Name:

Unit 1: The Living World: Ecosystems

Topics:

I. Tragedy of the Commons
II. Themes of APES: The Big Ideas
III. Scientific Thinking
mensional Analysis
stems & Feedback Loops
roduction to Ecosystems
VII. Terrestrial & Aquatic Biomes
VIII. Biogeochemical Cycles
IX. The Hydrologic Cycle
X. Energy Flow

***Textbook Modules:** 1-7, 12, 13, 20*

Vocabulary:

● 10% Rule	● Food Web	● Primary productivity
● Abiotic	● GPP	● Producer
● Ammonia	● Groundwater	● Qualitative Data
● Biogeochemical Cycle	● Histogram	● Quantitative Data
● Biome	● Hydrologic Cycle	● Reservoir
● Biotic	● Independent/Dependent Variable	● Resource Partitioning
● Cellular Respiration	● Laws of Thermodynamics	● Salinity
● Commensalism	● Mutualism	● Scatterplot
● Community	● Nitrogen fixation	● Sink
● Competition	● NPP	● Source
● Constants/controlled variables	● Null Hypothesis	● Symbiosis
● Control Group	● Nutrient	● System
● Decomposition	● Parasitism	● Tragedy of the Commons
● Dimensional Analysis	● Photosynthesis	● Trophic level
● Ecology	● Population	● Turbidity
● Ecosystem	● Positive/Negative Feedback Loops	● Uptake
● Food Chain		

Topics from the intro video:

Opinion Statements

1. It is important for people to preserve wilderness areas.

2. The world's natural resources exist for people to use.

3. Environmental degradation is the biggest problem facing humanity today.

4. People will eventually develop new technologies to cope with environmental problems.

5. People have a responsibility to protect all life forms on Earth.

6. Protecting a country's natural resources and natural heritage is primarily the government's responsibility.

7. The government is doing a good job of protecting the country's natural environment.

8. Recycling is the most important thing people can do to help improve the environment.

9. People should be able to use their own land in whatever way they see fit (for farming, housing, logging, wildlife habitat, and so on).

10. All people have a right to clean air and water.

11. Human consumption is the greatest factor contributing to Earth's environmental problems.

12. Use of compact fluorescent light bulbs, which use less energy than incandescent bulbs, should be required in all public buildings.

13. Global treaties are needed to address the earth's changing climate.

14. New energy production on the planet should be limited to only renewable energy sources.

15. There should be laws restricting development on farmland or forestland outside cities or towns.

16. Zoning laws should prevent people from living in places with a history of major forest fires.

Choose 3 of the statements you find most interesting and discuss each with your group for 2 minutes. Jot down bulletpoint notes below.

Statement #	My own points:	Other people's points:

I. Tragedy of the Commons

Objectives:
Explain the concept of Tragedy of the Commons and provide examples of this concept.
Describe three ways a society could lessen negative effects on a commons.

https://fs.blog/2011/08/the-tragedy-of-the-commons/ Read and highlight/annotate (print *or* digitally)

Video: Tragedy of the Commons TED-Ed https://www.youtube.com/watch?v=CxC161GvMPc *(4:57)*

Points from the video:

See also Lab Activity → ***Fishing for the Future***

II. The Big Ideas

Brain Dump: List as many terms, concepts, or topics you can think of that are associated with these "Big Ideas". Consider your previous knowledge you have gained from science classes, media, and everyday life. (There are no wrong answers)

BIG IDEA 1: ENERGY TRANSFER (ENG)
Energy conversions underlie all ecological processes. Energy cannot be created; it must come from somewhere. As energy flows through systems, at each step, more of it becomes unusable.

BIG IDEA 2: INTERACTIONS BETWEEN EARTH SYSTEMS (ERT)

The Earth is one interconnected system. Natural systems change over time and space. Biogeochemical systems vary in ability to recover from disturbances.

BIG IDEA 3: INTERACTIONS BETWEEN DIFFERENT SPECIES AND THE ENVIRONMENT (EIN)

Humans alter natural systems and have had an impact on the environment for millions of years. Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.

BIG IDEA 4: SUSTAINABILITY (STB)

Human survival depends on developing practices that will achieve sustainable systems. A suitable combination of conservation and development is required. The management of resources is essential. Understanding the role of cultural, social, and economic factors is vital to the development of solutions.

III. Scientific Thinking

Objectives:

Explain the differences between: pseudoscience and science

Describe the process of the scientific method (not a specific number of steps!)

Identify the relevant components in an experiment and be able to design an experiment using those components (see vocabulary for complete list)

→ Horoscope Activity (in-class)

Tape/paste your personalized horoscope here:

To discuss (not written)→ What was the outcome of the activity? Did anything surprise you?

→ What are some examples of **pseudoscience** that you have seen on the Internet?

Match the scientific method term to the definition/description.

A. Constants		A specific, testable prediction about the outcome of the experiment
B. Control Group		Descriptive, non-numerical information collected about the experiment
C. Controlled Variables		Increase accuracy and validity of the data by ensuring that similar results occur more than once
D. Dependent Variables		Numerical information collected about the experiment
E. Experimental Group		The subjects that receive the changed conditions in the experiment
F. Hypothesis		The subjects that remain in the original, unchanged conditions in order to provide a baseline for comparison
G. Independent Variable		These are the same thing as constants!
H. Large sample size		These factors are **measured;** they respond to changes

I. Qualitative Data		These must be kept as close to identical as possible among all the subjects or it won't be clear what it affecting the outcome
J. Quantitative Data		This is the factor being **changed;** there should be only one per experiment
K. Repeated trials		This will increase accuracy and validity of the data by lessening the effect of any outliers

_____: Predicts NO RELATIONSHIP between two phenomena, no difference among groups *(ex: "There is no link between cigarette smoking and development of lung cancer")*

M **D**

I **R**

X **Y**

*There should only be **one** IV in an experiment; however, there can be different **levels** (ex. Test 50 mg, 100 mg, 150 mg of a medicine on a liver illness)*	*There can be **many** DVs, leading to qualitative and quantitative data (ex. Color of liver, % of abnormal liver cells in a biopsy, mass of liver, patient's pain level)*

Different Types of Graphs:
Common Issues with Experimental Design:

Writing a **Conclusion:**

1. **Restate the problem question** which explains the reason for doing the lab. ("The purpose of this experiment was to determine whether…")
2. Was **hypothesis** supported, not supported or inconclusive based on the data? Why?
3. What did the **data** say? What was the **control group, IV, and DV**? Describe the graph and any **trends** that are visible.
4. Possible **causes of error** (there is no experiment that will ever have none of these).
5. What are some **"real world" applications** of this experiment?
6. What are **new questions** that have come up as a result of this experiment? What are suggestions for **further research**?
7. **Final summary statement**: Answer the original question. ("In conclusion, …")

NEVER USE I, we, us, me, my, our, etc. –any pronouns—anywhere in a lab report. Example: "We knocked over and broke a beaker." Should be: "A beaker was knocked over and broken." *("Mistakes were made!" –Nixon)*

Practice: Simpsons scientific method problems.

 Smithers thinks that a special juice will increase the productivity of workers. He creates two groups of 50 workers each and assigns each group the same task (in this case, they're supposed to staple a set of papers). Group A is given the special juice to drink while they work. Group B is not given the special juice. After an hour, Smithers counts how many stacks of papers each group has made. Group A made 1,587 stacks, Group B made 2,113 stacks.	Identify the: 1. Control Group 2. Independent Variable 3. Dependent Variable 4. What should Smithers' conclusion be? 5. How could this experiment be improved?
 Homer notices that his shower is covered in a strange green slime. His friend Barney tells him that coconut juice will get rid of the green slime. Homer decides to check this out by spraying half of the shower with coconut juice. He sprays the other half of the shower with water. After 3 days of "treatment" there is no change in the appearance of the green slime on either side of the shower.	6. What was the initial observation? Identify the- 7. Control Group 8. Independent Variable 9. Dependent Variable 10. What should Homer's conclusion be?
 Bart believes that mice exposed to microwaves will become extra strong (maybe he's been reading too much Radioactive Man). He decides to perform this experiment by placing 10 mice in a microwave for 10 seconds. He compared these 10 mice to another 10 mice that had not been exposed. His test consisted of a heavy block of wood that blocked the mouse food. he found that 8 out of 10 of the microwaved mice were able to push the block away. 7 out of 10 of the non-microwaved mice were able to do the same.	Identify the- 11. Control Group 12. Independent Variable 13. Dependent Variable 14. What should Bart's conclusion be? 15. How could Bart's experiment be improved?

