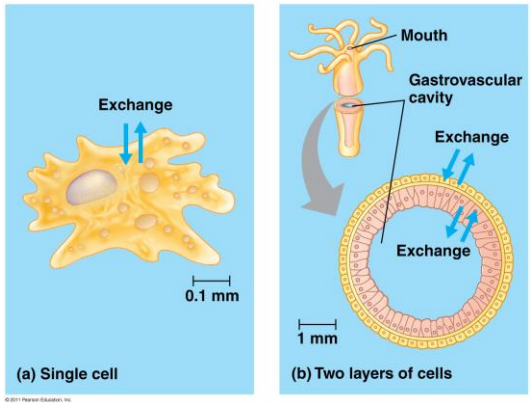
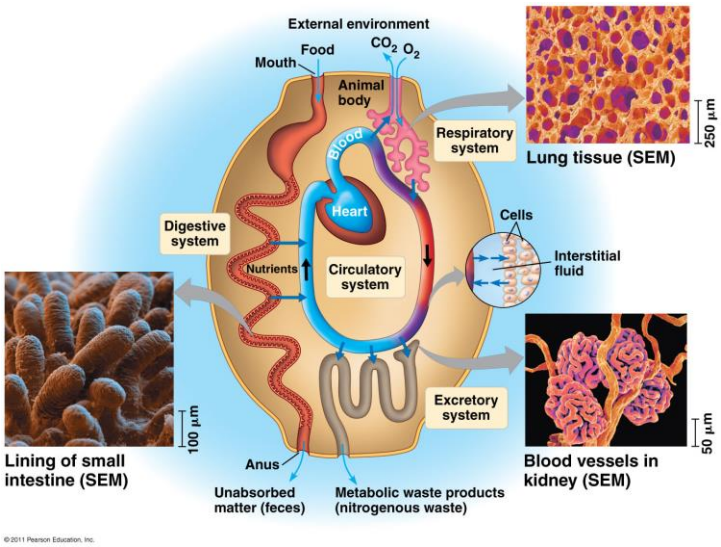
AP Biology 12-13 **Name** _____
CH 40 - Basic Principles of Animal Form and Function

Overview To Basic Principles of Animal Form and Function
Is it natural to be curious about how our bodies work? _____ (Yes / No / Stop You're Embarrassing Me!)
The study of structure is _____; the study of function in animals is _____.
Name the hierarchy of structures between the cell and organism levels of organization.
1. Cell 2. _____ 3. _____ 4. _____ 5. Organism

40.1 Animal Form and Function are Correlated at all Levels of Organization

The body plan of an animal is the result of the g_____ and not c_____ invention. Physical laws govern evolution in regards to s_____ , d_____, m_____, and h_____ e_____. Many fast swimmers have s_____ bodies which is an example of c_____ evolution. Maximum size is governed by t_____ of skeleton (both internal and external) and m_____ for locomotion for mobility. Speed can be estimated by looking at the body m_____ of leg muscles and the effective f_____ such muscles generate.





Animals must exchange materials with the environment. The rates of exchange for nutrients, w_____ products, and gases are proportional to membrane s_____ a_____ while the amount of m_____ to sustain life is proportional to c_____ v_____. The opportunity to exchange depends on the n_____ of cells. A multicellular organization only works if e_____ cell has access to an a_____ environment for exchange of d_____ substances. Some animals like the hydra have a t_____ cell layer thick s_____ body plan, or a f_____ shape like the tapeworm. In larger more complex animals there is a decrease in the ratio of outer s_____ area to v_____.
This is solved by having specialized surfaces that are extensively b_____ or f_____ and within the body so they are protected. In humans the digestive, circulatory and respiratory systems each have more surface area for exchange than _____ times that of the skin. Internal body fluids, i_____ f_____ and b_____. This more complex body plan allows for better survival on l_____.

Tissues

There are four *main categories of tissues in animals. They are epithelial tissue, connective tissue, nervous tissue, and muscle tissue.*
Epithelial Tissue – Check (√) the statements that describe epithelial tissue:
_____ Cells separated by abundant matrix. _____ Often found on an inner or outer organ surface.
_____ Most cells capable of contraction. _____ Epithelial cells conduct nerve impulses

What?

