

Physics 160 Biomechanics

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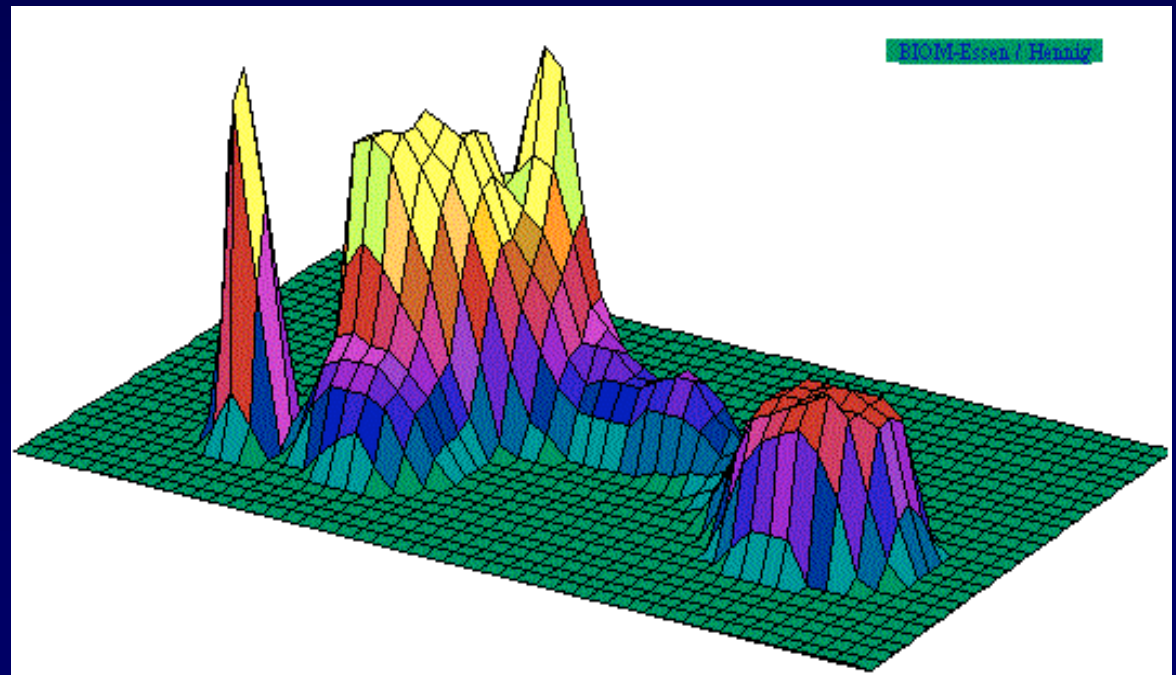
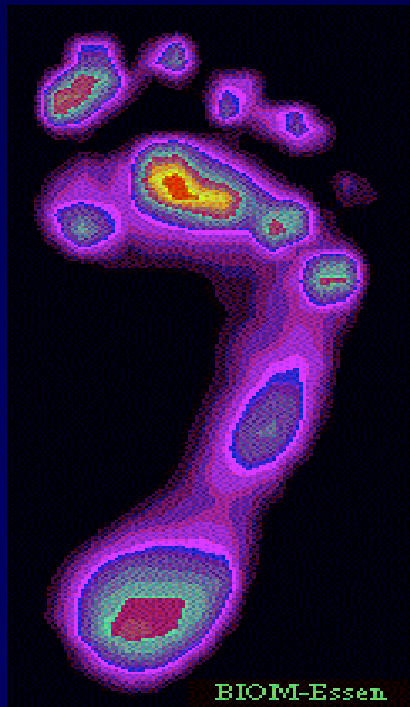
Chapter 1: What is Biomechanics?

Basic Biomechanics, 5th edition

Susan J. Hall

Objectives

- Define basic concepts in Biomechanics
- Provide an overview of the sport, clinical, and occupational applications of biomechanics.



