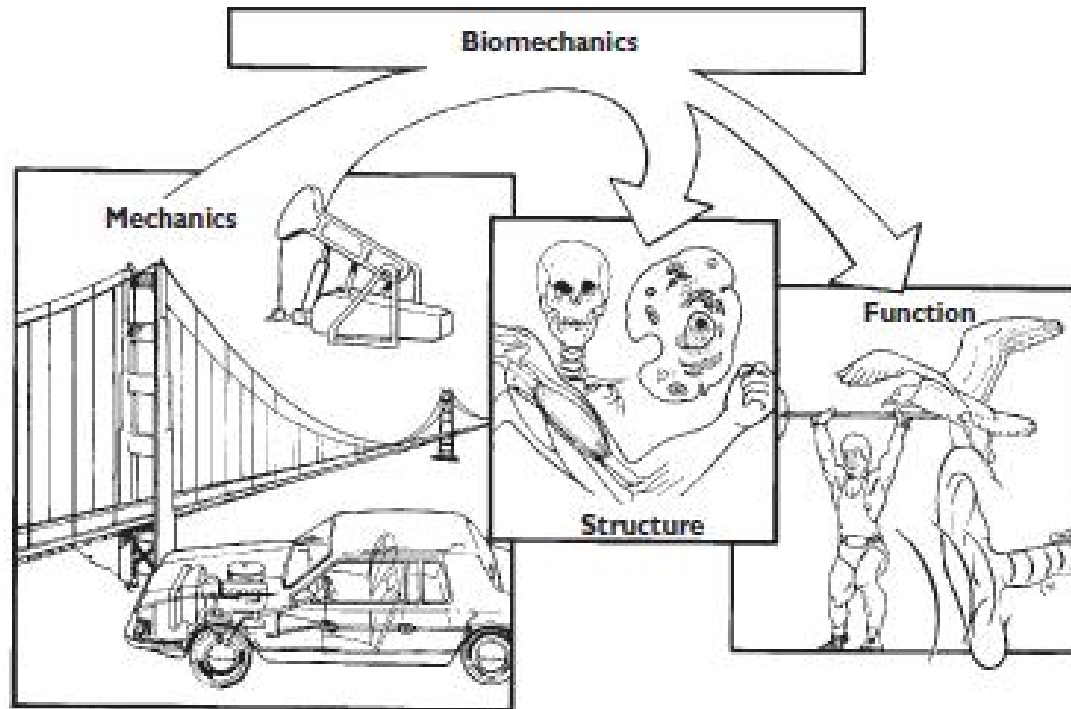


Chapter 1

What is Biomechanics?

Basic Biomechanics, 6th edition
By Susan J. Hall, Ph.D.



mechanics

branch of physics that analyzes the actions of forces on particles and mechanical systems