_____ What junction type holds together epithelial tissues?
_____ What name is applied to an epithelial tissue with a single layer or cells?
_____ What do anatomists call epithelial tissues with multiple layers of cells?
_____ What name is given to epithelial tissues that look multi-layered but are really single-layered?
_____ What do we call cube-shaped epithelial cells?
_____ What do we call flat epithelial cells?
_____ What do we name cells that are shaped like columns?

Connective Tissue

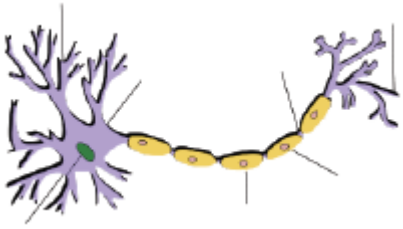
Connective tissue is the tissue type that holds _____ tissue and o_____ together and in p_____. Connective tissue has a _____ (greater / lesser) number of cells than epithelial tissue, and the material between the cells is called m_____. This matrix often has f_____ embedded in l_____, j_____, or s_____ material. These fibers are of three types: c_____, e_____, and r_____.

Connective Tissue Types

_____ The most widespread connective tissue in the vertebrate body.
_____ The connective tissue type that insulates the body and stores energy.
_____ The connective tissue type secreted by chondrocytes.
_____ The mineralized connective tissue is _____.
_____ The connective tissue type found in tendons and ligaments.
_____ Liquid connective tissue.

Nervous Tissue

A nerve cell is called a(n) _____.
The signals transmitted by nerve cells are called _____ _____.
On the nerve cell drawn to the right, indicate the axon, the dendrite(s), and the nerve cell body.



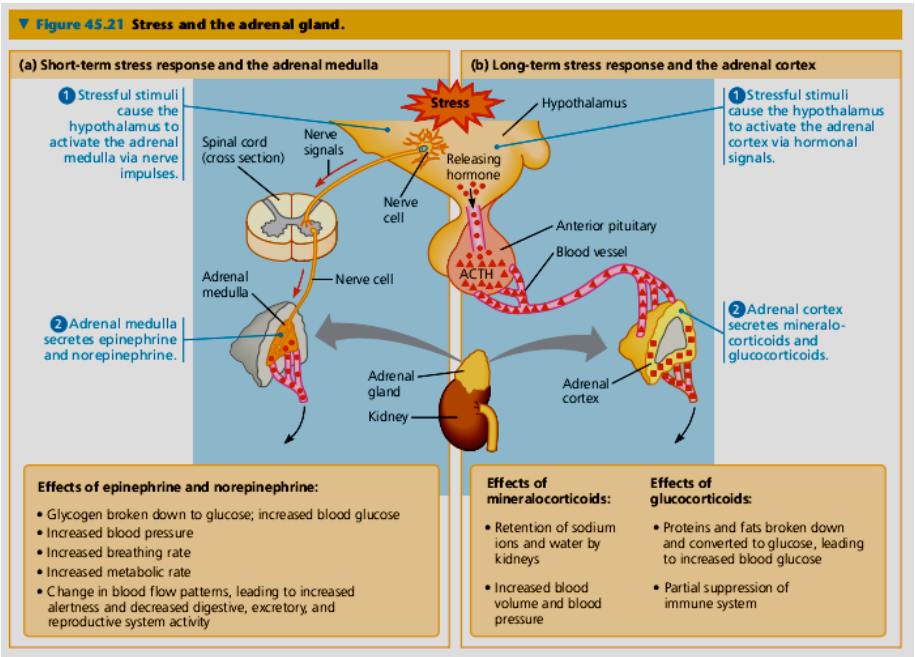
Muscle Tissue

A skeletal muscle cell is more properly called a muscle _____.
The contractile proteins of muscle cells are named _____ and _____.
The type of muscle tissue responsible for voluntary movement is _____ muscle tissue.
The type of muscle tissue located in the heart is _____ muscle tissue.
The type of muscle tissue that lines glands and body cavities is _____ muscle tissue.

Coordination and Control

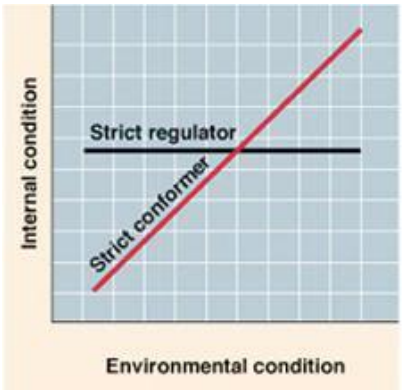
Coordination across an organisms body requires c_____ and there are two major systems that control and respond to stimuli, n_____ and e_____ systems.