 Krusty was told that a certain itching powder was the newest best thing on the market, it even claims to cause 50% longer lasting itches. Interested in this product, he buys the itching powder and compares it to his usual product. One test subject (A) is sprinkled with the original itching powder, and another test subject (B) was sprinkled with the Experimental itching powder. Subject A reported having itches for 30 minutes. Subject B reported to have itches for 45 minutes.	Identify the- 16. Control Group 17. Independent Variable 18. Dependent Variable 19. Does the data supports the advertisements claims about its product? Why/why not?

The Case of The Lorax and Truax

➔ ***Video: The Lorax*** (25:13) https://www.youtube.com/watch?v=8V06ZOQuook
Book Link: https://www.chrisrossarthur.com/uploads/3/8/5/9/38596187/dr._seuss_the_loraxbokos-z1.pdf

Group work: Complete the following questions about the Lorax.

1. Did the Once-ler have real progress? Why or why not?
2. What is the significance of not being able to see the Once-ler?
3. What were the **benefits** to the town that were brought by the Once-ler? Did those last?
4. How could the "thneeds" have been made without destroying all of the truffula trees?

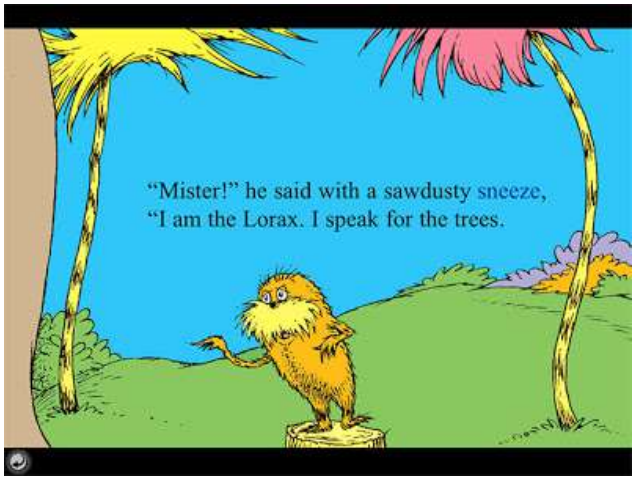
5. Give three examples of environmental problems created by the actions of the once-ler.
6. What did the Lorax's message "UNLESS" mean?
7. Why do you think Dr. Seuss wrote the Lorax?

→ ***Reading: Truax*** https://www.woodfloors.org/truax.pdf

If you have any sort of environmental conscience, ***The Truax*** should disturb and unsettle you a bit. I want you to break it down with your group and figure out exactly what the issues are here. Consider whether there is an economic bias in the funding of this story, what illustrations and words are used to create a particular type of imagery, and what the actual "facts" are that are presented (I am **not** saying that nothing in this story is true!).

What are your thoughts about the illustrations portraying Greenbark and the Logger?	Why do you think this book was written?
Identify an **emotional** appeal by the logger:	Is it effective?
Devil's Advocate time! Think back to the Lorax. Are there any issues with the way that story is presented? Does the Once-ler have any good points at all? If you were forced to come up with a criticism of the Lorax, what could you say (and feel sincere about)?	

*Remember! We must hold on to, and always keep developing, our **Critical Thinking** skills. Blindly accepting something as a whole that appears to agree with your viewpoints is not good science at all! By holding people on **your** side of an issue to the highest possible standard of integrity, your arguments will only become more solid, more sound, and convince more people (that is, if you don't change your own mind along the way, which is allowed to happen)!*



IV. Metric System Review/Dimensional Analysis

Objectives:

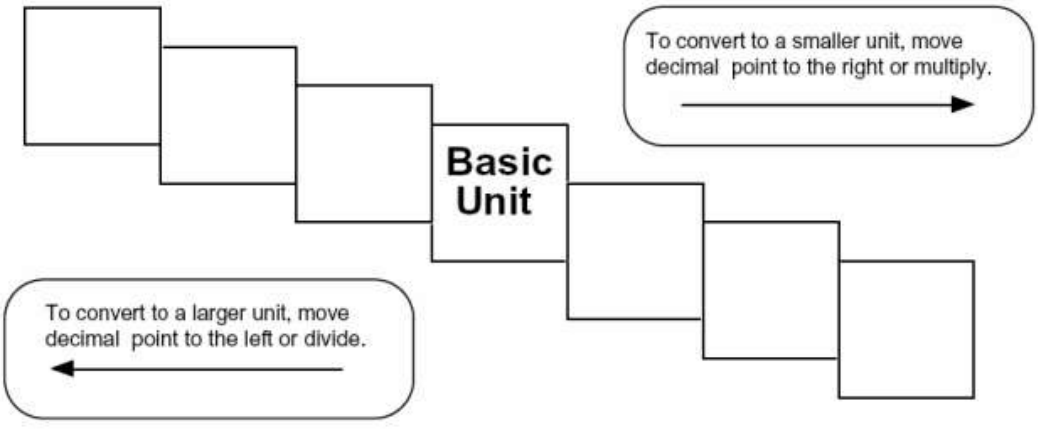
- Review the metric system units and be able to convert from one unit to another
- Review/learn the dimensional analysis method of conversion for any units
- Practice using dimensional analysis to solve conversion problems

Rather than write out the full metric names, *i.e.*, liters, centimeters, millime etc., we use abbreviations. Below is the list of abbreviations for each level each measurement (meters, grams, liters).

LENGTH:			**Abbreviation Used:**
K: 1 Kilometer	=	1000 Meters	km
H: 1 Hectometer	=	100 Meters	hm
D: 1 Decameter	=	10 Meters	dam
U:	1 Meter		m
D: 1 Decimeter	=	0.1 Meter	dm
C: 1 Centimeter	=	0.01 Meter	cm
M: 1 Millimeter	=	0.001 Meter	mm
MASS/WEIGHT:			
K: 1 Kilogram	=	1000 Grams	kg
H: 1 Hectogram	=	100 Grams	hg
D: 1 Decagram	=	10 Grams	dag
U:	1 Gram		g
D: 1 Decigram	=	0.1 Gram	dg
C: 1 Centigram	=	0.01 Gram	cg
M: 1 Milligram	=	0.001 Gram	mg
VOLUME:			
K: 1 Kiloliter	=	1000 Liters	kl
H: 1 Hectoliter	=	100 Liters	hl
D: 1 Decaliter	=	10 Liters	dal
U:	1 Liter		l
D: 1 Deciliter	=	0.1 Liter	dl
C: 1 Centiliter	=	0.01 Liter	cl
M: 1 Milliliter	=	0.001 Liter	ml

King
Henry
Died by
Drinking
Chocolate
Milk

Fill in the boxes in the stair step diagram.



Practice:

1123 mg = g	109 g = kg	2.3 cm = mm
14 km = m	160 cm = mm	873 mL = L
1.2 L = mL	0.2 kg = mg	6 mm = m

Dimensional analysis (also known as the factor-label method or unit-factor method) is about conversion--converting from one set of units to another. This is something you will often have occasion to do in real life. Remember, anything you measure will have a number with some sort of "unit of measure" (the dimension) attached. A unit could be miles, gallons, miles per second, peas per pod, or kilowatt hours per year.