What is Biomechanics?

Mechanics

- Study of the action of forces on particles and mechanical systems; a branch of physics

Bio-

- Prefix for “life” or “living organism”

Biomechanics

- Application of the principles of mechanics to the study of living organisms (e.g. the human body and its parts)



Kinesiology

- Scientific study of human movement
- Biomechanics is a sub discipline of kinesiology



Kinesiology

Biomechanics

Adapted physical education

Exercise physiology

Motor behavior

Athletic training

Sport history

Pedagogy

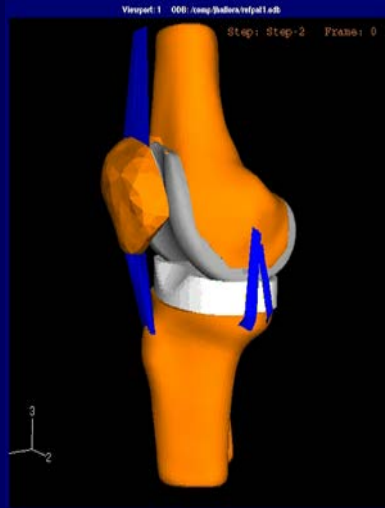
Sport philosophy

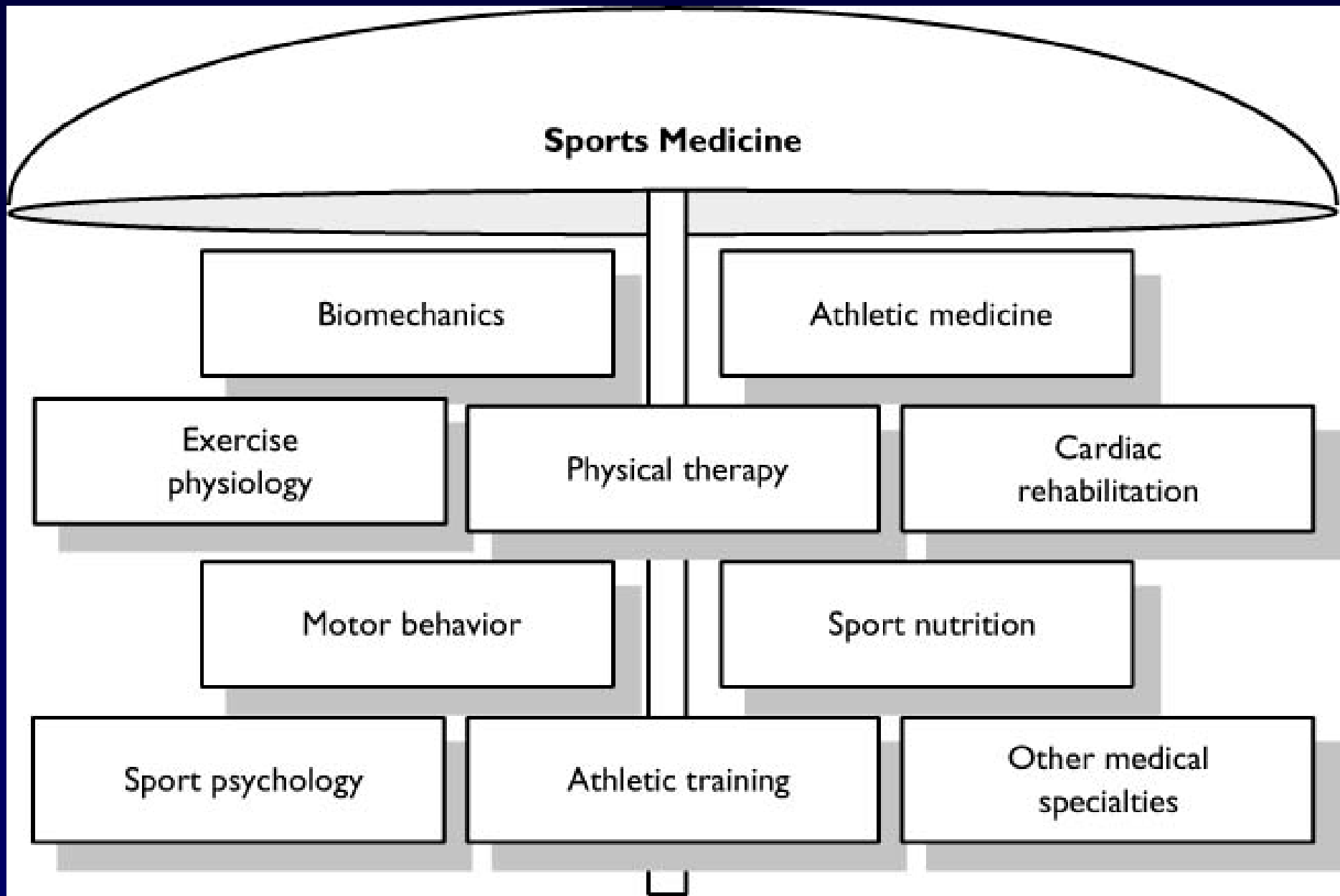