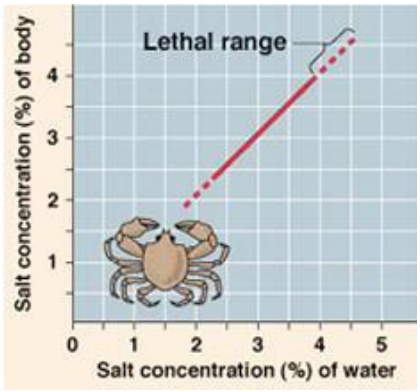
In the endocrine system named h_____ are released into the b_____. Different hormones have distinct effect and only



effect those cells that have the r_____ and may effect a s_____ location or throughout the body. Hormones are s_____ acting and l_____ lasting.
In the nervous system each impulse travels to s_____ target cells along dedicated lines known as a_____. Four types of cells can receive nerve impulses: n_____, m_____, e_____ and e_____ cells.
Information is conveyed along the signal pathway unlike the endocrine. Transmission is extremely _____ and last for only a f_____ of a second.
Endocrine system is adapted to coordinating g_____ changes that effect the entire body like g_____, r_____, m_____ processes. The nervous system is adapted to directing i_____ changes and fast l_____ and b_____. These two systems work _____ to contribute to a stable i_____ environment.

40.2 Feedback Control Maintains the Internal Environment in Many Animals

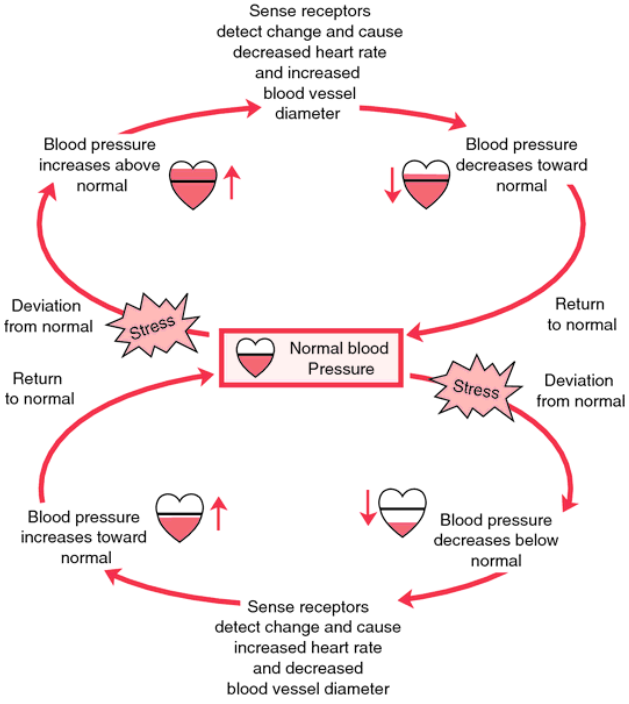


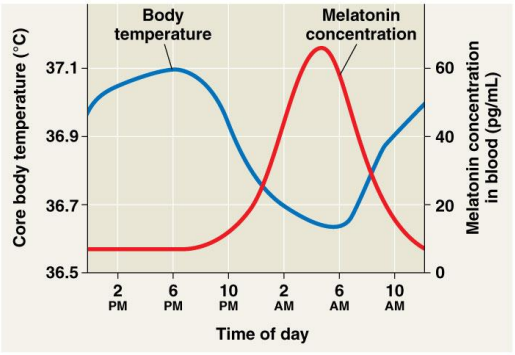


Animals manage their internal environment by either r_____ or c_____. A regulator uses i_____ mechanisms to control internal change in the face of e_____ fluctuations. A conformer allows internal conditions to change in accordance with e_____ fluctuations. These are extremes since many organisms will r_____ some internal conditions and c_____ for others. For example the sea bass conforms to t_____ but r_____ the solute concentration of the blood.