1 inch = 2.54 cm	1 lb. = 454 g	1 qt = 0.946 L	1 cc = 1 cm^3 = 1 mL
1 mi = 5280 ft	1 lb = 16 ounces	4 qt = 1 gal	1 cubic inch = 16.39 cm^3
1 ft = 12 inches	1 yd = 3 ft	1 ft^3 = 0.0283 m^3	10,000 cm^2 = 1 m^2

Example

How many seconds are in a day?

1. Ask yourself, "What units of measure do I want to know or have in the answer?" In this problem you want to know "seconds in a day." After you figure out what units you want to know, translate the English into math.

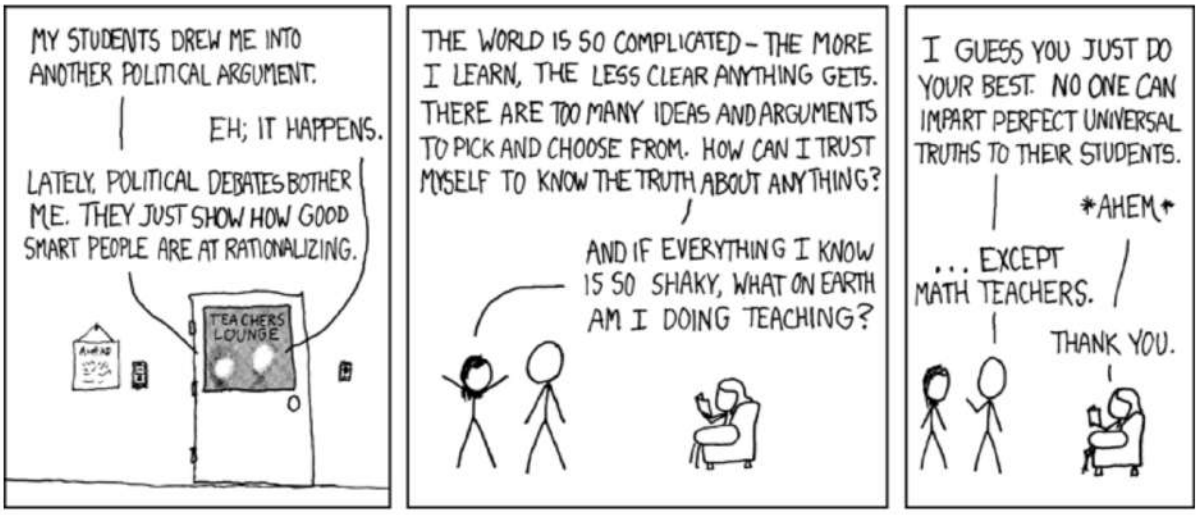
2. Ask, "What do I already know or what am I being given?" What do you know about how "seconds" or "days" relate to other units of time measure?

3. Now pick from the other things you know another factor that will cancel out the unit you don't want.

4. Solve it. When you have cancelled out the units you don't want and are left only with the units you do want, then you know it's time to multiply all the top numbers together, and divide by all the bottom numbers.

Remember that you don't need to worry about the actual numbers until the very end. Just focus on the units.

The good thing about APES Math is that they are asking you about real-life situations. So it's important to consider: DOES MY FINAL ANSWER MAKE SENSE? If you found that a family is paying $3 million/yr for their electricity or that a farmer is growing 0.8 potatoes a month, you already know you made a mistake.



Dimensional Analysis (factor labeling) Practice Problems Stations:

With your partner, circulate around the stations and answer the problems. You don't have to do them in order but make sure you put the right answer for the right question. Show your work by setting up the answer like the example on the board.

	Setup	**Answer (with correct units!!!)**
1		
2		
3		
4		
5		
6		
7		

Extra Practice can be found on MyMitty

V. Systems

Objectives:
Define a system and describe the three key components
Define feedback loops and provide at least three examples each of positive and negative loops that relate to environmental systems

System:

3 Key Components:

1. _____ from the environment
2. _____ or _____ of matter and energy within the system at certain _____
3. _____ to the environment

_____: any process that increases (_____ feedback) or decreases (_____ feedback) a change to a system

→ ***Video: Ted-Ed***—*Feedback Loops: How Nature Gets its Rhythms (5:11)* https://www.youtube.com/watch?v=inVZoI1AkC8

Draw the three loops discussed in the video (I'll do the first as an example on the board)

Important! Does a positive feedback loop always have a positive ("good") effect? _____

With your partner move around to the different stations and draw feedback loops for each of the described scenarios. Use arrows, boxes and plus/minus signs as in our examples.

1	2

3	4
5	6
7	


I HAVE LEFTOVER CHEESE.
I SHOULD GET CHIPS
AND MAKE NACHOS.
I HAVE LEFTOVER CHIPS.
I SHOULD GET CHEESE
AND MAKE NACHOS.

(Positive or negative?)

VI. Ecology & Ecosystems

Objective:
Explain how the availability of resources influences species interactions.

Levels of Organization

Ecology:

O	**P**	**C**	**E**	**B**
One living being	Many individuals of the same species	Many individuals of different species	Both the biotic and abiotic components in a habitat	All portions of earth where life exists
Examples: Squirrel				

3 factors that sustain life on earth:

List five **biotic factors** in a **<u>forest</u>** ecosystem, but only one can be an animal and one can be a plant:	List five **abiotic factors** in a **<u>desert</u>** ecosystem, three physical and two chemical:

Organism 1	Organism 2	Description of the relationship	Symbiotic Relationship
Dog	Flea	The flea feeds on blood from the dog. There is no benefit to the dog and the itching and bites may lead to infection.	
Fungus	Algae	The photosynthetic algae provide food for the fungus, which in turn provides a suitable living environment for the algae.	
Termite	Cellulose-digesting bacteria	The bacteria in the gut of the termite breakdown and feed on some of the cellulose taken in by the termite. The termite would be unable to digest cellulose without these bacteria and they gain an additional source of nutrition from the surplus digested cellulose.	
Shark	Remora	The Remora fish swim alongside the shark and take scraps of food that the shark drops during feeding. The shark does not eat the Remora and appears unaffected by its presence.	
Cattle	Cattle egret	The cattle egret follows herds of cattle and eats the insects that the cattle stir up as they move through the grassland. The cattle appear to be unaffected by the egrets.	
Human	Tapeworm	The tapeworm lives in the small intestines where it feeds and grows, robbing the human of essential nutrients.	

3 Types of

+/+

+/0

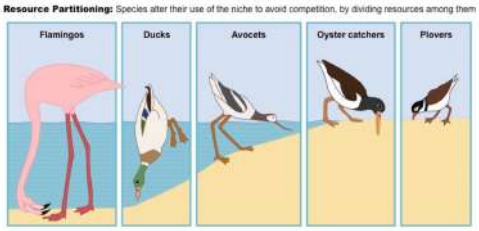
+/-

_____: _____

- Preferred habitat
- Position in the food web
- Mating and eating behaviors

_____ : Species avoid competition by dividing use of resources

_____



Fundamental niche:
Realized niche:

VII. Terrestrial & Aquatic Biomes

Objective:
Describe the global distribution and principal environmental aspects of terrestrial biomes.
Describe the global distribution and principal environmental aspects of aquatic