statics

branch of mechanics dealing with systems in a constant state of motion

dynamics

branch of mechanics dealing with systems subject to acceleration

kinematics

study of the description of motion, including considerations of space and time

kinetics

study of the action of forces



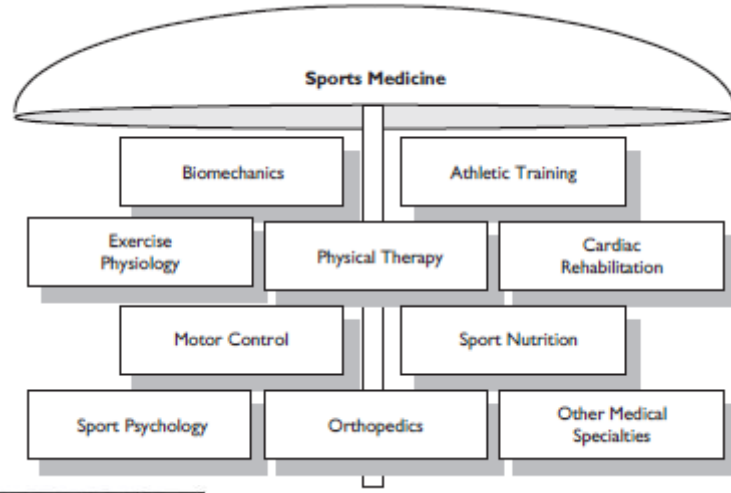
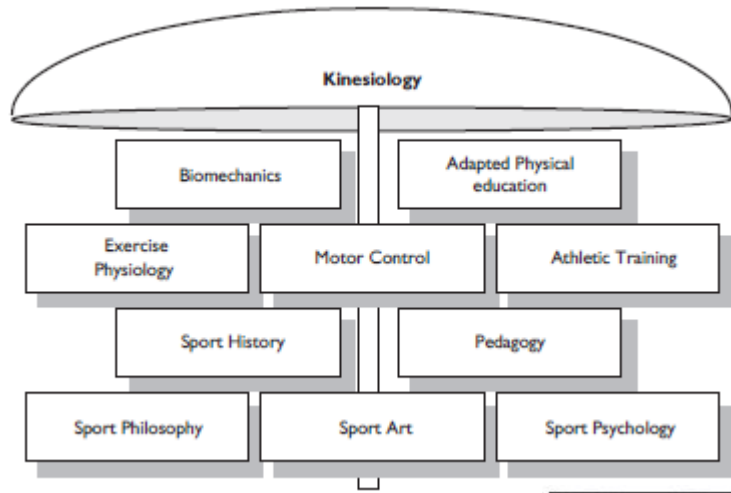
Learning to walk is an ambitious task from a biomechanical perspective.
Photo © PhotoAlto/PictureQuest.

kinesiology

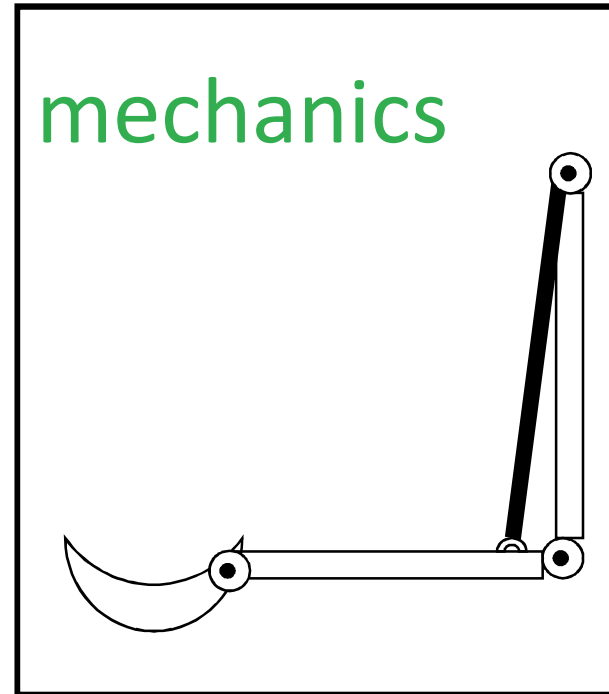
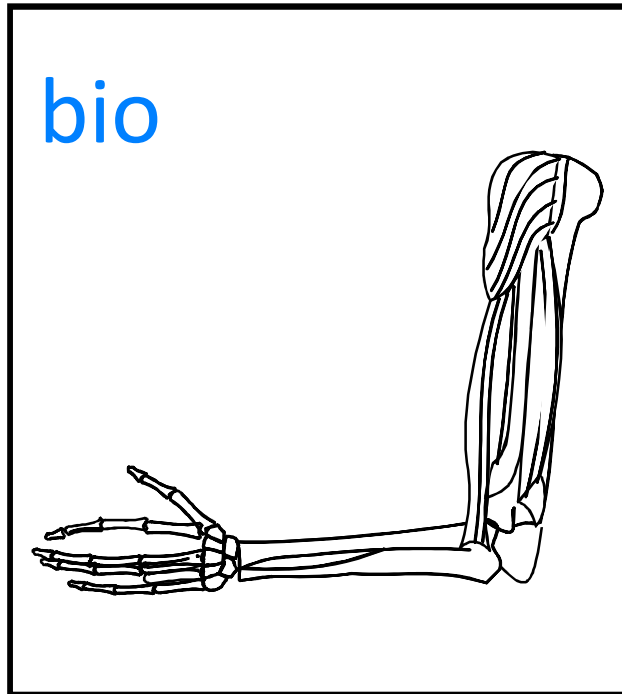
study of human movement

sports medicine

clinical and scientific aspects of sports and exercise



What is biomechanics?



