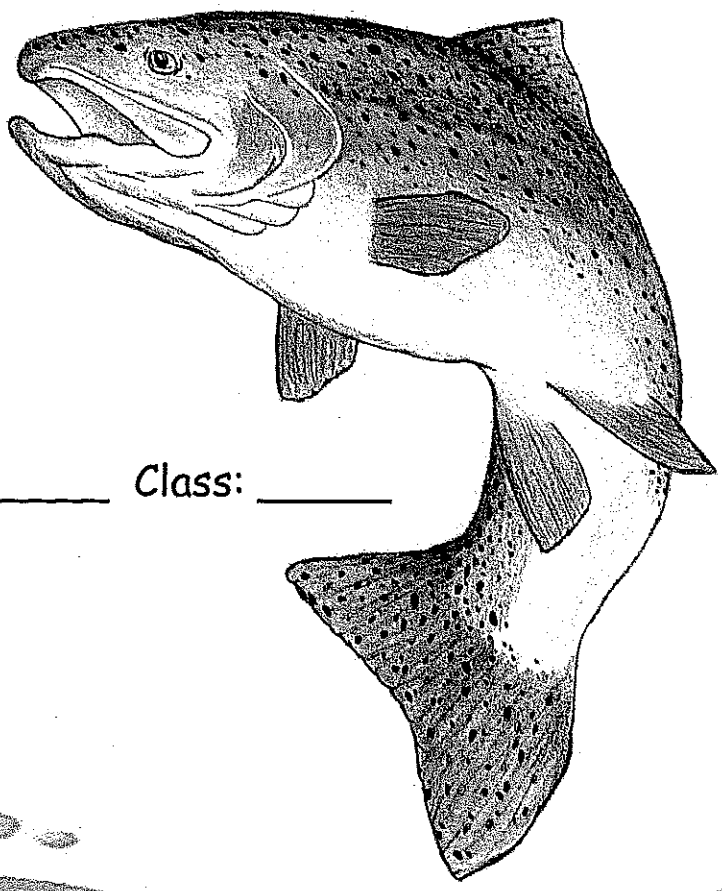
TROUT IN THE CLASSROOM

Student

Interactive

Logbook



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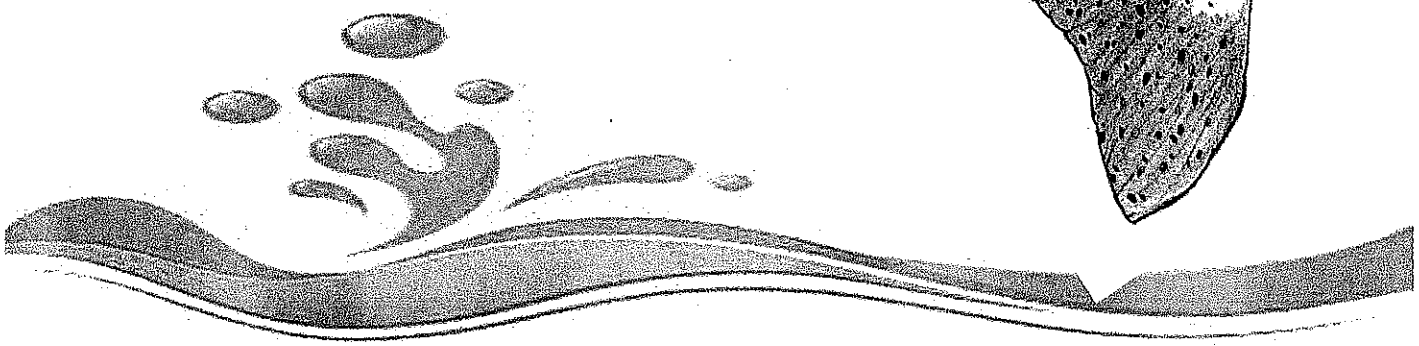

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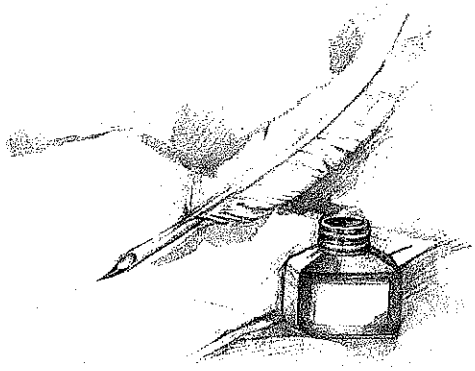


Topic

Prompt:

Name: _____
Date: _____

THE MYSTERY OF EASTER ISLAND

An Ecology Case Study

Article by Rhett A. Butler

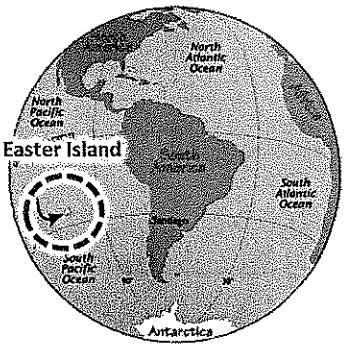


Figure 1 *Location of Easter Island on the Globe.*

The history of Easter Island, its statues and its peoples, has long been shrouded in mystery. Some have suggested that aliens marooned on earth planted the statues as signals to their fellow aliens to rescue them. Others have said that the statues were constructed by a great race of guilders that were stranded on the island and built them before being rescued. Still others are convinced that an ancient society with the capability of flight constructed them along with the Nazca lines in Peru. However new evidence based on pollen analysis supports a much simpler theory, that the Easter Island inhabitants destroyed their own society through deforestation.

When Easter Island was "discovered" by Europeans in 1722, it was a barren landscape with no trees over ten feet in height. The small number of inhabitants, around 2000, lived in a state of civil disorder and were thin and emaciated. Virtually no animals besides rats inhabited the island and the natives lacked sea-worthy boats. Understandably, the Europeans were mystified by the presence of great stone statues, some as high as 33 feet and weighing 82 tons. Even more impressive were the abandoned statues-as tall as 65 feet and weighing as much as 270 tons. How could such a people create, and then move such enormous structures? The answer lies in Easter islands' ecological past, when the island was not a barren place.

Figure 2 ***Moai*** *are giant human figures carved from rock on the Polynesian island of Rapa Nui (Easter Island) between 1250 and 1500 CE.*

The Easter Island of ancient times supported a sub-tropical forest complete with the tall Easter Island Palm, a tree suitable for building homes, canoes, and latticing necessary for the construction of such statues. With the vegetation of the island, natives had fuel wood and the resources to make rope. With their sea-worthy canoes, Easter Islanders lived off a steady diet of porpoise. A complex social structure developed complete with a centralized government and religious priests.

It was this Easter Island society that built the famous statues and hauled them around the island using wooden platforms and rope constructed from the forest. The construction of these statues peaked from 1200 to 1500 AD, probably when the civilization was at its greatest level. However, pollen analysis shows that at this time the tree population of the island was rapidly declining as deforestation took its toll.

Around 1400 the Easter Island palm became extinct due to over harvesting. As well, its capability to reproduce had become severely limited by the proliferation of rats, introduced by the islanders when they first arrived, which ate its seeds. In the years after the disappearance of the palm, ancient garbage piles reveal that porpoise bones declined sharply. The islanders, no longer with the palm wood needed for canoe building, could no longer make journeys out to sea. Consequently, the consumption of land birds, migratory birds, and molluscs increased. Soon land birds went extinct and migratory bird numbers were severely reduced, thus spelling an end for Easter Island's forests. Already under intense pressure by the human population for firewood and building material, the forests lost their animal pollinators and seed dispersers with the disappearance of the birds. Today, only one of the original 22 species of seabird still nests on Easter Island.

With the loss of their forest, the quality of life for Islanders plummeted. Streams and drinking water supplies dried up. Crop yields declined as wind, rain, and sunlight eroded top soils. Fires became a luxury since no wood could be found on the island, and grasses had to be used for fuel. No longer could rope by manufactured to move the stone statues and they were abandoned. The Easter Islanders began to starve, lacking their access to porpoise meat and having depleted the island of birds. As life worsened, the orderly society disappeared and chaos and disarray prevailed. Survivors formed bands and bitter fighting erupted. By the

arrival of Europeans in 1722, there was almost no sign of the great civilization that once ruled the island other than the legacy of the strange statues. However, soon these too fell victim to the bands who desecrated the statues of rivals.

Easter Island is a prime example of what widespread deforestation can do to a society. As the forests are depleted, the quality of life falls, and then order is lost. The example of Easter Island should be enough for us to reconsider our current practices.