Sport art

Sport psychology

Sports Medicine

- Clinical and scientific aspects of sports and exercise
- Biomechanics is a specific branch of sports medicine





Subdivisions of Mechanics

Kinematics

- The description of motion as a function of space and time
- The forces causing the motion are *not* considered

Kinetics

- The relationship between the forces acting on a system and the motion of the system



Branches of Mechanics

Statics

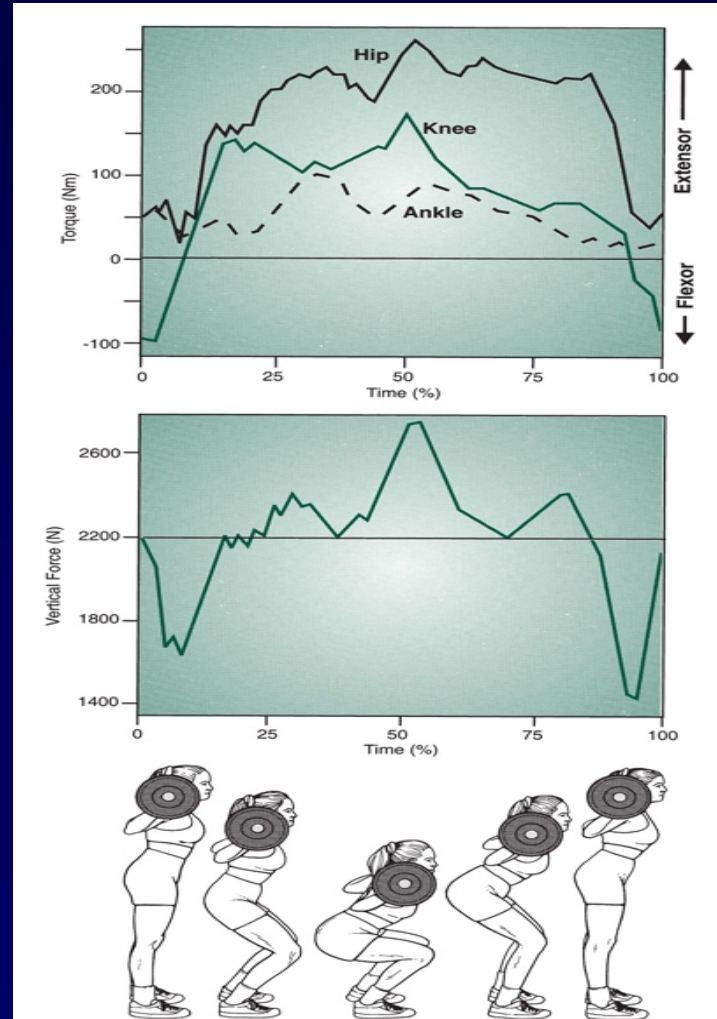
- Deals with systems in a constant state of motion;
- Includes systems that are:
 - – at rest (*i.e.* not moving)
 - – moving with a constant speed and direction