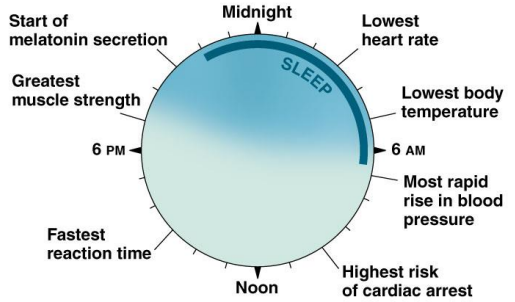
Homeostasis

The maintaining of a steady body temperature by animals is an example of _____. Examples of homeostasis in humans are pH of blood and interstitial fluid of _____, concentration of glucose in the bloodstream of _____ per 100mL and a body temp of _____°C. A nonliving example is the _____ in your house.
Maintaining homeostasis involves keeping values within a s_____ or a normal range where fluctuations above or below act as a s_____ detected by a receptor or a sensor that triggers a r_____ to return the variable back to the set point. Homeostasis relies largely on n_____ feedback that r_____ the stimulus. Homeostasis m_____ but does not e_____ changes in the internal environment.
Homeostasis is e_____ by adaptations like insulation and buffers. Positive feedback a_____ the stimulus and rather than helping to maintain homeostasis but help drive a process to c_____.





(a) Variation in core body temperature and melatonin concentration in blood



(b) The human circadian clock

Negative or Positive Feedback (N or P)? (Not all examples are in the book)

_____ Fruit ripening
_____ Childbirth in mammals
_____ Glucose concentration in blood
_____ Blood pressure
_____ Stomata opening and closing
_____ Blood clotting

The set points can change and some are r_____ changes such as p_____ and a woman's menstrual cycle. The 24 hour alterations in homeostasis are known as c_____ r_____ and is intrinsic to the body although it is normally controlled by the cycle of l_____ and d_____. The normal range of homeostasis may change by a_____ as the external environment changes such as moving up into the m_____. Acclimatization is not an a_____ because it is a temporary change that occurs in the animals lifetime not brought about by n_____ s_____.

40.3 Homeostatic Processes for Thermoregulation

Thermoregulation is the process animals use to r_____ body temperature within a tolerable r_____. It is critical to survival because b_____ and p_____ processes are very sensitive to temperature changes. A decrease in temperature will decrease enzyme mediated reaction by t_____ to threefold while an increase in temperature will cause some proteins to become _____ active. Endothermic organisms are warmed by m_____ and ectothermic organisms are warmed by e_____ resources. When temperatures at the extremes are either warm or cold many e_____ are not active but e_____ have mechanisms to withstand the extremes. An advantage to being an ectotherm is having to consume _____ food since they can moderate their body temperature with b_____, like going into the shade.

Regulation Matching

A – Endotherm
B – Ectotherm

1. _____ 

2. _____ 

3. _____ 

4. _____ 

5. _____ 

Balancing Heat Loss and Gain

Organisms and objects exchange heat by r_____, e_____, c_____ and c_____ and it always flow from _____ (*lower / higher)* to _____ (*lower / higher)*.

Thermoregulation therefore is a balance between heat l_____ and heat g_____.

Thermoregulation Adaptations Matching

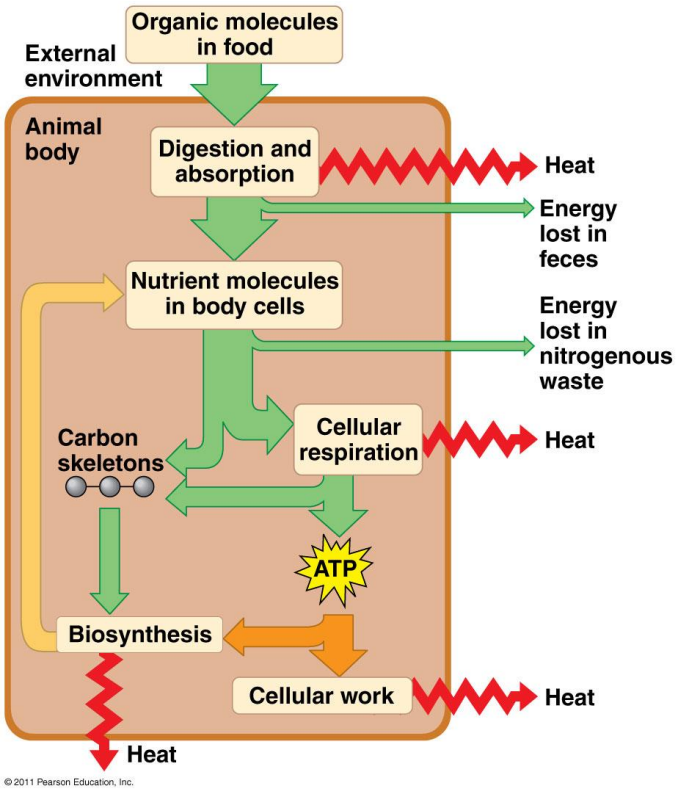
Match the adaptations animals use for thermoregulation below (A-F) to the descriptions and examples in the boxes. You will use the choices many times.