Article Questions

1. Define the word *sustainability.*

2. Explain what happened to all the palm trees on Easter Island.

3. Where did the rats come from and why did they have such a negative effect on the palm tree?

4. Explain what happened to the birds on Easter Island.

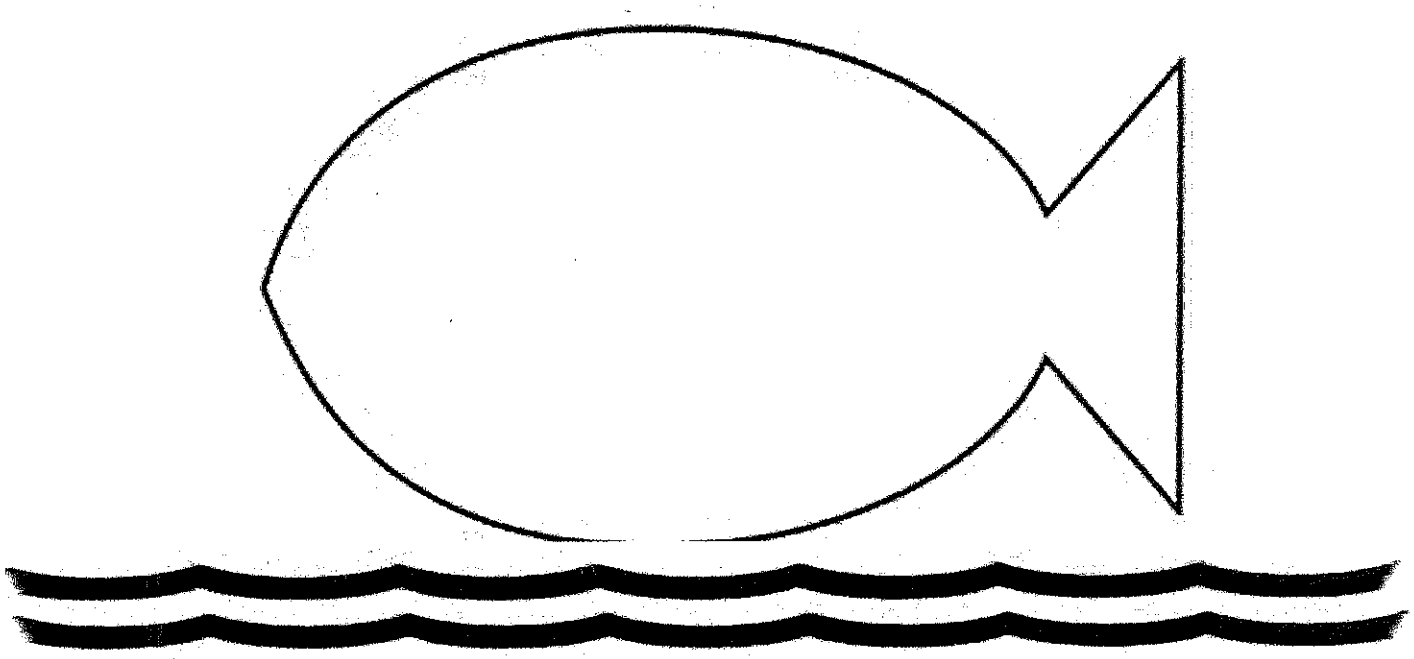
5. What did the decline of porpoise (e.g. dolphin) bones in garbage piles indicate?

6. Why weren't the people on Easter Island able to grow their own food to survive?

7. Why did the Easter Islanders stop producing giant Moai statutes?

8. Imagine that you could help the people of Easter Island prevent the destruction of their civilization before it happened. What three pieces of advice would you give them to help them avoid the collapse of their society and make them live more sustainably?

Draw a Fish



Common "Fishconceptions" about what fish look like:

1.

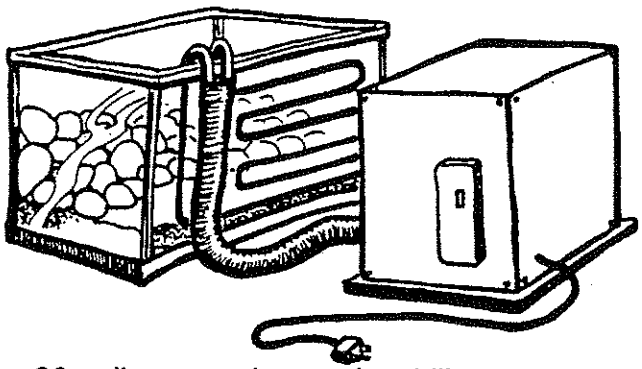
2.

3.

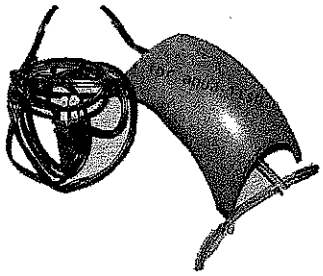
4.

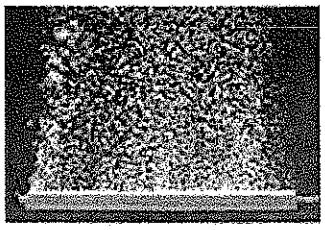
Famous Fish that shape our impressions of what a fish looks like:

Equipment at a Glance

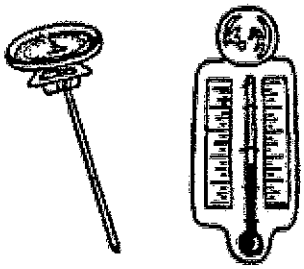


20 gallon aquarium and a chiller



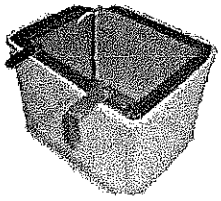


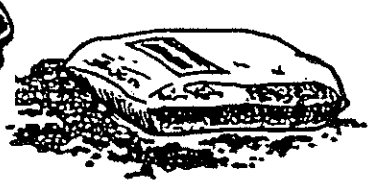
Air pump, connected to an air stone to provide oxygen in the tank



Thermometers

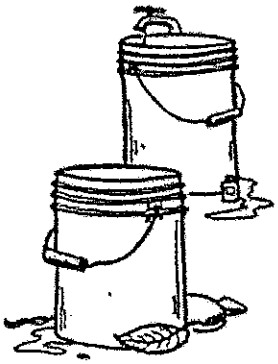
Breeder Basket





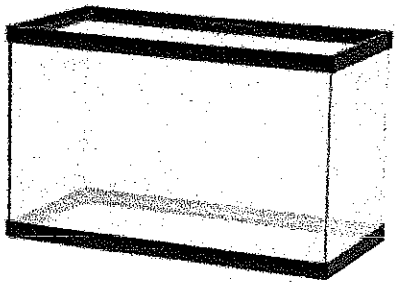
River Rock or Large Gravel

and Pea Gravel

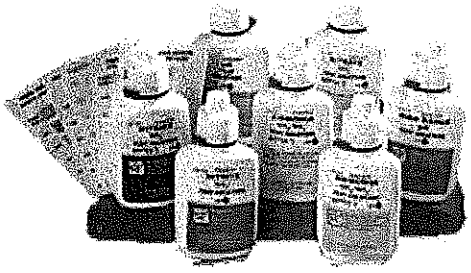


Clean non-chlorinated water

Filter



Tank



Water Test Kit

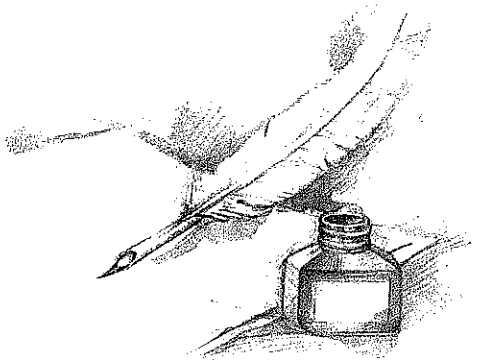
Siphon

Tank Setup

Draw you tank setup below. Use the "Equipment at a Glance" page to help you.

Journal Entry

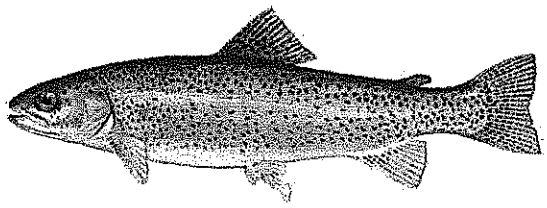
Date: _____



Topic

Prompt:

Rainbow Trout – Student Background Information



Scientific Name: *Oncorhynchus mykiss*

Oncorhyncus means "hooked nose" (This refers to the hook or "kype" which develops on the lower jaw of breeding males.); *mykiss* is probably a Russian native name. Rainbow trout are members of the Salmon family and are related to Pacific salmon. Like Pacific salmon, some Pacific populations of rainbow trout are anadromous. They spend their adult years in the ocean and return to fresh water to spawn. Unlike salmon, however, anadromous rainbow trout do not spawn once and die, but return to spawn several times. Rainbow trout in Maryland are not anadromous.

Range:
The native range of rainbow trout in North America is the Pacific Coast from northern Mexico to Alaska and inland to the Rocky Mountains. They have since been introduced into every state in the United States and every continent except Antarctica. In Maryland, over 500,000 rainbow trout are stocked in more than 100 streams and lakes all over the state.

