AP Biology Review Packet 6: Organismal Response to Environment & Maintaining Homeostasis

2C2: Organisms respond to changes in their external environments

2D2: Homeostatic mechanisms reflect both common ancestry and divergence due to adaptation to different environments.

2D3: Biological systems are affected by disruptions to their dynamic homeostasis.

2D4: Plants and animals have a variety of chemical defenses against infections that affect dynamic homeostasis.

2E1: Timing and coordination of specific events are necessary for the normal development of an organism, and these events are regulated by a variety of mechanisms.

2E2: Timing and coordination of physiological events are regulated by multiple mechanisms.

2E3: Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection.

3E1: Individuals can act on information and communicate it to others.

4A4: Organisms exhibit complex properties due to interactions between their constituent parts.

4B2: Cooperative Interactions within organisms promote efficiency in the use of energy and matter.

1. **Taxonomy- classification**
2. Domain System- Archaea (Archaebacteria), Bacteria (Eubacteria) and Eukarya,
3. Eukaryotic Kingdoms- Protista (mainly uni auto/hetero), Fungi (mainly multi hetero), Plantae (auto), and Animalia (hetero)
4. Animalia are divided into invertebrates (Cnidaria- jellyfish, anemones; Flatworms- planaria; Round worms- parasites; Segmented Worms- earthworm, sandworms, leeches; Mollusks- clams, oysters, snails, octopus; Echinoderms- starfish, sea urchin, sand dollar; Arthropods- insects, crustaceans, millipedes, spiders, etc). OR vertebrates (fish, amphibians, reptiles, birds, and mammals)
5. Classification under domain= Kingdom Phylum Class Order Family Genus Species
6. Species is two part name (binomial nomenclature); system created by Linneaus; genus and specific epithet; genus is capitalized and s.e. is lower case; both underlined or italicized in print. Ex. *Homo sapiens*

B. **Physiology**

1. Organelle (allows for specialization of cell)🡪 Cell🡪 Tissue🡪 Organ (contributes to function of organism)🡪 Organ System

2. Interactions among cells of a population of unicellular organisms can be similar to those of multicellular organisms, and these interactions lead to increased efficiency and utilization of energy and matter.

● Bacterial community in the rumen of animals

● Bacterial community in and around deep sea vents

3. Organ Systems Include:

* Respiratory: Exchange of gases (lungs, gills, alveoli)
* Circulatory: Circulation of fluids (heart, arteries, veins, capillaries)
* Digestion: Breakdown of food into simpler compounds/polymer🡪 monomer (stomach, intestines, pancreas)
* Excretory: Filtration of Blood (kidney, bladder, malphighian tubules, metanepridia
* Nervous: Rapid communication in organism (nerves, brain, spinal cord)
* Endocrine: Slow communication in organisms (hormones and glands)
* Immune: Protection against pathogens (lymph nodes, white blood cells- B cells, T cells, and macrophages, skin, tears, cilia)
* Plant vascular (xylem, phloem, roots and leaves)
* Plant reproductive organs (flowers and fruit)
1. **Evolution of Homeostasis**
2. Gas exchange in aquatic (aerial roots, cypress knees) and terrestrial plants (stomata under leaves)
3. Digestive mechanisms: food vacuoles in protists, gastrovascular cavities used for digestion and distribution (one-way digestive systems) in jellyfish/flatworms
4. Respiratory systems of aquatic (gills with countercurrent exchange to maximize O2 uptake) and terrestrial animals (lungs with alveoli next to capillaries to maximize O2 uptake)
5. Nitrogenous waste production and elimination in aquatic (ammonia) and terrestrial animals (uric acid as precipitate in birds ,insects, snails and reptiles and urea in mammals, sharks, frogs and some bony fish)
6. Excretory systems in flatworms (protonephridia- filters interstitial fluid but not paired with circulatory system) earthworms (metanephridia- filters fluid and paired with circulatory system) and vertebrates (kidneys with nephrons that selectively filter blood to keep good stuff and excrete waste via urinary system)
7. Osmoregulation in bacteria (osmoconformers- same tonicity as environment), fish (osmoregulators- fresh water fish urinate excessively and salt water fish drink excessively) and protists (use contractile vacuole to pump out excess water)