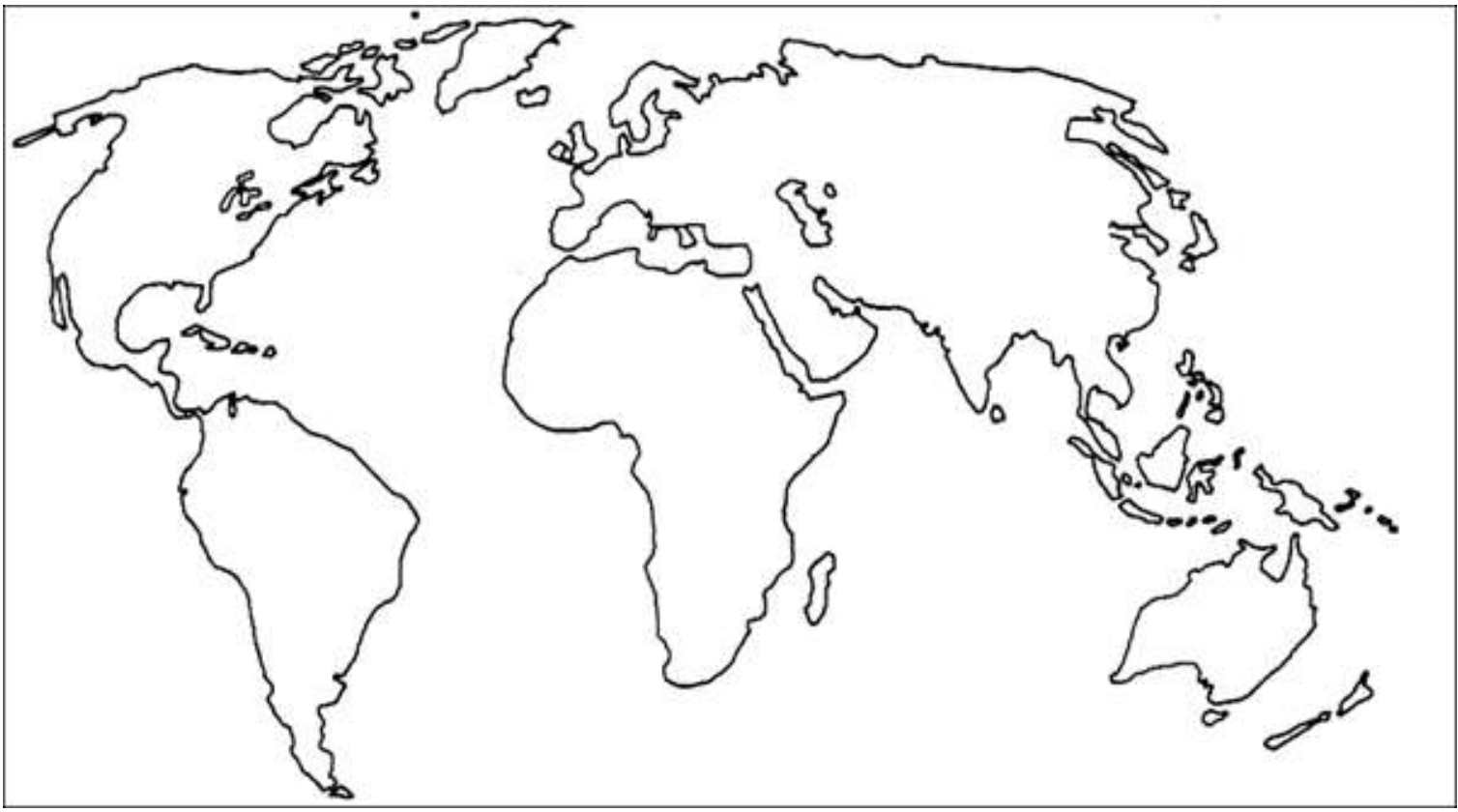
Terrestrial Biomes are most commonly characterized by **PLANT GROWTH FORMS, TEMPERATURE, and PRECIPITATION**

ome	Location/ Distribution (global location/latitude)	Biota (plants/animals)	Climate (temp/precip)	Relative Productivity	Harmful activity (*this; fill in*)
Tropical ainforest					
emperate ainforest					
emperate sonal Forest					
Taiga/ real Forest					
Desert					
Savanna					
hrubland/ haparral)					
emperate sland/Prairie					
Tundra					

Aquatic Biomes are most commonly categorized by **SALINITY, DEPTH,** and **WATER FLOW**

ome	Salinity/Flow	Biota (plants/animals)	Depth Zones	Relative Productivity	Harmful activity (*this; fill in*)
Streams					

Rivers					
onds/ FW Lakes *(akes are rare)*					
Wetland mp, marsh, bog)					
pen Ocean					
lt Marsh/ Estuary					
oral Reef					