Appearance:
Rainbow trout are colored like typical trout with dark spots on a light background. Most rainbow trout in Maryland are olive-green on the back, shading to silver on the sides and then to white on the belly. There is a faint red or pink band along the lateral line, and the body, dorsal fin and tail fin are covered with dark spots. The anal and pelvic fins are often tipped with white. The average size of rainbow trout is 20 to 30 inches and the average weight is 2 to 16 pounds. The world record is a fish caught in Canada in 2009 which weighed 48 pounds; the Maryland record is a fish which weighed 14 pounds 3 ounces and was caught in the Savage River Reservoir in 1987.

Habitat:
In the wild, rainbow trout do best in mountain streams or streams whose water comes from underground springs, which supply the cold water that trout need. Their ideal temperature range is between 10° and 16° C (50° and 60° F) although rainbow trout can survive warmer temperatures than some other species of trout. They can also live in lakes which have deep areas that tend to stay colder than the surface water. Trout also need a high level of dissolved oxygen - at least 5 ppm. Moving streams tend to have high levels of dissolved oxygen because the tumbling water mixes in oxygen from the air.The streams or lakes need to have plenty of surrounding vegetation to prevent erosion, since trout need clear water in order to see their prey. There also needs to be plenty of natural cover – aquatic vegetation, overhanging stream banks, large rocks or

deep pools – to provide places to hide from predators. Rainbow trout are more sensitive to acid water than other trout and do best in water with a pH of 6 to 8, so they do not do well in areas where there is acid rain or acid mine drainage. In order to spawn successfully, rainbow trout prefer a stream bottom that is covered with gravel, since the eggs sink into the gravel until they hatch and the alevins hide there until they are able to swim.

Diet:

Rainbow trout, like other trout, eat a variety of food as long as it fits in their mouth. Rainbow trout, especially juveniles, tend to have a larger proportion of insects, both larvae and adults, in their diet than other trout. Large rainbows will also eat smaller fish, including other trout.

Predation:

Rainbow trout, especially juveniles, are often eaten by larger fish. Adults are also eaten by birds such as kingfishers and herons, water snakes, and mammals such as raccoons, otters and minks.

Reproduction:

Rainbow trout reach maturity between the ages of 1 and 2. In Maryland, there are only three streams that have a naturally spawning population of rainbow trout. These trout spawn any time between late summer and early spring. Spawning and growth occurs best when the temperature is 10 -16° C (50 - 60° F). The male arrives first at the spawning grounds. When the female arrives, she constructs the nest or "redd" and deposits her eggs. Once the eggs are fertilized, they sink to the bottom of the redd and the female covers them with gravel. The eggs hatch in the gravel and the "alevins", which are only 3/4" to 1" long, remain buried in the gravel, hidden away from light. They do not feed, but absorb nutrients from the attached yolk sac. Once the yolk sac is absorbed, the little fish, now called "fry", wiggle up through the gravel into the stream and begin feeding on tiny insects and crustaceans. Because they rely on vision to find prey, they need clear water. As the fry grow, the size of their prey gets bigger, too.

Most rainbow trout only live for 3 or 4 years; the maximum recorded age is 11.

SPORT FISH RESTORATION

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Nature or Nurture – Worksheet

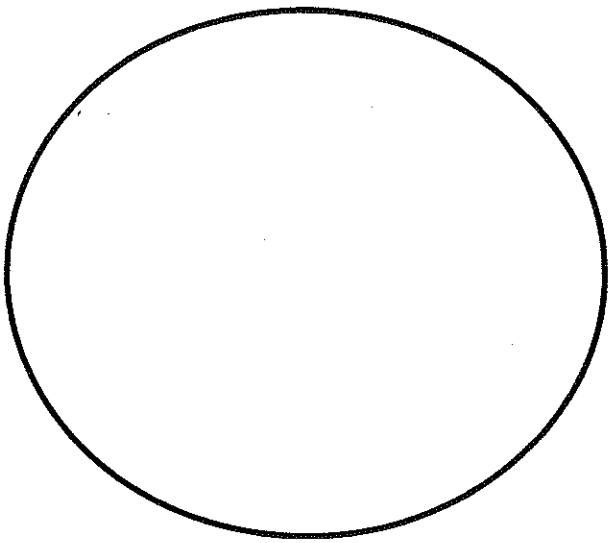
Need	What do Rainbow Trout prefer?	How is this need met in the wild?	How will you meet this need in the aquarium?
Water temperature for growth			
Dissolved oxygen			
pH			
Clean or cloudy water?			
Amount of light			
Food			
Predators			

SPORT FISH RESTORATION

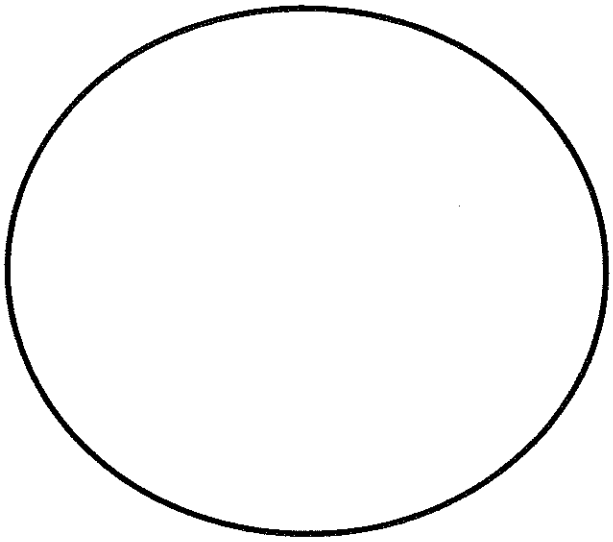
MARYLAND DEPARTMENT OF NATURAL RESOURCES

DRAW AN EGG - MICROSCOPE LAB

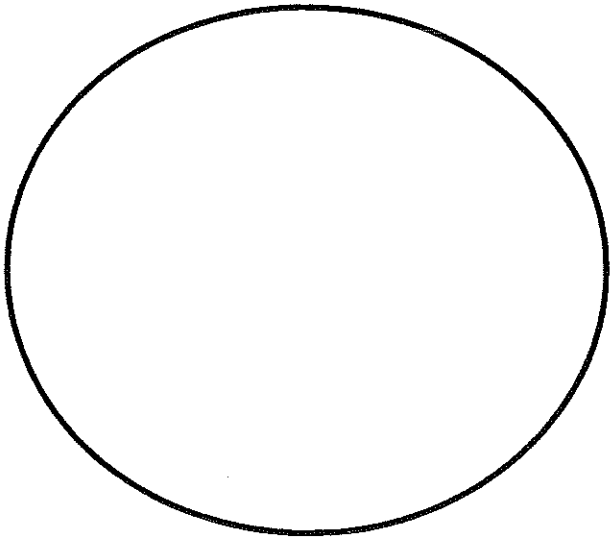
Draw exactly what you see with the naked eye:



Draw exactly what you see using your microscope:



Draw exactly what you predict the egg will look like when it hatches:



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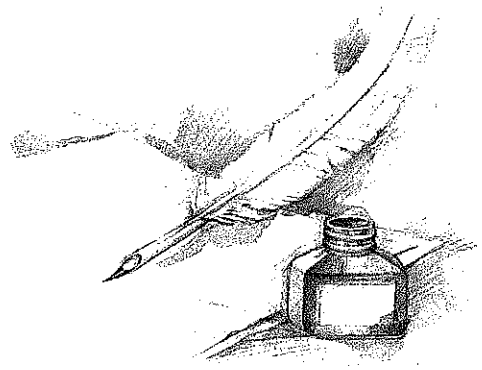


Topic

Prompt:

Trout Survival Rates

Answer these questions about the livelihood of our trout. Do your best to predict.