7. Osmoregulation in aquatic (osmosis) and terrestrial plants (roots, transpiration, stomates, CAM plants, cuticle)

8. Circulatory systems in fish (2 chambered heart in a circuit- to gills, then body, then back to heart), amphibians (3 chambered heart- mixing of oxygenated and deoxygenated blood in ventricle, from gills, lungs, or skin to heart which mixes with blood returning to heart from body) and mammals (4 chambered heart with separation of blood in ventricle, one side pumps to lungs back to heart, other side of heart pumps to body and then back to heart)

9. Thermoregulation in aquatic and terrestrial animals (countercurrent exchange mechanisms)

D. **Timing of Events (maintains homeostasis)**

1. Transcription factors results in sequential gene expression (pace development).
2. Homeotic (HOX) genes are involved in developmental patterns and sequences (body segments).
3. Embryonic induction (influence of one cell on another) in development
4. Temperature (warm and dark) and the availability of water (imbibition works with hormones) affect seed germination in most plants.
5. Programmed cell death (apoptosis) - formation of fingers and toes, immune function, etc.



E. **Environmental Influence on Organisms**

1. Phototropism (movement towards light due to auxin concentration on shady side of plant) and photoperiodism (long day/short night and short day/long night blooming plants due to phytochromes in plant that detect type of light)
2. Circadian rhythms, or the physiological cycle of about 24 hours that is present in all eukaryotes

and persists even in the absence of external cues

1. Diurnal/nocturnal and sleep/awake cycles
2. Jet lag in humans
3. Seasonal responses, such as hibernation, estivation and migration

F. **Behavior and Adaptations**

1. Taxis (moving towards a stimulus like light or chemicals- pill bug experiment) and kinesis (movement that is not purposeful)
2. Fight or flight response (stress hormones- epinephrine give a fast reaction regulated by brain and adrenal medulla)
3. Predator warnings (warning calls)
4. Protection of young (nesting, fish in mouth)
5. Plant (toxins, thorns, hairs)
6. Territorial marking in mammals
7. Coloration in flowers (attract pollinators)

8. Animals use visual, audible, tactile, electrical and chemical signals to indicate dominance, find food, establish territory and ensure reproductive success.

● Bee dances

● Birds songs

● Territorial marking in mammals

● Pack behavior in animals

● Herd, flock, and schooling behavior in animals

● Predator warning

● Colony and swarming behavior in insects

● Coloration

**G. Natural selection favors innate and learned behaviors that increase survival and reproductive fitness.**

● Parent and offspring interactions

● Migration patterns

● Courtship and mating behaviors

● Foraging in bees and other animals

● Avoidance behavior to electric fences, poisons, or traps

● Pack behavior in animals

● Herd, flock and schooling behavior in animals

● Predator warning

● Colony and swarming behavior in insects

--------------------------------------------------------------------------------------------------------------------------------------------------

***AP Biology Investigation 11: Transpiration***

Overview Part I: Put whole plants in four different environments (fan, light, room conditions, and humidity) to determine water loss via transpiration over four days.

IV: Conditions

DV: Percent change in mass

Overview Part II: Determine the surface are of the leave and average stomata per square millimeter.

Equations:

* Trace leaf and count grids record as cm
* Rate of transpiration/surface area = ml of water loss/surface area
* Count stomates of leaf in a field of view and get area of view by πr2 and calculate density by #/area
* Calculate number of stomates per leaf by using surface area of leaf

***AP Biology Investigation 12: Fruit Fly Behavior (Substituted old pill bug lab)***

Overview: Pill bugs are observed in a choice chamber (one side is moist the other is dry). Students designed their own experiment to determine which factors affect pill bug behavior and taxis.

IV: Environment (dark, acidic, basic, noisy, etc.)

DV: # of pill bugs on each side

***AP Biology- Old AP Lab 10- Physiology of the Circulatory System***

Overview Part I: Observed factors that affected pulse and blood pressure.

IV: Exercise and position (standing up or laying down)

DV: Pulse rate increases with exercise; blood pressure increases when changing position

Overview Part II: Measured the effect of temperature on Daphnia heart rate.