A. Insulation
B. Circulatory adaptations
C. Evaporative heat loss
D. Behavioral responses
E. Adjusting metabolic heat production
F. Acclimatization

_____ Alter the amount of blood flow between core and extremities
_____ A variation in enzyme production
_____ Body posture
_____ Brown fat
_____ Change in the ratio of lipids in plasma Membrane
_____ Flow of fluids in opposite directions exchanging heat (countercurrent exchange)
_____ Hair and Feathers
_____ Hibernation or Migration
_____ Huddling behavior within a colony, changing positions within the huddle

_____ Great white sharks, blue fin tuna
_____ Growing a thicker coat or layer of fat
_____ Hormone triggering ATP production
_____ Loss of water through skin or respiratory surfaces
_____ Major method of regulation in mammals and birds
_____ Moving or shivering
_____ Oily secretions to repel water
_____ Panting
_____ Produce "antifreeze" compounds
_____ Seeking a heat source
_____ Sweating
_____ Vasodialation

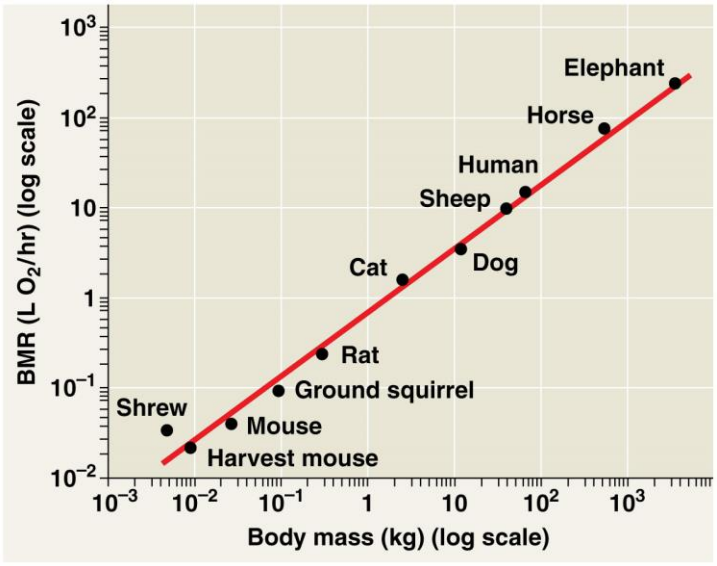
40.4 Energy requirements are related to animal size, activity and environment