Dynamics

- Deals with systems in which acceleration is present
- (*i.e.* where speed or direction is not constant)



Kinetics of Squat



Kinetics of the Foot

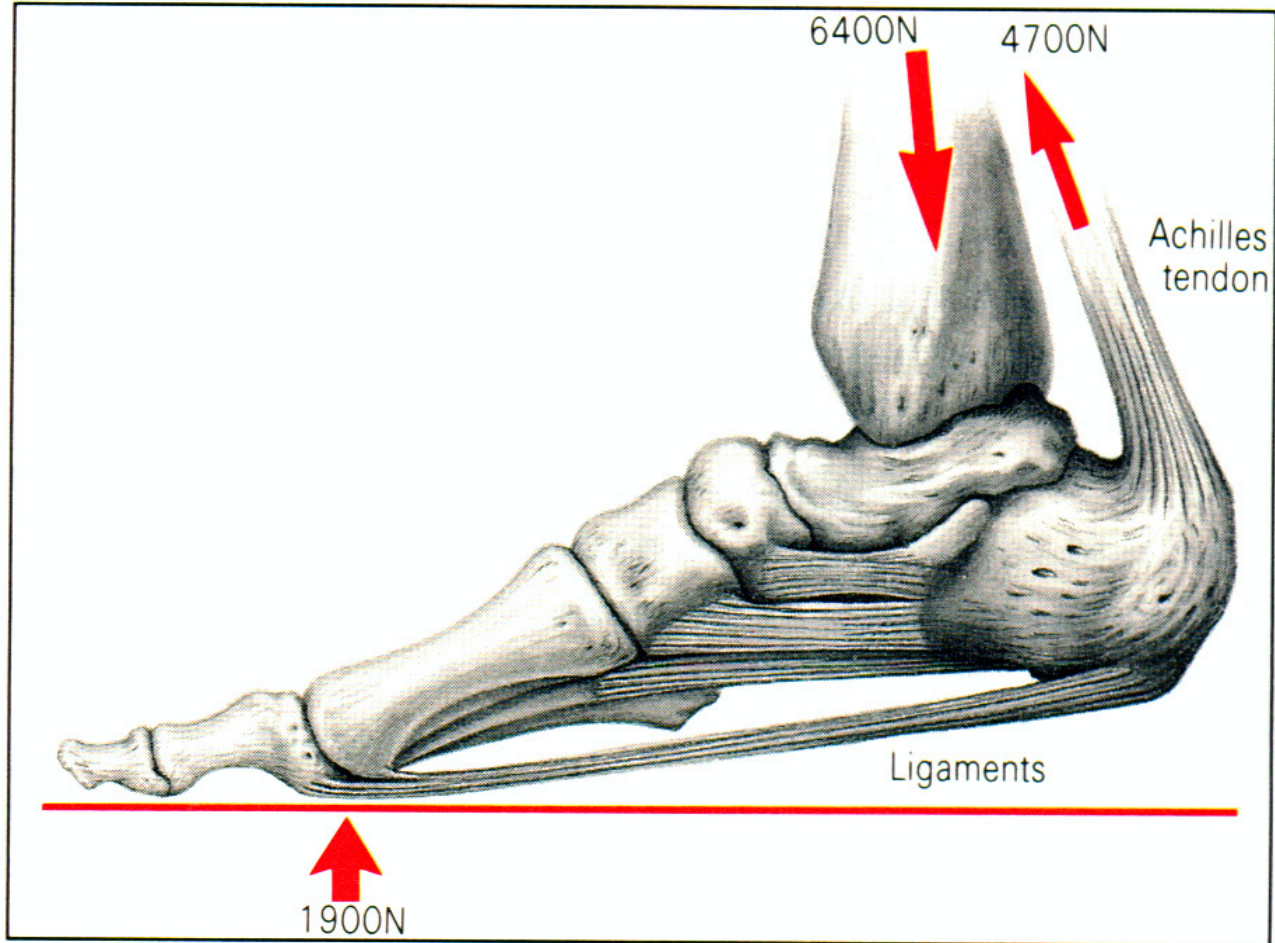


FIG. 6.8 *Skeleton of a foot, showing the Achilles tendon and the ligaments of the arch. The arrows represent the peak forces in a running stride.*

Who Uses Biomechanics?