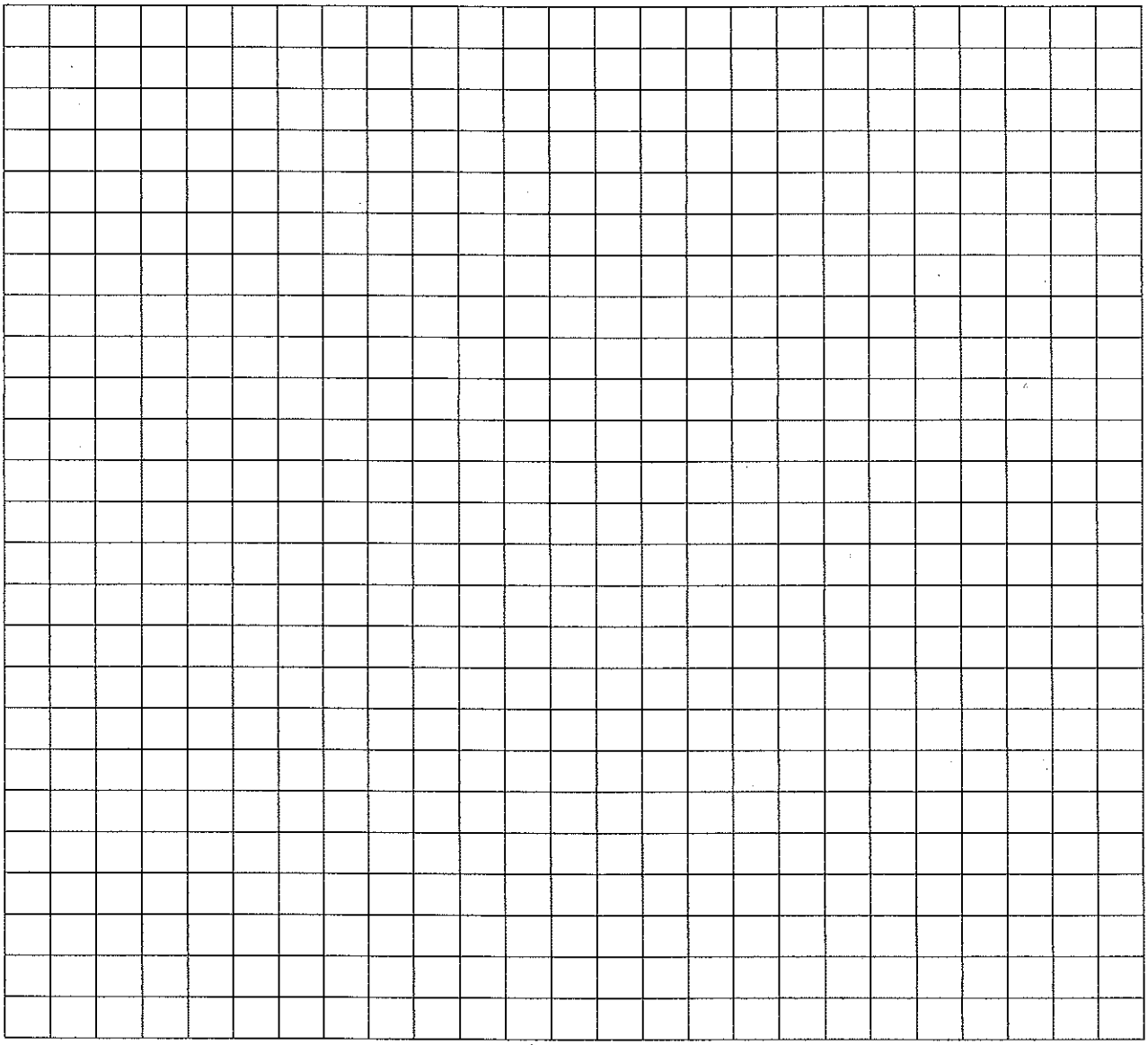
1. What will be the single most important factor in keeping our fish alive?

2. How do you think the survival rate of our fish will compare to those in the wild?

3. How will you know if a fish is "not doing well?" in our tank?

Weekly Count	Number of live trout/eggs	Number of dead trout/eggs	Unusual cases?
1/27			
2/3			
2/10			
2/17			
2/24			
3/3			
3/10			
3/17			
3/24			
3/31			
4/7			
4/22			
4/28			
5/5			
5/12			
5/19			

Make a line graph of our data to show the change in mortality over time. How will you number your graph?



Journal Entry

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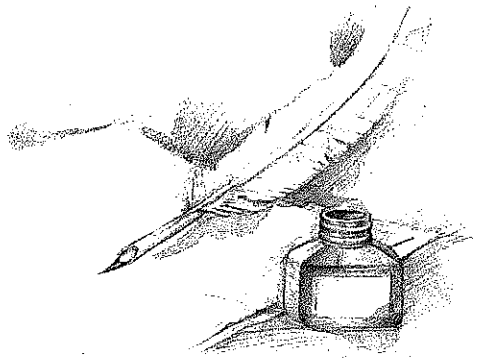
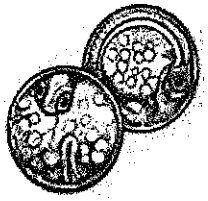


Topic

Prompt:

TROUT LIFE CYCLE

Color each stage the color you predict you will see in our own tank.



Use the chart below to compare each stage of the Trout's Life Cycle to the stage of development in a human.

Stage	Comparable Stage for a Human
Eggs	
Alevin	
Fry	
Fingerling	
Adult	

Class Discussion:

1. What is the survival rate for rainbow trout eggs in the wild?

2. What are some reasons why the eggs do not live until adulthood?

Journal Entry - How will the survival rate of the fish in our tank compare with the survival rate in the wild?

Name: _____

Date: _____

INTRO TO ECOSYSTEMS

PowerPoint Worksheet

INTRODUCTION TO ECOSYSTEMS

1. What does ***biology*** mean?

2. What does ***ecology*** mean?

3. Define the term ***ecosystem***.

A ***biotic*** component is _____

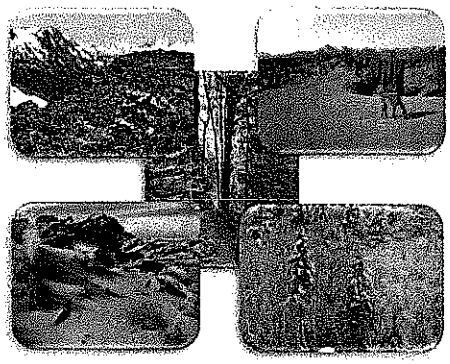
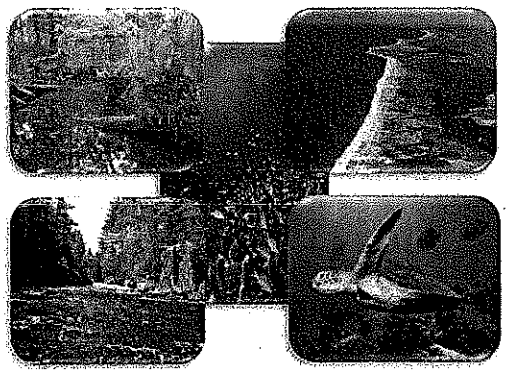
Examples:

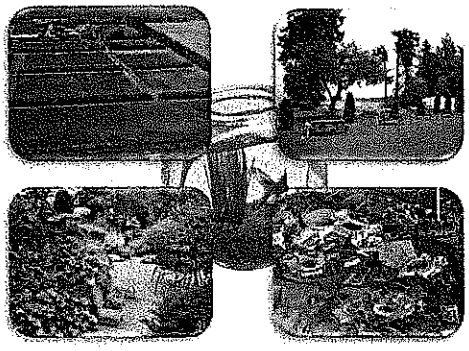
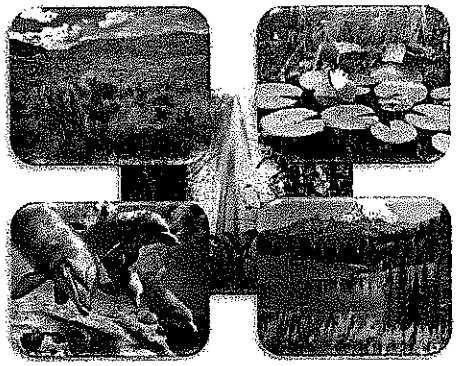
An ***abiotic*** component is _____

Examples:

TYPES OF ECOSYSTEMS

4. **Describe** each type of ecosystem and give examples of each.

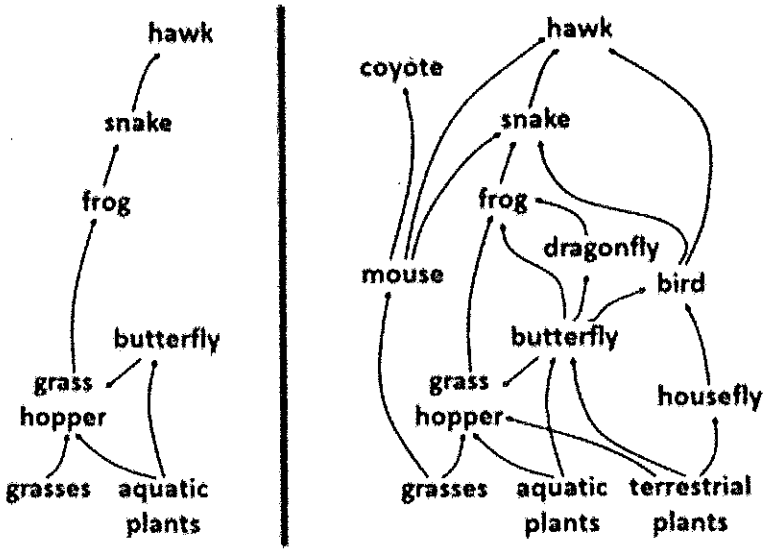
Type of Ecosystem: 1) _____	Type of Ecosystem: 2) _____
Definition:	Definition:
Examples: 	Examples: 

Type of Ecosystem: 3)	Type of Ecosystem: 4)
Definition:	Definition:
Examples: 	Examples: 

BIODIVERSITY

5. What is ***biodiversity***?

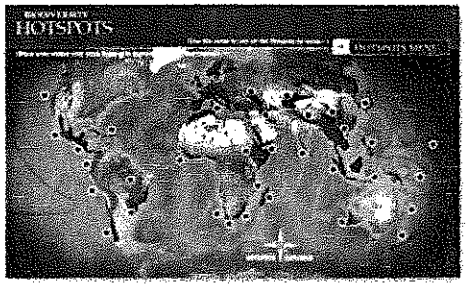
6. How is biodiversity ***different*** in the two food webs below?