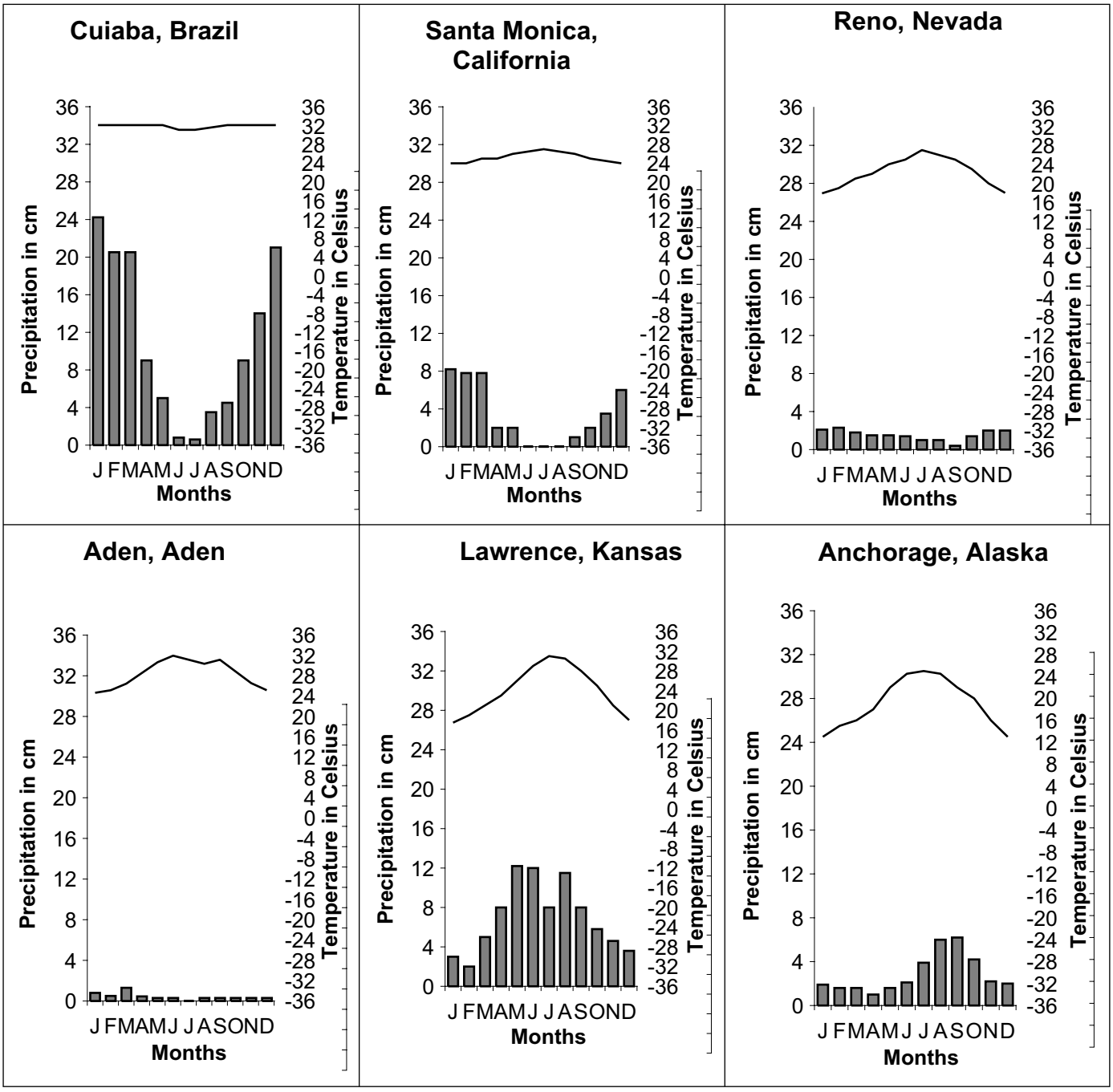


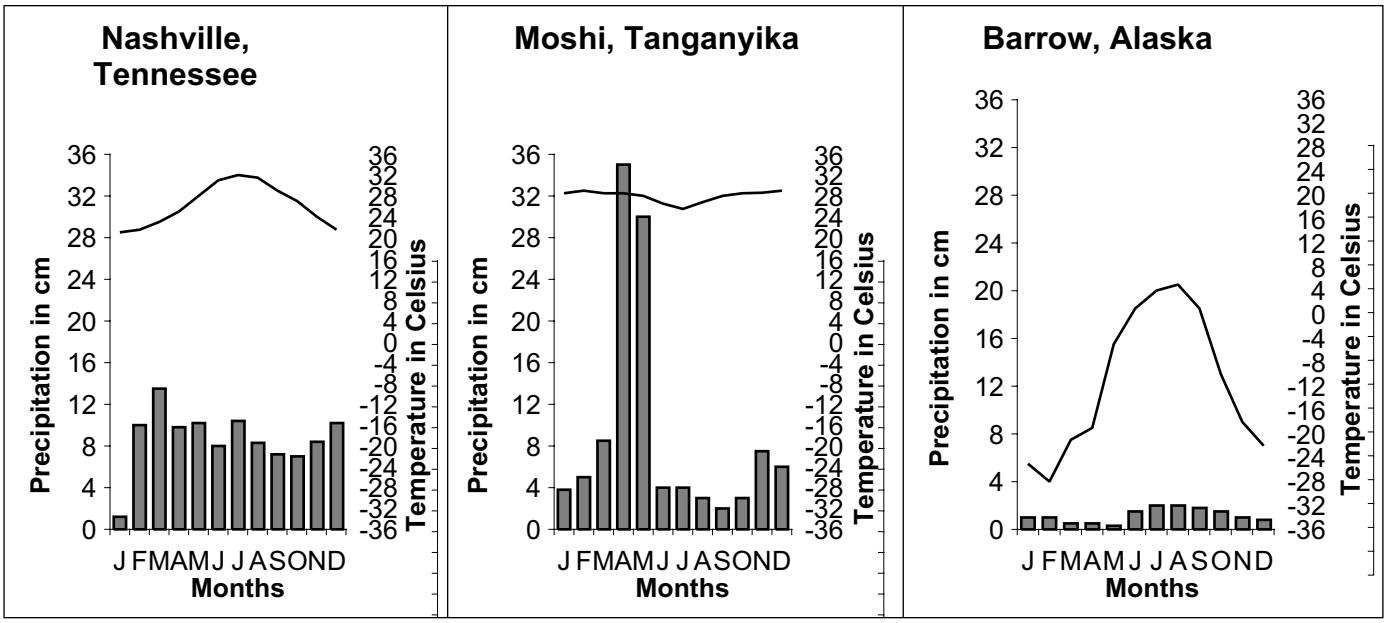
Average Rainfall			
High			
Medium			
Low			
	Cool	Temperate	Hot
	Average Temperature		

Coniferous forest (taiga)
Cool desert
Deciduous forest
Polar grassland (tundra)
Temperate desert
Temperate grassland (prairie)
Tropical desert
Tropical grassland (savanna)
Tropical rain forest

Climatograms

This exercise provides practice in associating climate (as expressed in monthly averages of precipitation and temperature) with biomes. Below are nine example climatograms, grids on which averages of precipitation and temperature at a particular location are graphed. Although other factors may greatly affect climate, a climatogram provides enough information to identify a biome from which the data were obtained. All temperature readings are measured on the right side of the climatogram as a line graph. All precipitation measurements are on the left side of the climatogram and represented as a bar graph.





Answer the following analysis questions be examining the climatograms.

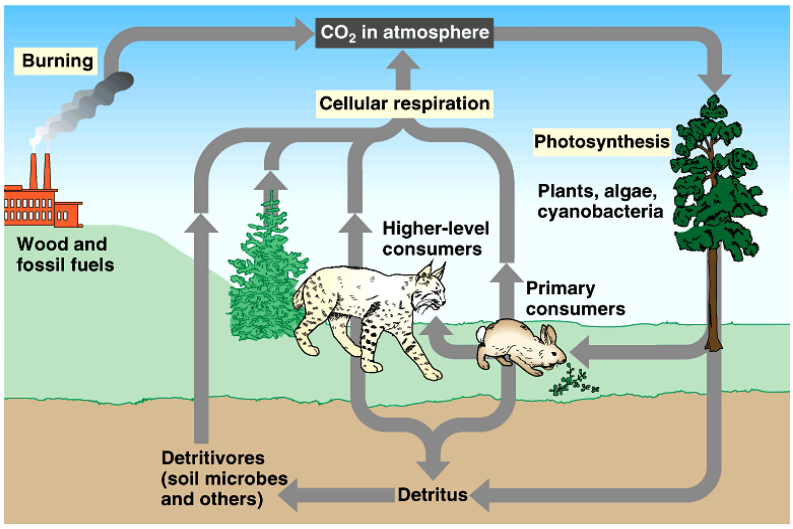
1. How are the Tundra and Desert similar?	Different?
2. How are the Tropical Rain and Tropical Deciduous Forests similar?	Different?
3. Lawrence, Kansas and Nashville, Tennessee occupy similar latitudes. Why is one found in a grassland and the other in a forest biome?	
4. Which biome has the most rainfall? Why might this be?	
5. Which biome has the least rainfall? Why might this be?	
6. Which biome has the highest average temperature? Why might this be?	
Which biome has the lowest average temperature? Why might this be?	
7. Which biome has the most consistent year round temperature? Where is it located?	
8. Which biome has the most variable year round temperature? Where is it located?	
9. Considering that the information in your climatograms is presented on a monthly basis, How would you determine which biomes are located in the southern hemisphere?	
10. Which biomes have 4 seasons? How can you tell?	
11. Explain 2 patterns you observe in the different biomes.	

VIII. Biogeochemical Cycles

> Explain the steps and reservoir interactions in the carbon, nitrogen, and phosphorus cycles.

The elements and compounds that make up nutrients move continually through _____ _____in ecosystems and in the biosphere in cycles called ***biogeochemical cycles.***

A. The _____ Cycle



- Carbon is the _____
- The concentration of carbon in living matter (18%) is _____ greater than in the earth (0.19%)
- For life to continue, carbon must be _____

Carbon in the abiotic environment

- Carbon dioxide (CO_2) in _____
- CO_2 dissolved in _____— HCO_3^-
- _____ rocks (limestone and coral)—$CaCO_3$
- Deposits of _____, petroleum, and natural gas from _____ organisms
- Dead organic matter (_____)

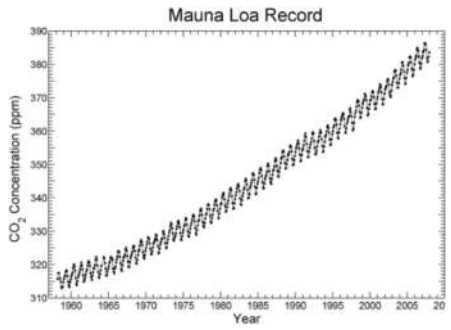
Carbon enters the biotic world through…

- _____ (plants/algae/cyanobacteria)
- _____ (archaebacteria)

Carbon returns to the atmosphere and water by

- _____ (reverse of photosynthesis)
- _____
- _____
  - produces _____ if oxygen is present
  - Produces _____ (CH_4) if oxygen is not present

→Uptake and Return of CO2 are not in balance



Keeling Curve

Carbon Cycle Interactive on Learner.org

https://www.learner.org/courses/envsci/interactives/carbon/index.php

Use the simulator and follow the directions to fill out the data tables and answer the questions.

DATA TABLES: CARBON CYCLE

LESSON 1

Lesson 1: Step 1	Gaseous Carbon	Ocean Water		Fossil Fuels		Biosphere Gaseous Carbon	
To Year	Atmosphere	Ocean Surface	Deep Ocean	Oil and Gas	Coal	Soil	Terrestrial Plants
2010							
2060							
2110							

Lesson 1: Step 2	Total Carbon Emissions	Gaseous Carbon	Ocean Water		Fossil Fuels		Biosphere Gaseous Carbon	
To Year	Smokestack	Atmosphere	Ocean Surface	Deep Ocean	Oil and Gas	Coal	Soil	Terrestrial Plants
2010								
2020								
2030								
2040								
2050								
2060								
2070								
2080								
2090								
2100								
2110								

Responses to questions

You do NOT have to answer all the questions, or write full sentences. Discuss with your group and note down key responses.