IV: Temperature

DV: Heart Rate

Equation:  or 

--------------------------------------------------------------------------------------------------------------------------------------------------

Archaea

Bacteria

binomial nomenclature

class

Eukarya

family

genus

kingdom

order

phylum

species

taxon

Homeostasis

Negative Feedback

Positive Feedback

Dynamic Equilibrium

Control Center

Receptor

Stimulus

Effector

Cell

Tissue

Organ

Organ System

Thermoregulation

Vasoconstriction

Vasodilation

Evaporative Cooling

Gas Exchange

Direct Contact

Tracheal Tubes

Gills

Countercurrent exchange

Thoracic cavity

Bronchi

Bronchioles

Alveoli

Digestion

Intracellular Digestion

Gastrovascular Cavity

Alimentary Canal

Dentition

Herbivore

Carnivore

Pancreas

Small Intestine

Large Intestine

Excretion

Flame Cells

Protonephridia

Malphighian Tubules

Metanephridia

Kidney

Nephron

Ureter

Ammonia

Nitrogeneous Waste

Urea

Uric Acid

Osmoregulation

Osmolarity

Osmoconformer

Osmoregulator

Contractile Vacuole

Transpiration

Closed Circulation

Vertebrate Heart

---------------------------------------------------------------------------------------------------------------------------------------

Questions and Practice

1. How do the organization of cells, tissues, and organs determine the structure and function in plant and animal systems?
2. What adaptive features have contributed to the success of various plants and animals on land?
3. What are the responses of plants and animals to environmental cues?
4. Discuss bacteria in regard to the following:
5. Digestion/Excretion
6. Immune
7. Osmoregulation
8. Behavior
9. Discuss plants in regard to the following:
10. Gas exchange
11. Transport and Water Balance
12. Response to Environment
13. Defense/Immune
14. Reproduction
15. Discus invertebrates in regard to the following:
16. Respiration
17. Circulation
18. Excretion
19. Osmoregulation
20. Behavior
21. Thermoregulation
22. Discuss mammals in regard to:
23. Respiration
24. Digestion
25. Circulation
26. Excretion
27. Osmoregulation
28. Thermoregulation
29. Discuss the difference between innate and learned behavior.
30. Discuss the selective benefits of innate and learned behaviors.
31. Discuss timing of events in plants and animals and how they have adaptive value.
32. What adaptive modifications might be useful for the digestive system of an animal living on a diet

that is mainly:

a) animal -

b) grass -

c) nutritionally poor -

d) seeds –

13. For the fish, which describes their blood flow most accurately?

a) Body -> Heart -> Gills -> Body

b) Body -> Heart -> Gills -> Heart -> Body

c) Body -> Gills -> Heart -> Body

d) Body -> Gills -> Body -> Heart -> Body

Hemoglobin is a protein that binds oxygen for efficient delivery in many animals. Hemoglobin is made up of four subunits. Each subunit contains a heme group that binds to one oxygen molecule. The diagram

on the right represents the binding efficiency of human adult during exercise. 

14. How many oxygen molecules does human adult hemoglobin carry at normal pH at a PO2 of 60 mm Hg? \_\_\_\_

15. Where would you expect to find the partial pressure of oxygen to be lowest?

a) In the air outside the mouth c) In the trachea

b) In the lungs d) In the blood stream next to the alveoli

16. If the curve shifts to the right- can the hemoglobin hold more or less oxygen?

17. Why does the pH decrease (more acidic) after exercise?

18. Organisms can have circulatory systems that are classified as single circulation or double circulation

paths. Fish have single circulation while human beings have double circulation.

a) Discuss the differences between single circulation and double circulation.

b) Does an organism with single circulation have a higher or lower metabolic rate when compared

to an organism with double circulation? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

19. An organism must be able to release the waste product of carbon dioxide from its cells.

a) What specific organelle in the cell produces Carbon Dioxide (CO2)? \_\_\_\_\_\_\_\_\_\_\_\_\_

b) After a blood donation, the blood is separated into various components, including plasma,

platelets, and red blood cells. Which component of the blood (AND WHY) would you find the MOST

CO2?

20. Several different examples of respiratory surfaces can be found in the animal kingdom.

a) What advantage does a large surface area in the alveoli have for animals that use lungs?

b) Why is it advantageous for an insect to rely on tracheal systems for delivery of oxygen to

individual cells, rather than their circulatory system?