- Phys.Ed. Teachers
- Coaches
- Athletes
- Personal Trainers
- Athletic Trainers
- Physicians
- Physical Therapists
- Occupational Therapists
- Engineers
- Researchers



What is Biomechanics Used For?

Maintaining Physical Function

- – (e.g. reducing injurious falls by older adults; preventing bone loss in space)

Improving Musculoskeletal Health

- – (e.g. increasing peak bone mass)

Improving Mobility

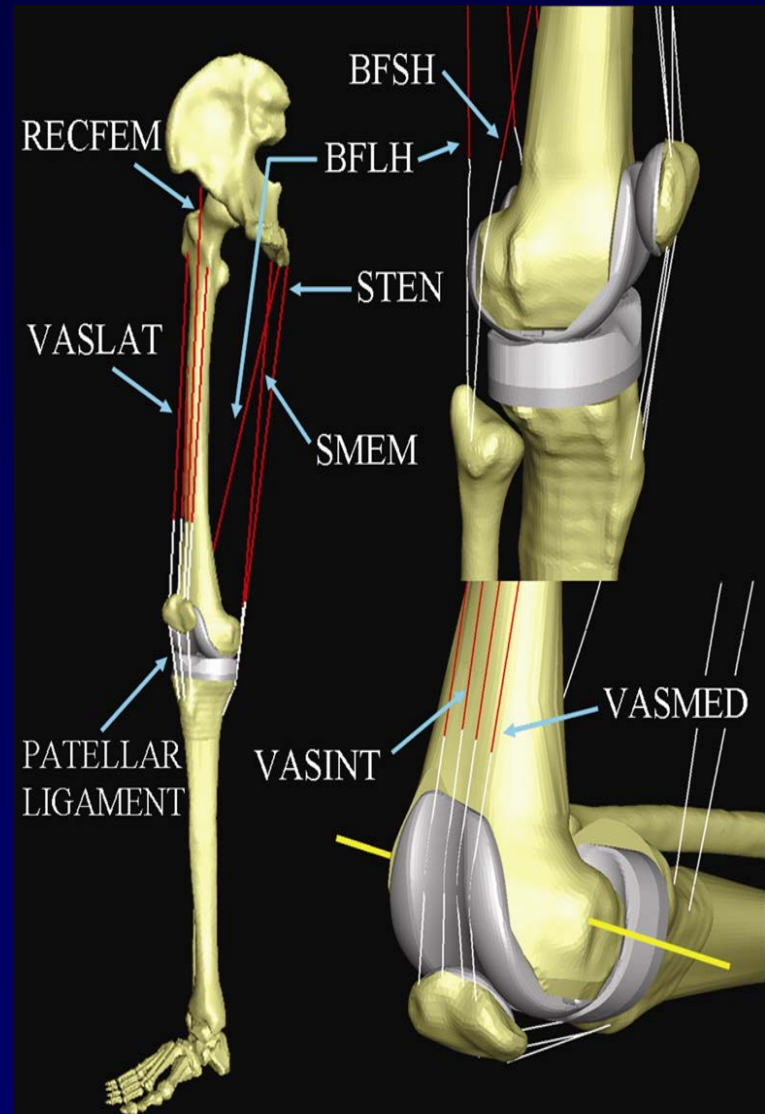
- – (e.g. surgery planning in Cerebral Palsy)

Product Design

- – (e.g. athletic shoes, prosthetics)

Forensic Biomechanics

- – (e.g. accident investigation)



Implant Products

- Shoulder
- Hip
- Wrist
- Finger
- Elbow
- Knee
- Ankle



Why study biomechanics?