LESSON 2

Lesson 2: Step 1	Gaseous Carbon	Ocean Water		Biosphere Gaseous Carbon	
To Year	Atmosphere	Ocean Surface	Deep Ocean	Soil	Terrestrial Plants
2010					
2060					
2110					

Lesson 2: Step 2			Gaseous Carbon	
To Year	Net Def. Rate	Fossil Fuel % Increase	Atmosphere	Deep Ocean
2010				
2060				
2100				

Responses to questions

You do NOT have to answer all the questions, or write full sentences. Discuss with your group and note down key responses.

Lesson 3: Step 1		Biosphere Gaseous Carbon	
To Year	Net Def. Rate	Soil	Terrestrial Plants
2010			
2070			
2090			
2110			

Lesson 3: Step 2		Tundra Melt Rate		Gaseous Carbon	Ocean Water		Fossil Fuels		Biosphere Gaseous Carbon	
To Year	Net Def. Rate	1/6	1/12	Atmosphere	Ocean Surface	Deep Ocean	Oil and Gas	Coal	Soil	Terrestrial Plants
2010										
2060										
2110										

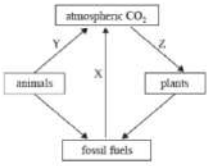
Responses to Questions

You do NOT have to answer all the questions, or write full sentences. Discuss with your group and note down key responses.

	Processes/Flows	*Stocks/Storages Reservoirs*	*Cycle pic*	*H*
Carbon Cycle				
Nitrogen Cycle *FNAAD ANPAN*				
Phosphorus Cycle				

13. Bacteria convert ammonium ions to nitrite ions and nitrate ions (plant nutrients) through the process of
    a. nitrification.
    b. nitrogen fixation.
    c. denitrification.
    d. assimilation.
    e. leaching.
14. Nitrate is converted to nitrogen gas through the process of
    a. nitrification.
    b. nitrogen fixation.
    c. denitrification.
    d. assimilation.
    e. leaching.
15. Humans remove nitrogen from the soil by all of the following *except*
    a. leaching water-soluble nitrate ions from soil through irrigation.
    b. harvesting nitrogen-rich crops.
    c. applying organic fertilizers to agricultural land.
    d. mining of nitrogen-rich mineral deposits.
    e. none of these answers
16. Which of the following is *not* one of the common phosphorus reservoirs in the ecosystem?
    a. soil
    b. organisms
    c. atmosphere
    d. rocks
    e. marine sediment
17. Which of the following are important storages of phosphorus?
    i. Atmosphere
    ii. Soils
    iii. Oceans
    a. I and II only
    b. I and III only
    c. II and III only
    d. I, II and III

8. The two ways in which humans have most interfered with the carbon cycle are
    a. removal of forests and aerobic respiration.
    b. aerobic respiration and burning fossil fuels.
    c. respiration and photosynthesis.
    d. burning fossil fuels and removal of forests and brush.
    e. respiration and removal of forests
9. The figure below shows a simplified model of the carbon cycle. Each arrow represents a process which involves a transfer of carbon.



What are processes X, Y and Z?

	X	Y	Z
A.	Combustion	Respiration	Photosynthesis
B.	Fossilisation	Combustion	Respiration
C.	Fossilisation	Respiration	Combustion
D.	Combustion	Assimilation	Photosynthesis

10. Computer models suggest that adding carbon dioxide to the atmosphere could
    a. reduce the natural greenhouse effect.
    b. increase food production.
    c. raise sea level.
    d. stabilize climate patterns.
    e. decrease food production.
11. Nitrogen gas is converted to ammonia through
    a. nitrification.
    b. nitrogen fixation.
    c. denitrification.
    d. assimilation.
    e. leaching.
12. Nodules containing nitrogen-fixing bacteria would be expected to occur on the roots of
    a. pine trees.
    b. roses.
    c. legumes.
    d. grasses.
    e. oak trees.

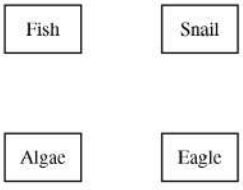
2012 AP® ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

4. Wetlands were once considered to be wastelands. Over 50 percent of the United States original wetlands have been destroyed.

   (a) Describe TWO characteristics that are used by scientists to define an area as a wetland.

   (b) Wetlands are highly productive ecosystems with complex food webs.

   (i) Complete the diagram of the wetland food web below by drawing arrows that show the direction of energy flow.



   (ii) Explain why it takes many hectares of wetland to support a pair of eagles.

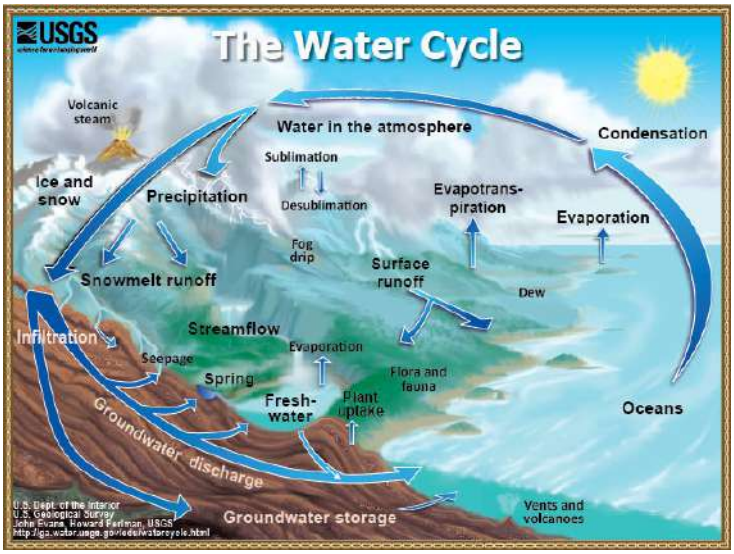
   (c) Describe TWO economic benefits (other than those related to water quality) that wetlands provide.

   (d) Describe one specific human activity that degrades wetlands.

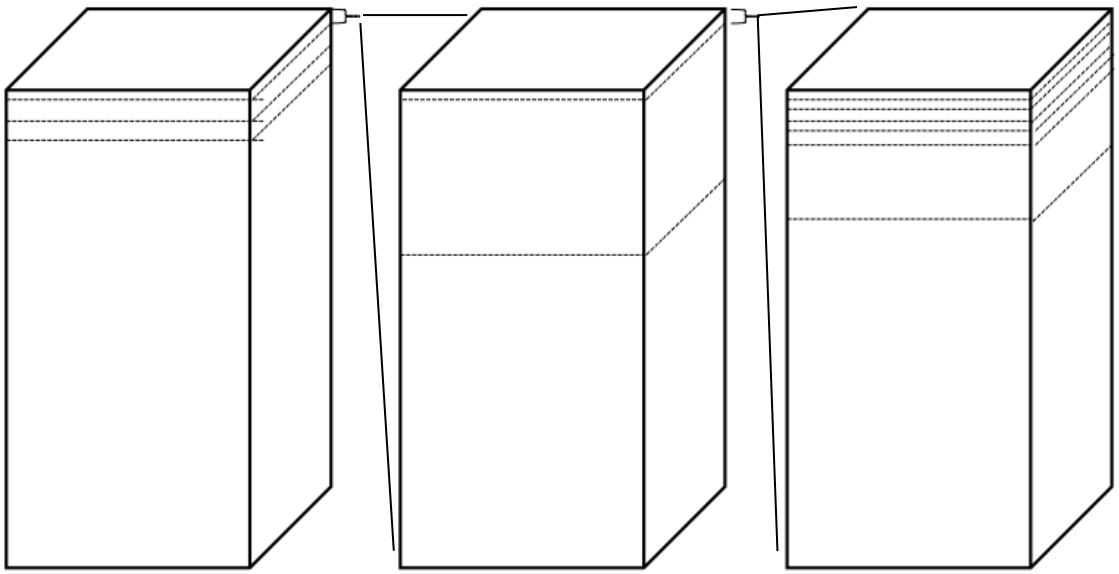
IX. The Hydrologic Cycle

Explain the steps and reservoir interactions in the hydrologic cycle
Describe the major sources of groundwater and surface water

Why is water important?