7. How does ***low*** or ***high*** biodiversity affect an ecosystem?

20

8. What are ***hotspots***?



a) What are the ***criteria*** for an area to become a hotspot?

b) ***How many*** hotspots have so far been identified in the world?

HABITAT

9. What is a ***habitat***?

10. What is significant about ***habitat destruction***?

11. What are some other negative effects of habitat destruction?

12. After deforestation, what are some of the things humans use the land for?

ECOLOGICAL NICHE

13. What is an ***ecological niche***?

14. What is the ***ecological niche*** of the following organisms

a) deer

b) bee

15. How do the ecological niches of the owl and the hawk ***overlap***?

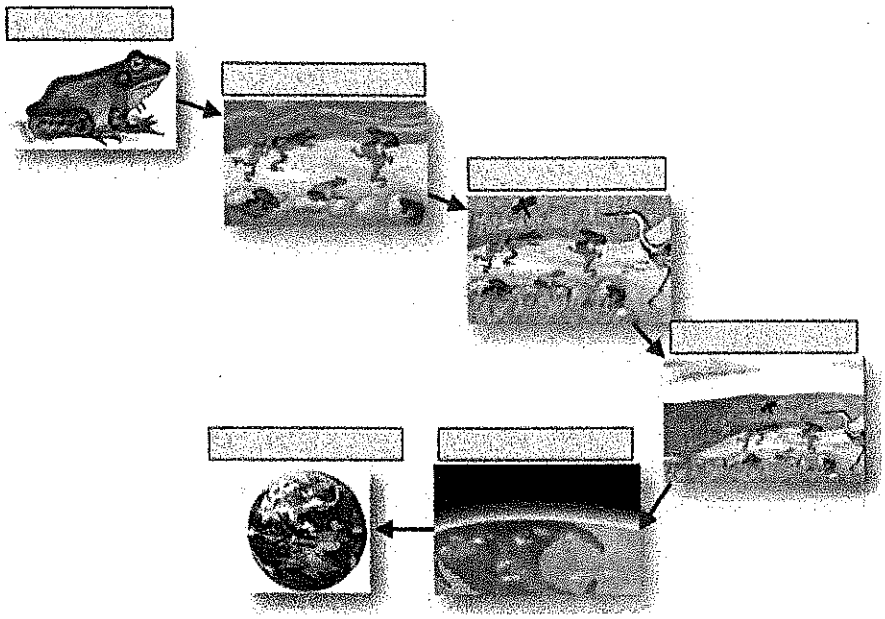
16. How do the ecological niches of the owl and the hawk ***differ***?

versus

17. Do any two species ever have ***exactly the same*** ecological niche? Why or why not?

GROUPINGS OF LIFE

18. Name and describe each level of life.



SPECIES

19. What ***three criteria*** are needed for members of a group to all be a part of the same species?

i) _____

ii) _____

iii) _____

20. What is a ***hybrid***?

21. ***Name*** the following hybrids and what ***type of parents*** made them.

HYBRID: _____

Parents: _____

Same species? _____

HYBRID: _____

Parents: _____

Same species? _____

HYBRID: _____

Parents: _____

and

Same species? _____

HYBRID: _____

Parents: _____

and

Same species? _____

22. What does ***environmental sustainability*** mean?

23. What does ***environmental stewardship*** mean?

Name: _____

Date: _____

ECOLOGICAL FOOTPRINTS

CALCULATE YOUR ECOLOGICAL FOOTPRINT - WEB ACTIVITY

Your **ECOLOGICAL FOOTPRINT** is a measure of your personal demand on the Earth's ecosystems. It compares your demand with Earth's ability to regenerate resources for your demands. It represents the amount of biologically productive land and sea area needed to regenerate the resources that you consume and to absorb and render harmless all the waste you make. If you calculate your ecological footprint, it is possible to estimate how many planet Earths it would take to support all the humans on Earth if everybody on Earth lived the same way you do.

Go to the website: http://www.cooltheworld.com/kidscarboncalculator.php . It is an ecological footprint generator based on United Kingdom statistics, but it is applicable to North American lifestyles. Once on the website calculate: **1)** your own personal ecological footprint, **2)** the ecological footprint of the most wasteful person - most Earths and least sustainable, **3)** the ecological footprint of the least wasteful person - least Earths and most sustainable. For each footprint record your responses below.

1) MY PERSONAL ECOLOGICAL FOOTPRINT

Fill in your own personal information to calculate your own ecological footprint. Once you answer the questions, you will get the results in a chart like below. Fill in the blank chart with your personal results

Sample Carbon Footprint:

Travelling to school	0	kgs CO_2/year
Watching television	116	kgs CO_2/year
Leaving TV on standby	12	kgs CO_2/year
Using the computer	27	kgs CO_2/year
Lights in the bedroom	47	kgs CO_2/year
Showers	86	kgs CO_2/year
Baths	114	kgs CO_2/year
Home total	402	kgs CO_2/year
Going on vacation	413	kgsCO_2/year
Your total	815	kgs CO_2 /year

My Carbon Footprint:

Travelling to school	kgs CO_2/year
Watching television	kgs CO_2/year
Leaving TV on standby	kgs CO_2/year
Using the computer	kgs CO_2/year
Lights in the bedroom	kgs CO_2/year
Showers	kgs CO_2/year
Baths	kgs CO_2/year
Home total	kgs CO_2/year
Going on vacation	kgsCO_2/year
Your total	kgs CO_2 /year

Now, using graph paper, make a bar graph of your personal ecological footprint showing the different areas your use of energy is noteworthy – in both good and bad ways. Be sure to include the following:

- A title
- Label bot axes
- Clear, easy to read, data

Cut and glue your graph here:

2) HIGHEST ECOLOGICAL FOOTPRINT- USES UP THE MOST EARTHS
LOWEST ECOLOGICAL FOOTPRINT - USES UP THE LEAST EARTHS

Pretend that you are the most wasteful/least sustainable person, and play with the fields in the survey until you create the ecological footprint of someone who would end up using **the MOST Earths**, or is the least sustainable. Repeat the survey again and find the ecological footprint of a person who is the most sustainable – or uses up the least amount of energy resources. Record both results below.

Low Carbon Footprint:

Travelling to school	kgs CO_2/year
Watching television	kgs CO_2/year
Leaving TV on standby	kgs CO_2/year
Using the computer	kgs CO_2/year
Lights in the bedroom	kgs CO_2/year
Showers	kgs CO_2/year
Baths	kgs CO_2/year
Home total	kgs CO_2/year
Going on vacation	kgsCO_2/year
Your total	kgs CO_2 /year

High Carbon Footprint:

Travelling to school	kgs CO_2/year
Watching television	kgs CO_2/year
Leaving TV on standby	kgs CO_2/year
Using the computer	kgs CO_2/year
Lights in the bedroom	kgs CO_2/year
Showers	kgs CO_2/year
Baths	kgs CO_2/year
Home total	kgs CO_2/year
Going on vacation	kgsCO_2/year
Your total	kgs CO_2 /year

ANALYZING THE FOOTPRINT TEST

The more energy we personally use, the more "Earths" we are consuming over a lifetime. Now that you have an idea of how much energy it would take for everyone on Earth to live your lifestyle, let's look at the footprint test itself. Change the responses in the footprint calculator and see what results you get to help you answer the questions below.

1. When you come to school each day, what method of travel uses the least amount of Earths and **why?**

2. If you want to use up less Earths, what is the best type of holiday to take and **why**?

3. Why does the size of home you live in matter to the number of Earths used up?

4. Does living with more people, or living with less people use up more Earths and **why**?

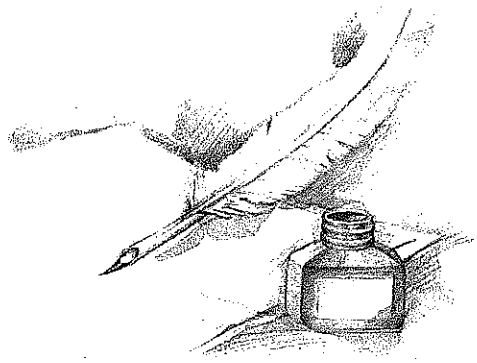
5. Why does the amount of meat you eat affect the number of Earths used up?

6. How does the amount and type of waste you produce affect the number of Earths used up?

7. Even if you changed the answers to get the Lowest Ecological Footprint there still would not be enough "Earths" to support everyone. What explanation do you have for this?

