4 sets of 12 repetitions each of seated knee extensions using a 3 pound ankle weight for resistance.

What are the resistive forces working against Mr. King as he performs the exercise?

Answer: Gravity, friction (from movement of joint surfaces), ankle weight, clothing (pants or shoes), the weight of his own leg.

If Mr. King is having difficulty carrying out these exercises to completion, which of the above resistive forces may be altered to help him?

Answer: All may be altered except friction and the weight of his own leg. Mr. McDonald may have Mr. King do the exercise in a side-lying position, reducing the effects of gravity.

Using the principle of mechanical advantage, how might the therapist alter this exercise without changing the amount of the resistance?

Answer: Move the weight higher up on the lower leg. Doing this reduces the resistance arm of the knee (lever) by moving the resistance closer to the knee joint (fulcrum), therefore increasing it's efficiency.

Activities

Have two students of roughly equal size come to the front of the room. Ask the students who they think can hold one of two backpacks of equal weight up the longest. With the student voted to hold it longer by the class, place the backpack in their hand with their arm raised straight out to their side. Place the other backpack on the other student's upper arm and see who can hold it the longest. This demonstrates the use of mechanical advantage.

Supplies needed: Backpacks of equal weight.