Flows/Throughputs	
Transfer Processes (Location change)	
Transformation Processes (Phase change)	
Climate Change Effects	
Other Human Effects	
Stocks/Storages/ Reservoirs	



Only about liquid ◯ of the earth's water supply is available to us as freshwater

Article → **Here's Where the Post-Apocalyptic Water Wars Will Be Fought**
https://earther.gizmodo.com/here-s-where-the-post-apocalyptic-water-wars-will-be-fo-1829793126

1. What are some of the specific factors that may lead to hydro-political issues in the future? (In other words, how were the "5 hotspots" determined)
2. List the 5 regions that are potential hydropolitical hotspots:

Important water terms:

	Precipitation infiltrates the ground and is stored in soil and rock
	Water that does not sink into the ground or evaporate into the air runs off into bodies of water
	The land area that delivers runoff, sediment, and any dissolved substances to a stream
	Underground caverns and porous layers of sand, gravel, or bedrock through which groundwater flows
	Has a permeable water table
	Bounded above and below by less permeable beds of rock where the water is confined under pressure
	Pressure from the confined aquifer pushes water up at a location without a pump
	The level below which the ground is saturated with water

Watershed Boundary
Mountain Ranges: Sierra Nevada, Northern Coastal Ranges, Southern Coastal Ranges, Klamath Mountains
Rivers: San Joaquin, Sacramento
Delta

How does climate change affect the water cycle?

1. The hydrologic cycle refers to the movement of
    a. hydrogen.
    b. oxygen.
    c. water.
    d. hydrocarbons.
    e. nitrogen.
2. Of the following processes of the water cycle, the one working against gravity is
    a. percolation.
    b. infiltration.
    c. runoff.
    d. transpiration.
    e. precipitation.
3. Humans strongly affect the hydrologic cycle through all of the following *except*
    a. water withdrawal in heavily populated areas.
    b. clearing vegetation for agriculture.
    c. boiling water.
    d. paving roads and parking lots.
    e. creating housing developments.
4. In the water cycle, the process by water moves into the ground is known as
    a. Transpiration
    b. Evaporation
    c. Percolation
    d. Infilitration
    e. The water table
5. In the water cycle, the process by water moves through the ground to the groundwater below, is known as
    a. Transpiration
    b. Evaporation
    c. Percolation
    d. Infilitration
    e. The water table
6. Humans are most likely to alter the earth's thermostat through their impact on the compound
    a. carbon dioxide.
    b. nitrogen gas.
    c. phosphate.
    d. hydrogen sulfide.
    e. water.

X. Energy Flow & Primary Productivity

Objectives:

Explain how solar energy is acquired and transferred by living organisms.
Explain how energy flows and matter cycles through trophic levels.
Determine how energy decreases as it flows through ecosystems.
Describe food chains and food webs, and their constituent members by trophic level.

Energy:

_____ Energy: Moving energy with mass and velocity: *Ex: Wind, heat, electricity, flowing water*

_____ Energy: Stored energy

The First Law of Thermodynamics:

The Second Law of Thermodynamics:

- When energy changes from one form to another, it is always **degraded** to a more dispersed form.
- **Energy efficiency** is a measure of how much useful work is accomplished before it changes to its next form.
- **SUN =** low entropy/high order energy
    - Food pyramid = loses efficiency with each step; we're at the top
    - **Low entropy locally** is derived at the expense of **increased entropy globally**

Law of Conservation of Mass:

How is this important in the environment?

- We're not "consuming" resources, we're just borrowing them and transforming them.

_____ ! We will always be faced with pollution of some sort. What kind? And how do we reduce it

Food Web Vocabulary Matching. *The powerpoint slides are not in order!* ***Read*** *the definitions!*

	Organisms that can produce their own energy through **photosynthesis** (99%) or **chemosynthesis** (<1%; deep-sea vents)
	Organisms that can only obtain energy by eating other organisms
	The second level in a food chain; only eats producers
	The third level in a food chain
	May eat plants or animals
	Only eats animals; must be at least a secondary consumer
	Only eats animals that it has killed
	Breaks down **organic** matter to **inorganic** compounds. **Only** bacteria and fungi belong to this group
	These organisms break down dead organisms and feces to smaller **organic** molecules; includes earthworms, seastars, pillbugs, flies, etc.

What trophic level supports all other levels? _____

Many of these categories overlap. Name **3** of the above categories that describe a:

Sea turtle (eats jellyfish): _____

Gorilla: _____

Pillbug: _____

Practice

1. Use the table to the right to draw a 4-member **food chain.** Label the producer and the levels of consumers.

Organism	Food Source
cat 	mice, birds
shrew 	worms
robin 	worms, seeds
wheat 	photosynthesis
mouse 	wheat seeds
badger 	shrews
rose plant 	photosynthesis
worm 	rotting leaves

2. Use all of the organisms in the table to draw a **food web.** Label the producer and levels of consumers.

_____ **:** Graphical models of the quantitative differences between trophic levels of a single ecosystem

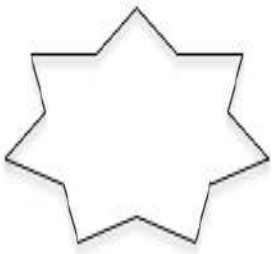
Three types of pyramids:
1.
2.
3.

Pyramid of Energy

- Shows _____

  _____
- _____ of energy is lost at each transfer
- _____:

  ratio of net production at one level to that of the next



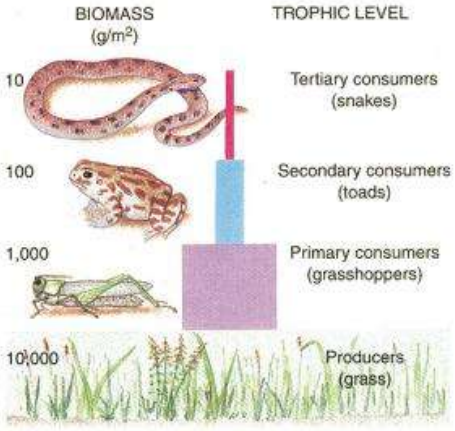
Where does the remaining 90% go?
1.
2.
3.

Pyramids of Biomass

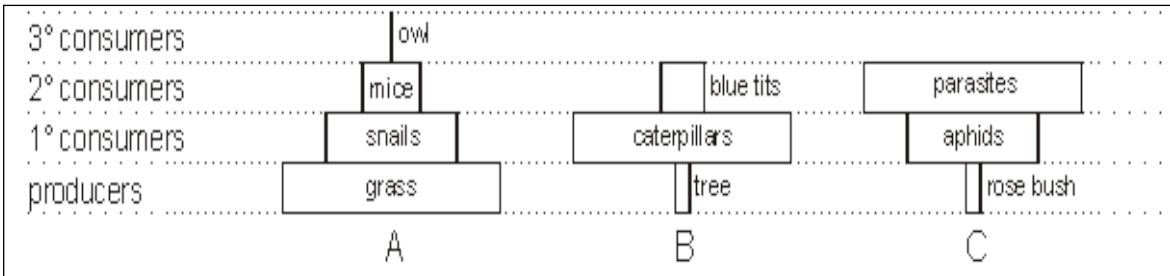
Biomass: _____

_____

What happens to the missing mass in a biomass pyramid?