Journal Entry

Date: _____



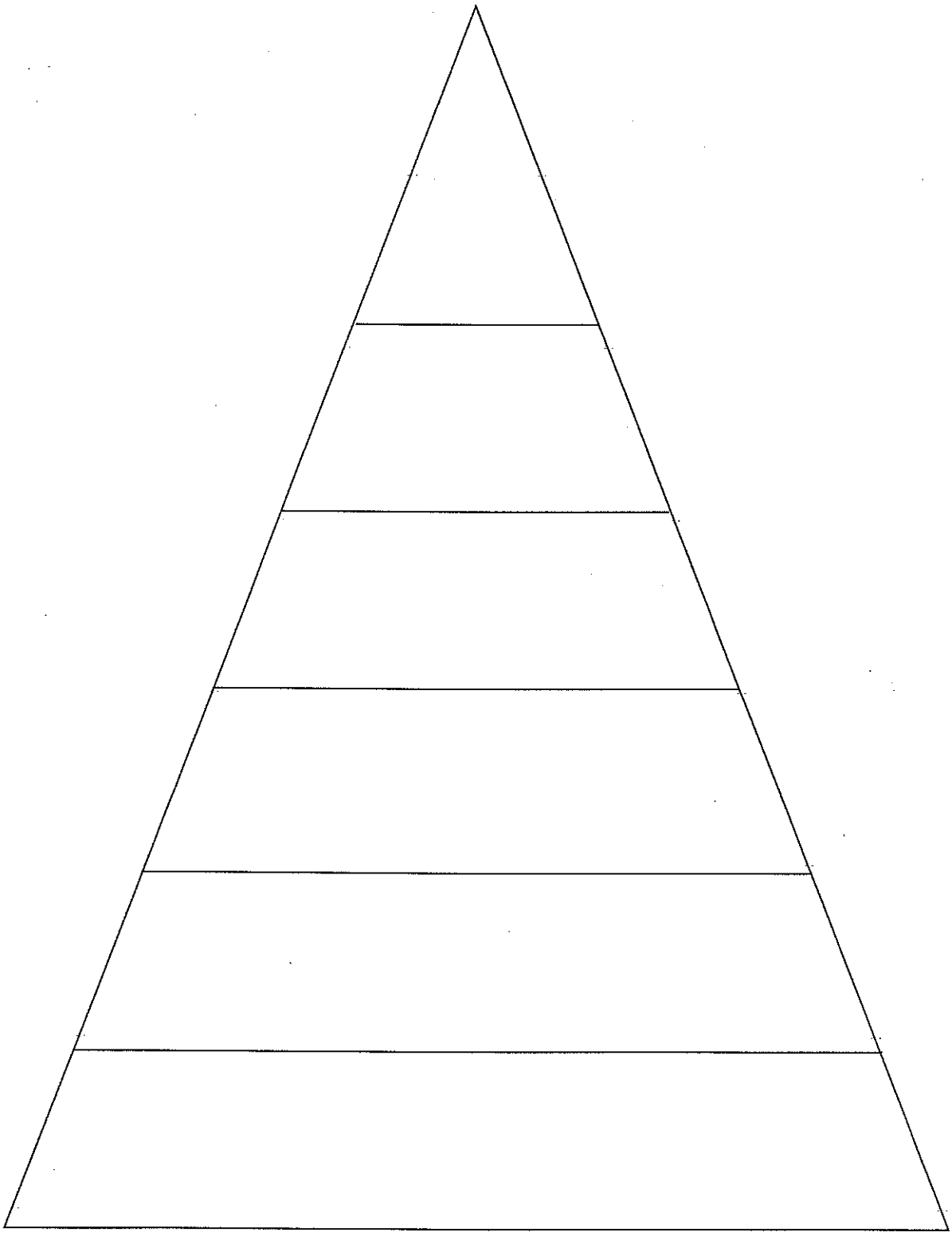
Topic

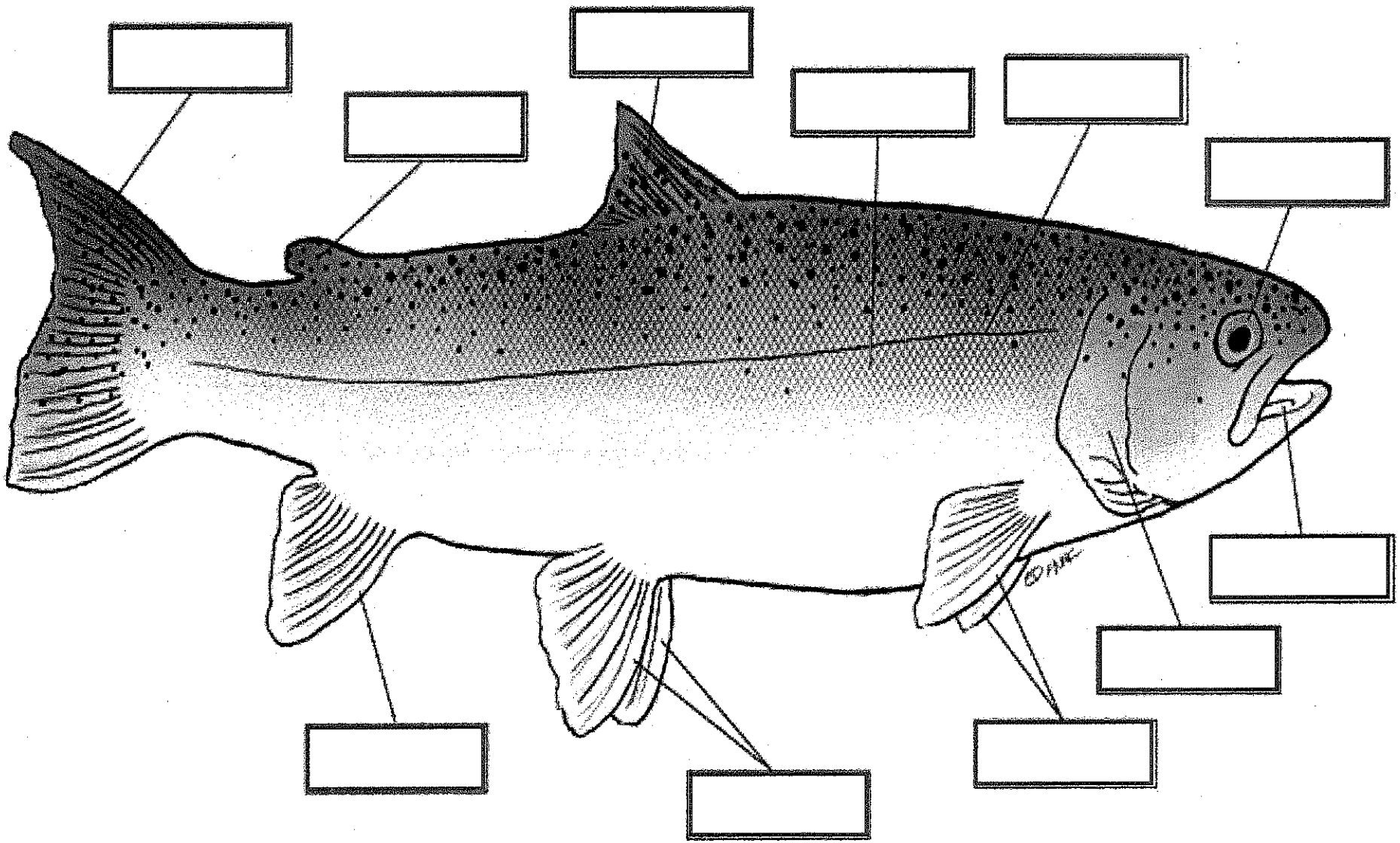
Prompt:

ECOSYSTEMS TASK CARDS

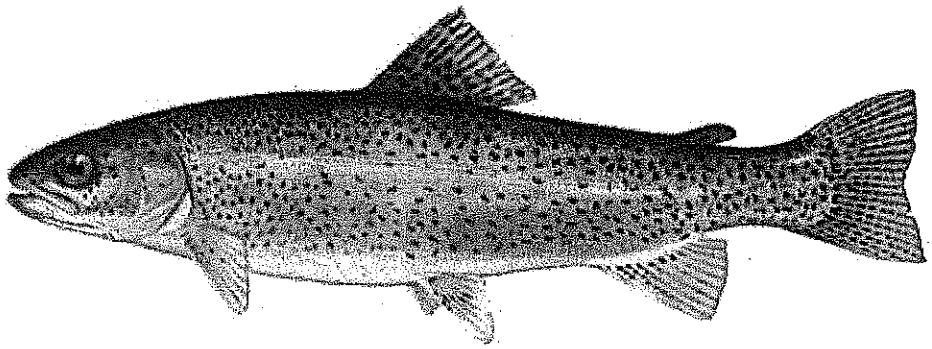
Task Card #	Answer	Task Card #	Answer
1		13	
2		14	
3		15	
4		16	
5		17	
6		18	
7		19	
8		20	
9		21	
10		22	
11		23	
12		24	

Ecosystem Organization Pyramid





Rainbow Trout



Trout Anatomy Vocabulary

Adipose fin – the soft fin on the fish's back closest to the tail. It is called "adipose", which means "fatty", because it has no fin rays. It may serve to help with stability and to sense the flow of water over the fish's back.