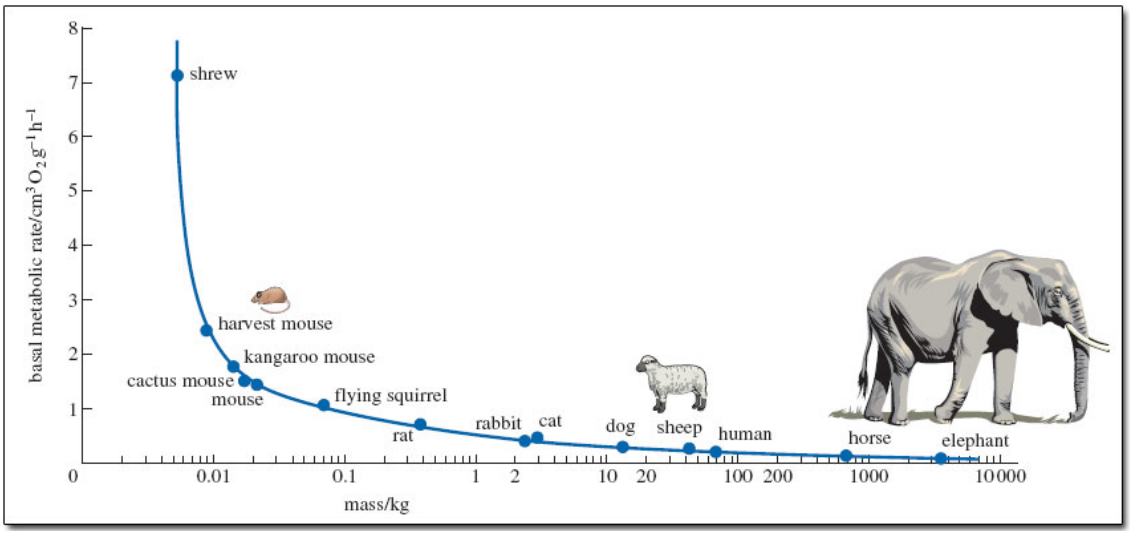
The overall flow and transformation of energy in an animal is b_____, which determines the nutritional needs and is related to the animal's s_____, a_____ and e_____. Animals use energy harvested from their food for ATP production in a process known as c_____ r_____ or f_____. This ATP powers cellular work and also b_____. This ATP production generates _____ that is lost to the environment. To determine how much total energy an organism needs to stay alive and how much is needed to move or reproduce physiologists measure the rate an animal u_____ chemical energy and how the rate changes in different circumstances. The amount of energy used in a unit of time is the _____ and is measured in j_____, c_____ or k_____. The metabolic rate can be measured by monitoring heat loss using a c_____ or from measuring o_____ consumed or c_____ produced. For longer periods of time the rate of food consumption and chemical energy lost in waste are measured.

Minimum Metabolic Rate & Thermoregulation

The minimum metabolic rate for basic function is known as the b_____ m_____ r_____, in endotherms and it is measured when the organism is not growing, at rest with an empty stomach and not experiencing any stress. It is known as the s_____ m_____ r_____ for an ectotherm and it is measured at a particular temperatures since environmental temperature alters the body temperature but the organism must still be fasting, at rest and nonstressed. Based on comparisons of endothermic and ectothermic organism metabolic rates it has been found that they have different e_____ costs. For example an adult female has a cost of _____ kcal per day and an American alligator has a cost of _____ kcal per day at 20°C. Besides thermoregulation other key factors effect metabolic rate, some are a_____, s_____, size, activity and n_____.



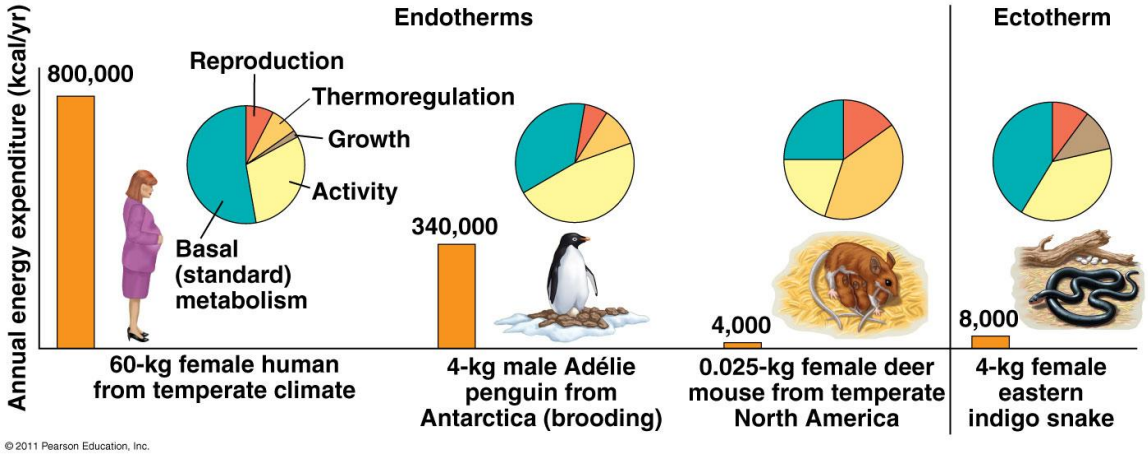
(a) Relationship of basal metabolic rate (BMR) to body size for various mammals