Pyramids of Numbers: How many individuals are present in the food chain

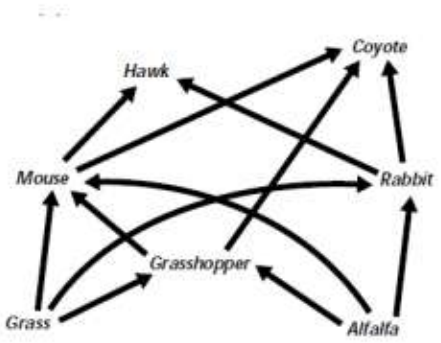


Pyramid A shows:	**B shows:**	**C shows:**

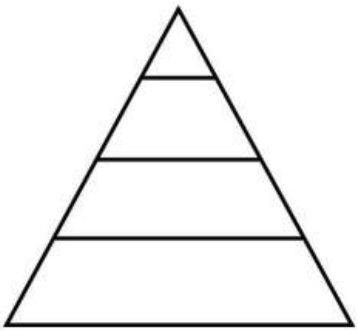
Inverted Pyramids

- Can occur in _____
- Occurs more often with _____
- Can also result from _____

.



Choose a 4-step food chain from the web to the left and draw an energy pyramid. Add a **decomposer** (bacteria). *Detritivores and decomposers should be added to pyramids on the side, outside of the shape, feeding into every level.*



Article It All Started With a Few Trout. Now Yellowstone's Iconic Birds Face 'Collapse.' *(7/2/18)*
https://www.nationalgeographic.com/environment/2018/07/yellowstone-lake-trout-trumpeter-swan-avian-collapse-animals/

How does an understanding of food webs help researchers determine the best strategies to protect species?

STAMP for group activity------

Food Web Math Practice

Problem: The owner of a soybean farm raises guinea hens for food and insect control. Guinea hens will eat grasshoppers and other insect pests and ticks. They also act as a "watchdog" by making a lot of noise when intruders approach their territory. The farmer allows the hens free range in his fields during the day and provides roosts for them at night.

For purposes of the following exercises, you may make these assumptions:

- The farmer lives on 1 hen/day for a year
- 1 hen eats 25 grasshoppers/day
- 1,000 grasshoppers have a mass of 1 kg
- 1 grasshopper requires about 30 g of soy/yr

- 1 human requires about 600 grasshoppers day
- Dry soybeans have about 3.3 cal/g

Show all your math using proper units!

1. Calculate the number of grasshoppers a hen needs per year.
2. How many grasshoppers are needed for a year's supply of hens for the farmer each year?
3. What is the total mass, in kilograms, of the grasshoppers needed to feed all the hens for one year?
4. How many kilograms of soybeans are needed to feed all the grasshoppers for one year?
5. Estimates of early Native American hunter-gather societies indicated that a person could collect about 90 kg (200 lb) of grasshoppers per hour, when they are abundant (in other words, it is possible to gather enough grasshoppers to live on). Now suppose the farmer chose to eat grasshoppers instead of hens. **How many people could the grasshoppers feed in a year, compared to the one person that the hens fed?** (use your calculation of the number of grasshoppers needed to support the hens for a year)
6. The farmer needs to consume 3,000 Cal/day. If he ate only soybeans instead of the hens or the grasshoppers, how many people would his soybean crop feed (see your response to question 4)?

7. Draw a Biomass Pyramid, using data you have developed to this point. Why do most food chains not have a fourth and/or fifth trophic level?

2. After reading the following excerpt from an article about the interrelationships among organisms in an oak forest, answer parts (a), (b), and (c), which follow.

Chain Reactions Linking Acorns to Gypsy Moth Outbreaks and Lyme Disease Risk

Oak trees (*Quercus* spp.) produce large autumnal acorn crops every two to five years, and produce few or no acorns during intervening years. Acorns are a critical food for white-footed mice (*Peromyscus leucopus*). Mice are important predators of the pupal stage of the gypsy moth (*Lymantria dispar*). This introduced insect periodically undergoes outbreaks that defoliate millions of hectares of oak forests, decreasing tree growth, survival, and acorn crop production. An abundance of acorns provides food for white-tailed deer (*Odocoileus virginianus*). Mice and deer are the primary hosts of the black-legged tick (*Ixodes scapularis*), which carries Lyme disease.

(a) In the space provided below, diagram a food web based on the interrelationships of the organisms identified in the excerpt.

(b) Design a controlled experiment that tests the relationship between acorn production and gypsy moth population. Include the hypothesis that the experiment tests.

Primary Productivity:

- In other words, how fast are the producers (plants and algae) photosynthesizing? How much is being produced and how fast?

GPP:

NPP:

- Not all of the GPP goes into making biomass (growth and reproduction)
- Some productivity is used in the autotroph's **own life processes** (respiration) and this energy is ultimately lost as **heat**

Productivity Formula:

Units used

rgy:	**nass:**

Factors that affect primary productivity:

1. _____ : quality/quantity of light

2. _____
   - In general, warmer temps correlate to _____ productivity
   - However, high temperatures can _____ enzymes
   - Also, there may be high productivity in cold ocean waters due to _____ of nutrients
3. _____
4. _____
5. _____: any food, chemical element or compound required by an organism to live, grow and reproduce, e.g. iron, magnesium, calcium, nitrate, phosphate, silicate
   → _____ are often caused by an oversupply of a limiting nutrient, like phosphates from detergents in our lakes and rivers
6. _____ : grazing of autotrophs by herbivores can _____. productivity (e.g. sea urchins ing productivity of kelp forest habitat)

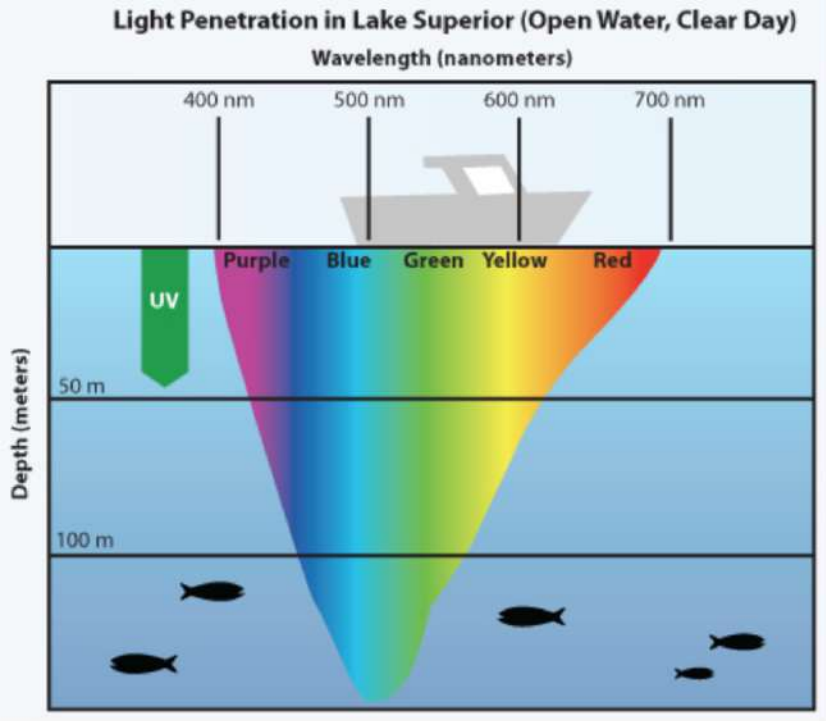
So the **most productive ecosystems** have: _____

Examine the graph in the powerpoint and write down the the most and least productive ecosystems.

3 Most Productive:	**3 Least Productive:**
1.	**1.**
2.	**2.**
3.	**3.**

- We use, waste, or destroy _____ of the earth's NPP.
- We are _____ of the biomass of earth's consumers.

Aquatic Light Penetration



What are **aquatic producers**?

Marine:

Freshwater:

1. Summarize what is shown in the figure above.

2. Nocturnal fish (awake at _____) are most commonly what color? _____ WHY?

3. Coral and algae need light in order for photosynthesis to take place. How do depth and the availability of light contribute to how these organisms are distributed on the ocean floor?

4. In some places ocean water is greener than in others. How do you think this color can be explained?