Anal fin – the single fin on the fish's belly closest to the tail. It helps with stability.

Caudal fin – also known as the tail fin, this fin is used mainly for swimming.

Dorsal fin – the fin on the fish's back closest to the head. It helps keep the fish from rolling over.

Eye – used for finding prey and avoiding predators. The relatively large size indicates the importance of sight for trout. The eye has no eyelid but is covered by a tough membrane for protection. Trout can see color.

Kype – the hooked part of the lower jaw found in spawning males. It is used for fighting with other males.

Lateral line – a sense organ that runs down both sides of the fish from the gills to the tail. It helps the fish sense movement and vibrations in the water.

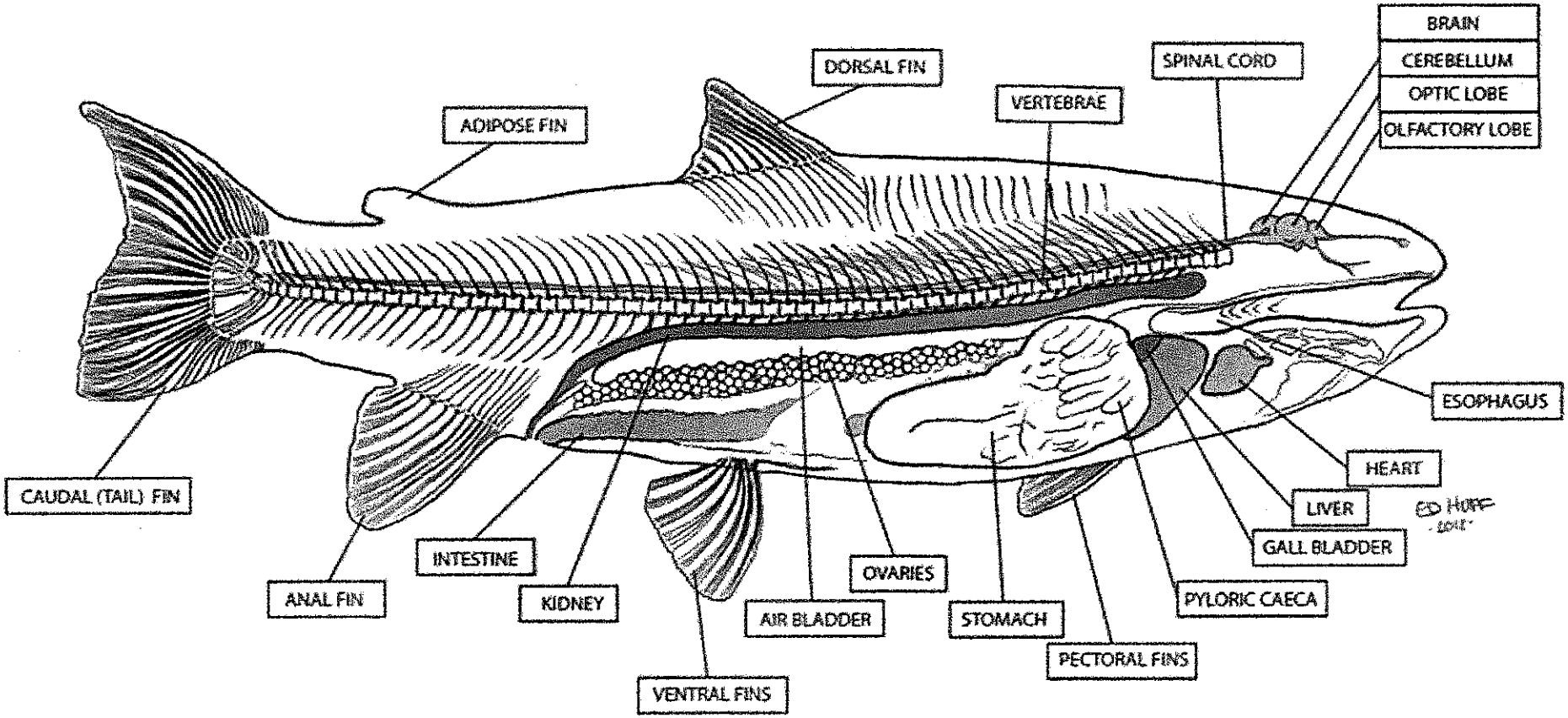
Operculum – the bony plate that covers the gills; sometimes called the gill cover.

Pectoral fin – the pair of fins on the sides of the fish near the operculum. They help the fish stop and change direction.

Pelvic fin – the pair of fins on the belly of the fish, directly below the pectoral fins. They help the fish stop and change direction, especially up and down.

Rainbow Trout – Internal Anatomy

Trout, like all animals have anatomical features that enable them to breathe, eat, see, move and reproduce. However, because trout are adapted for an aquatic environment, there are some significant differences between trout and humans.



The brain has three major divisions: the olfactory lobe is located in the front and is used for smell and taste, the large optic lobe is used for sight and the cerebellum in the rear coordinates and regulates muscle activity. The spinal cord exits the rear of the brain and passes through the vertebrae, which gives it protection. The olfactory lobes are located inside the nostrils of the fish and are connected to the brain by olfactory nerves. Although not shown in this illustration, the lateral line is a network of sensory canals that extend from the brain down the body to the tail and appear as a series of small openings aligned along the spinal cord. In each of these canals lies a sensitive receptor called a neuromast. These neuromasts provide the fish with important information about water movement which in turn allow the fish to detect moving prey or predators.

The heart is a muscular two-chambered organ (humans have four chambers) that is primarily responsible for circulating blood throughout the fish's body. The heart is situated at the base of the throat and lies in the pericardial cavity that is completely separated from the body cavity. In humans, the blood is pumped through the lungs, oxygenated and returned to the heart which in turn circulates the oxygen rich blood throughout the body. In trout, blood enters a chamber in the heart called the atrium and passes through a valve into the ventricle which forces the blood out and into the capillary networks of the gills. After the gas exchange in the gills, the oxygenated blood passes on to the capillary network throughout the body of the fish.

The stomach is a dilated, U-shaped section of the digestive tract located between the esophagus and the intestine. The fingerlike structures that extend from the stomach are called pyloric caeca. (pi-lorik see-ka) These caeca secrete the digestive enzymes required to digest some food. The digestive process begins in the stomach. The trout's stomach can easily extend to allow the fish to swallow large prey whole. The remainder of the digestion and food absorption processes take place in the intestine.

The liver acts as an accessory digestive organ. The liver secretes bile through a duct into the gall bladder. The liver also detoxifies heavy metals, drugs and pesticides to which the animal may be exposed.

The gall bladder is a small amber yellow to green sac attached to the liver. The gall bladder stores and discharges bile into the stomach. Bile aids in the digestion of fats.

The kidney lies along the ventral surface of the spine. The kidney is the main filter of the body and its primary function is to maintain the internal salt/water balance of the fish. In fish, the kidney plays only a minor role in the elimination of waste products like ammonia. In combination with the spleen, the kidney also produces white and red blood cells.

The spleen plays important parts in both the function of the red blood cells and the fishes' immune system. It removes old red blood cells, holds a blood reserve and recycles iron. The white blood cells of the spleen also synthesize antibodies.

The gas (swim) bladder is responsible for maintaining the fish's equilibrium in its environment. The fish does this by changing the amount of air in the bladder, raising and lowering its position in the water column.

The ovaries are the female trout's reproductive organs and produce eggs and sex hormones. A typical mature rainbow trout can produce from 1,000 to 8,000 eggs each season.

The skeleton of a trout gives structure, provides protection and anchors the muscles.

Journal Entry

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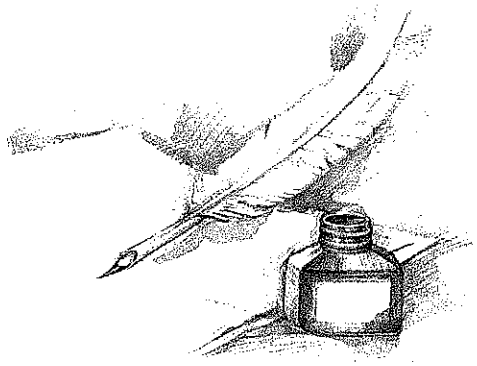
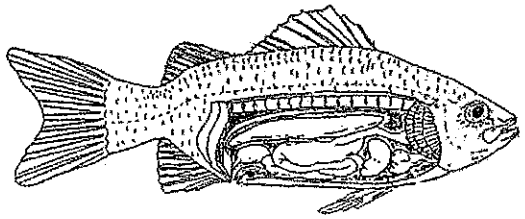


Topic

Prompt:

Insides and Outsides – Dissection and Anatomy of a Fish



Important reminders!

