

# HUMAN ADAPTABILITY

## natural selection

### human environment:

1. natural (physical) habitat: tropical, desert, polar etc.
2. biological: organism (*H. sapiens*)
3. culture (technological-cultural adaptations)



### Ways humans respond to environmental stress

1. Cultural/psychological/technological (behavioral) adaptations
2. Physiological acclimatization
  - > Long-term acclimatization
  - > Short-term acclimatization
3. Developmental adjustments (Anatomical) -Plasticity
4. Genetic change



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## Stress

> Central to study of adaptation is the concept of stress. Stress is taken as any factor that interferes with normal limits of operation

## Homeostasis

> Adaptation restores homeostasis

3 environmental stresses which have been examined in studies of human adaptability are: high altitude, cold and heat

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## High Altitude Adaptations

- elevations of 7,500 - 13,000 feet
- Himalayas (Tibet, Nepal – 15,000 ft.) Andes (17,500 ft), Ethiopia



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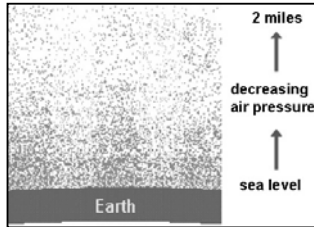
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- hypoxia (mountain sickness): oxygen starvation
  - physical fatigue, headaches, euphoria and nausea
- low humidity, cold, high winds, solar radiation etc.



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**primary acclimatizations:**

- increased cardiovascular & respiratory output

**secondary acclimatizations:**

- kidneys: more alkaline urine, increase r.b.c. & Hb, capillary network, stimulants?

**tertiary acclimatizations:**

- retarded growth & development
- right ventricle of heart enlarged
- miscarriage rate & infant mortality increase

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▪ Quechua have higher "aerobic capacity" than Europeans (genetic)

- Aerobic capacity is the body's ability to use available oxygen and the capacity to work

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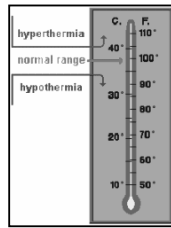
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## Adaptations to Temperature

### Cold Adaptation

- Cold is the most lethal of temperature stresses (-40° to -90° in Arctic)
- 20% of the earth is below freezing e.g., Eskimo, Laplanders, Ainu, Tibetan, Andean highlanders, Indians of Terra del Fuego
- Hypothermia (98.6F or 37C)



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### Problems:

1. Avoid lowering body temperature, frostbite and death.
2. Body temperature maintained at comfortable level
3. Maintain skin temperature for normal functioning

### Physiological/anatomical responses:

- vasoconstriction
- shivering (goose bumps)
- subcutaneous fat
- postural changes
- increased metabolic rate
- Lewis' 'hunting response'

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### Different mechanisms:

- Eskimo and Alacaluf of Terra del Fuego: increase overall metabolic rate



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➤ Australian Aborigines of Central Australia and Kalahari Bushmen: warm internal core temperature



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➤ Quechua of South America and the Lapps of Scandinavia : redistribute heat to the extremities differently

During the Korean conflict (1951-52), American Black servicemen had 41% higher cold injuries than Whites

cold stress studies: whole body cooling, cooling of extremities

- Eskimo, American Blacks, American Whites
- Lewis' 'hunting response' - Eskimos had response quicker; Blacks most delayed

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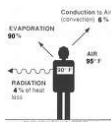
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## Heat Adaptation

4 ways body heat is lost

1. Radiation: heat flow from objects (electromagnetic)
2. Convection: heat exchange through air molecules.
3. Conduction: heat exchange through physical contact with object
4. Evaporation: loss of heat through conversion of water to vapor

in warm heat: convection, evaporation, and radiation contribute equally to heat loss  
at temperatures over 95°: evaporation accounts for 90% of heat loss



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Responses to heat stress involves two kinds of environment: dry heat and humid heat

Physiological Responses to Heat Stress include:

1. Blood vessel dilation
2. Sweating
3. Rise in skin temperature
4. Plasma and blood volume increase

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### Hot Humid Climates

- induce perspiration at an earlier stage
- darkly pigmented skin color
- excessive salt loss
- concentrated urine and dry feces

### Desert

- lean bodies, moderate skin color, concentration of water

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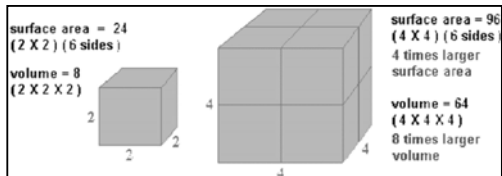
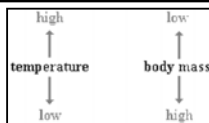
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### Bergmann's Rule

- the same species of warm-blooded animals, populations having less bulky individuals are more often found in warm climates near the equator, while those with greater bulk, or mass, are found further from the equator in colder regions



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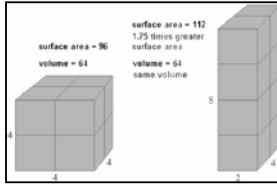
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### Allen's rule

- individuals in populations of the same species living in warm climates near the equator tend to have longer limbs than do populations living further away from the equator in colder environments



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