The term *biomechanics* combines the prefix *bio*, meaning “life,” with the field of *mechanics*, which is the study of the actions of forces, (both internal muscle forces and external forces.) In biomechanics we analyze the mechanical aspects of living organisms.

Sub-branches of **biomechanics**:

- **statics**: study of systems in **constant motion**, (including zero motion)
- **dynamics**: study of systems subject to **acceleration**
- **kinematics**: study of the **appearance** or description of motion
- **kinetics**: study of the actions of **forces** (Force can be thought of as a push or pull acting on a body.)

What is kinematics?



What we visually observe of a body in motion is called the **kinematics** of the movement. Kinematics is the study of the **size, sequencing, and timing of movement**, without regard for the forces that cause or result from the motion. The kinematics of an exercise or a sport skill is known, more commonly, as **form or technique**.

What is kinetics?



Kinetics is the study of **forces**, including internal forces (muscle forces) and external forces (the forces of gravity and the forces exchanged by bat and ball).

What questions are studied by biomechanists?



Whether lifting weights or lifting boxes in industry, the act of lifting places major mechanical stress on the low back. What lifting kinematics (techniques) can minimize this stress?

What questions are studied by biomechanists?



Pitching can lead to stress injuries of the elbow and shoulder joints. What pitching technique characteristics minimize the mechanical stresses to these joints?

What questions are studied by biomechanists?



Recreational runners, as well as athletes in many sports, often stretch before a work out. Does this actually help or hinder performance? (Increasing evidence suggests the latter...)

What **questions** are studied by **biomechanists**?



What biomechanical elements of running technique enable some sprinters to dominate over others who are just as well trained and have just as strong physiological attributes?

Qualitative vs. Quantitative:

- **qualitative:** pertaining to quality (without the use of numbers)

For example: strong, skillful, agile, flexible, fast

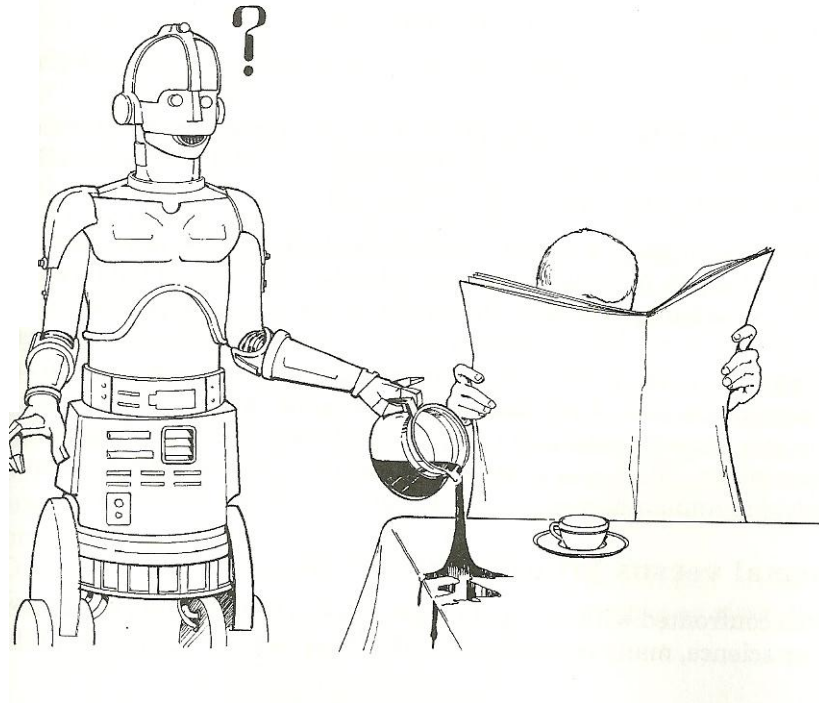
- **quantitative:** involving numbers

For example: running speed = 5 m/s

height = 1.75 m

mass = 68.2 kg

Qualitative vs. Quantitative:



Quantitatively, the robot missed the coffee cup by 15 cm.
Qualitatively, he malfunctioned.

Qualitative vs. Quantitative:



Coaches rely heavily on **qualitative** observations of athletes' performances in formulating advice about technique.