Improve performance

- Technique analysis
- Equipment design
- Training

Prevent injury and
improve rehabilitation



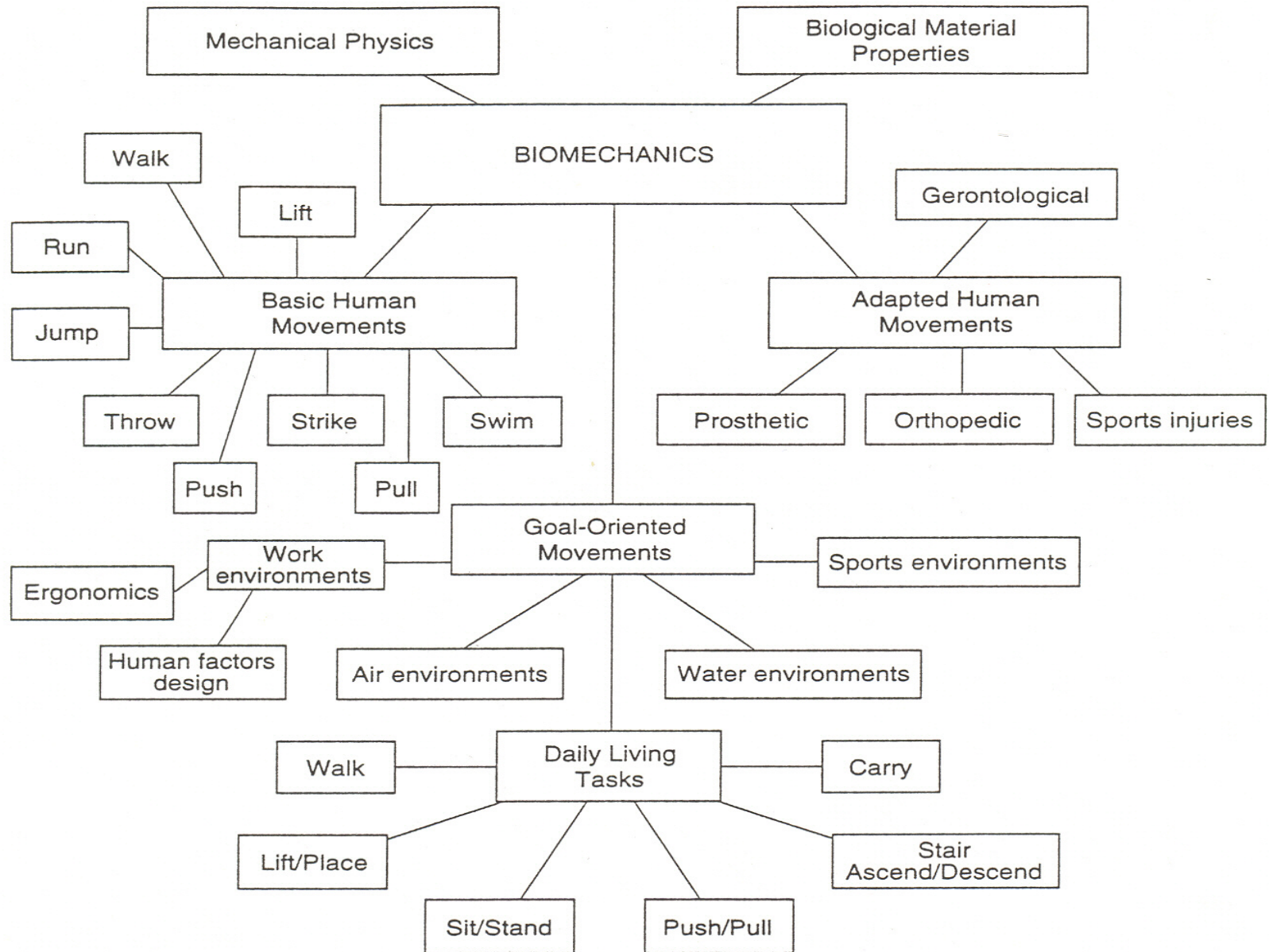


FIGURE 1.2

Application of biomechanics to movement-related areas.