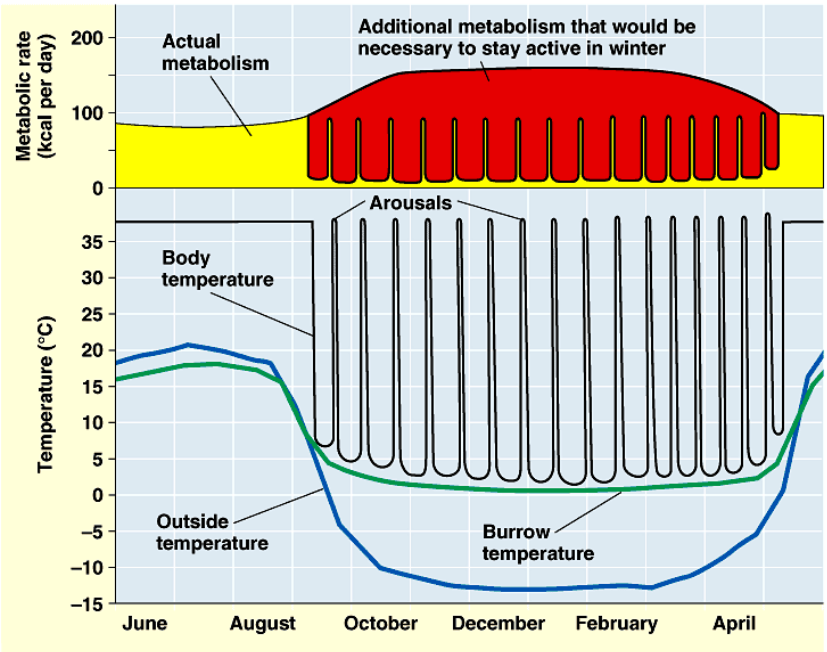
Interestingly, metabolic rate, when measured across the spectrum of endotherms, is a steady rate that remains roughly proportional to b_____ m_____ to the ¾ power. What is interesting is that the metabolic rate to size affects energy consumption by body cells as seen in the graph above and 40.19b in your textbook. The energy it takes to maintain each gram of body mass is i_____ related to body size. The smaller animals _____ (*higher / lower)* metabolic rate requires a _____ (*higher / lower)* rate of oxygen delivery and therefore a higher breathing rate, blood volume and heart rate. There is a trade off then in regards to body plans. The smaller a body size the _____(*higher / lower)* the energy costs per gram of tissue. As body size increases the _____(*higher / lower)* the energy costs per gram of tissue but _____ (*more / less)* tissue is necessary for support, exchange and locomotion.

In all organisms, activity greatly effects metabolic rate. M_____ metabolic rates occur during peak activity and is generally i_____ related to the duration of activity. The average daily rate of energy consumption for terrestrial animals is ____ to ____ times BMR or SMR. Humans in _____ (*developed / undeveloped)* countries have an unusually low metabolic rate indicative of a s_____ lifestyle.

ENERGY BUDGETS



An adult human female spends most of her budget on _____ with the growth accounting for only _____ about 1kg per year and reproduction (pregnancy and nursing) is only _____ of the yearly budget.
A male penguin spends the largest part of his budget on _____ because he must swim to catch food but _____ is low since he is well insulated and the reproduction coming mostly from the i_____ of the eggs.
The deer mouse spends a large part if her budget on _____ regulation because of the hig surface area to volume ratio of being s_____ and losing body heat rapidly.
The ectothermic snake has no _____ costs but does g_____ continually through life explaining the larger cost in growth. The snake is equal in size to the penguin but only expends _____ of the total energy that the penguin uses.
A major part of all the budgets is l_____ and other activities.



When an animal is stressed by conditions that are causing too much energy expenditure they may go into a state of t_____, a state of decreased activity and metabolism. Some animals experience torpor daily. These organisms tend to be relatively s_____ and there fore have high metabolic rates when active. Long term torpor is h_____ which allows an animal to survive when food is scarce. The body's thermostat is turned _____ so body temperature drops. Every two weeks or so a hibernating animal will undergo arousal and body temperature will r_____ briefly.
Metabolic rates during hibernation can be _____ times lower so an animal can survive on low food sources and cold temperatures. In the summer some animals will experience e_____ to enable them to survive high temperatures and s_____ water.