Technique Changes and Sport Biomechanics

- revolutionary technique changes
 - back-layout high jump
 - spin shot put
 - V-style ski jump
 - skate skiing
 - grab-start (swimming)
 - pole vaulting (fibreglass poles)



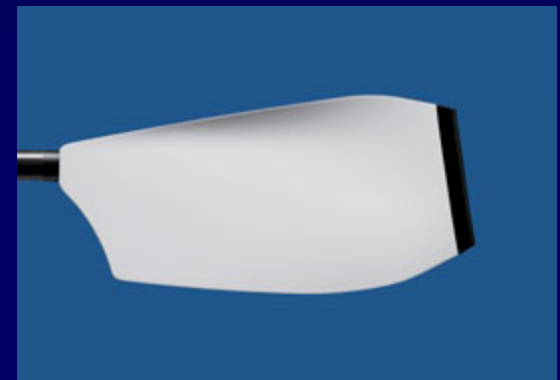
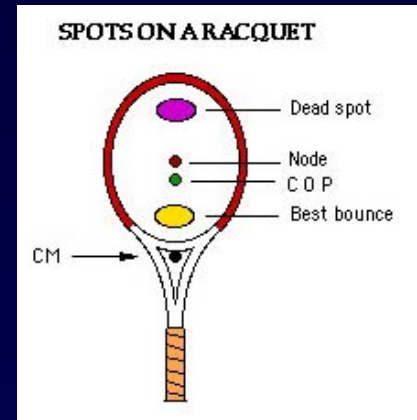
Sports Engineering

- mechanical innovations:
 - rowing (sliding seats, riggings)
 - bicycles (disc wheels, suspensions)
 - wheelchairs (4 to 3 wheels)
 - footwear
 - clothing
 - helmets
 - klapskate



Implements

- Racquet sports
 - stringing
 - materials
 - racquet shape
- Batting sports
 - materials (aluminum vs. wood)
 - composites (corking)
 - inertial properties
- Paddling sports
 - material properties
 - shape/structure
 - fluid dynamics



Ergometers/Simulators

- Treadmills
 - ski
 - instrumented with force platforms
- Ergometers
 - bicycle
 - rowing
 - swim
- Instrumented exercise machines
 - Cybex, KinCom, Biodex
 - bicycle cranks



Clothing

- Aerodynamics

The seaming in the suit was pushed to the front of the uniform to create the most aerodynamic garment possible. The Nike innovation team estimates that the hood helps eliminate drag by 3 per cent. This is the equivalent to eight feet in a 2000 metre race.



Surfaces

- Modern track surfaces use a mix of plastic rubbers combined with other plastic binders or with solid polyurethane, which is then glued to the ground like carpeting.
- tunable surfaces (stiff for sprinting, softer for distances)
- variable banking of tracks (athletics and cycling)
 - flat for 10 000 metres
 - 15% grade for 200 m
- “pitcher’s mounds” at high, long and triple jumps



Footwear

- Injury prevention
- Traction (temporarily glue shoe or sole of shoe or “spikes” to foot)
- Energy storage/release shoes (springs)
- Reducing energy absorption
- Skates (what’s beyond the klapskate?)
- Ski boots/bindings (microprocessor controlled)
- Computer monitoring of race by shoe



Which phrase best defines biomechanics?

- A) The scientific study of human movement
- B) The science of the structure of the body
- C) The application of the laws of mechanics to animate motion
- D) The study of characteristics of motion from a spatial and temporal perspective without reference to the forces causing the motion.