- **You will be working in teams. Be sure to share tasks with each other.**
- **Unless you are told otherwise, the fish is to remain in the dissecting tray at all times.**
- **A dissection is a scientific procedure; you must work carefully and neatly.**

I. Outsides - External anatomy

A. Shape and color

- Describe the general shape of your fish.
- What does the shape tell about where your fish lives?
- What color is your fish? What might this tell you about where it lives?

B. Skin and scales

- What does the fish feel like?
  - What is the purpose of the slime?
  - What is the purpose of the scales?
  - Use forceps to remove a scale and look at it under a microscope.
  - What do you think the rings indicate?

- Most fish have a faint line called the lateral line running from the head to the tail.
  - Does your fish have one?
  - What is its purpose?

- **Fins**
  - Locate and identify the fins. What is the purpose of each fin?
    - Caudal or tail fin

    - Dorsal fin – These are the fins on the fish's dorsal side (back); there may be one or two dorsal fins.

    - Anal fin – This is the single fin on the ventral side (bottom) of the fish near the caudal peduncle (tail).

    - Pectoral fins – These are the pair of fins on either side of the fish's body posterior (behind) to the operculum.

    - Pelvic fins – This is the pair of fins on the ventral side (bottom) of the fish, nearer the head.

  - What is the purpose of the spines (hard and sharp) or rays (soft) in the fins?

- Locate the nares (nostrils), two tiny holes in front of the eyes. What are they for? Be careful! This is a fish, not a human!

- **Eye**
  - Does the fish have an eyelid?

- Notice the size of the eye and pupil. A relatively large eye and pupil often indicates that vision is important to the fish. How important do you think vision is for your fish? Why might it be important?

- **Mouth** – Pick up your fish and look in its mouth.
  - Does your fish have a tongue?
  - Use your finger to feel carefully inside the mouth.
    - Are there teeth? If so, where?
    - What do they feel like?
  - Based on the location and size of the mouth and the type of teeth, predict how the fish catches food and what the fish might eat.
  - Open your fish's mouth wide and look inside. You should be able to see red things on either side of the throat. What do you think these are?
    - Stick your probe into the fish's mouth. Where does it come out?
    - If a fish took water into its mouth, where would it come out? What about food?

- **Gills**
  - Place the fish back in the tray and lift the hard flap on the side of the head. This is called the operculum. What do you think it is for?
  - Use your scissors and cut away the operculum.
    - Remove the gills by cutting the upper and lower attachments of the gill arch.
    - The bony things on the inside curve of the gill arches are called gill rakers. What do you think they are for? Hint: think about food.
    - The feathery things are called gill filaments. What do you think they are for?

Insides – Internal anatomy

- Locate the small hole on the bottom of the fish near the tail. This is called the vent. Insert your scissors into the vent and **carefully make a shallow cut** all the way to the operculum along the bottom of the fish. Carefully lift the flap of skin and cut it away so you can see the internal organs. Notice how neatly everything fits together!

- **Digestive system**
  - Find the beginning of the digestive tract by inserting the probe into the mouth and down the esophagus.
  - The large reddish organ on top of the stomach is the liver. What is its function?
    - The dark greenish tissue in the liver is the gall bladder which produces bile. What does bile do?
  - **Stomach**
    - The esophagus empties into a J-shaped bag called the cardiac stomach. What happens to food here?
    - The spleen is attached to the lower end of the cardiac stomach. The spleen produces red blood cells.
    - Food next goes into the pyloric stomach with lots of branching projections called ceca. What is the advantage of the ceca?
    - The pancreas surrounds the pyloric stomach and produces digestive enzymes.
  - The pyloric stomach empties into the intestine.
    - What is the function of the intestine?
    - Herbivorous fish have a longer intestine than carnivorous fish because plant material is harder to digest. Based on the length of your fish's intestine do you think it is herbivorous or carnivorous?

- Waste products are eliminated through the vent.
- Now use your scissors, cut open the stomach and look at the contents.
  - What did your fish eat last?
  - Does this agree with what you guessed, based on the type of teeth and the length of the intestine?

- **Swim bladder**
  - The swim bladder is the silvery or clear sack that runs the entire length of your fish's body between the digestive tract and the backbone.
  - What is its function?
  - Do all fish have a swim bladder? If not, what would that tell you about where the fish lives?

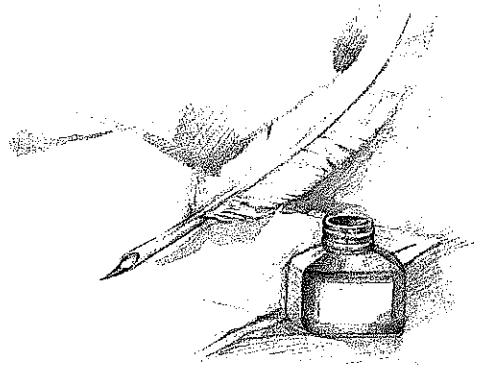
- **Kidney**
  - The streak of red tissue along the backbone is the kidney.
  - What is its function?

- **Heart**
  - The heart is the small triangular shaped organ just below the esophagus, near the fish's mouth.
  - How many chambers does it have?
  - Why do you think the heart is located near the gills?

- Does your fish contain a large sack filled with little round yellow, red or black things? If so, your fish is a female carrying eggs or roe.

- Does your fish contain a large creamy-white ribbon? If so, your fish is a male carrying sperm or milt.

Journal Entry



Date: _____

Topic

Prompt:

Name: _____
Date: _____

FOOD CHAINS, TROPHIC LEVELS AND ECOLOGICAL PYRAMIDS

POWER POINT WORKSHEET

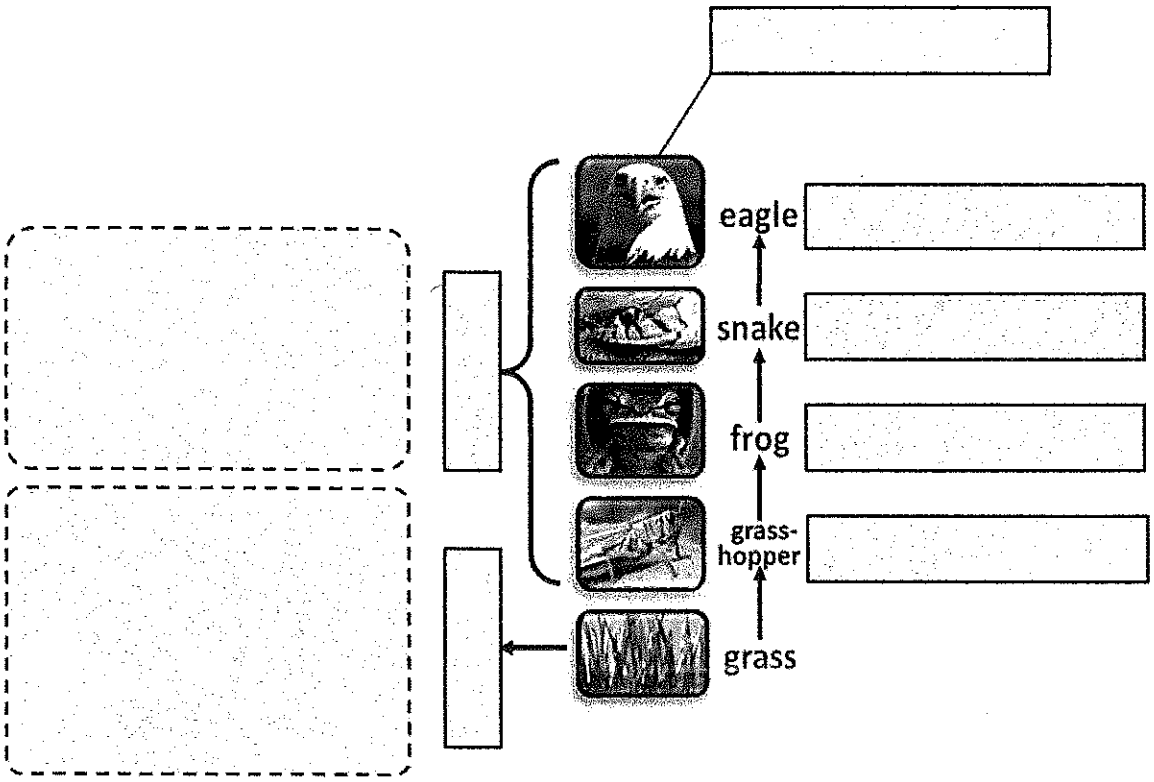
FOOD CHAINS

1. What is a ***food chain***?

2. What is the ***source of energy*** for most food chains?

3. What does the ***tip of an arrow*** in a food chain point to?

4. **LABEL DIAGRAM**: Label and write descriptions on the following diagram and answer the questions below.

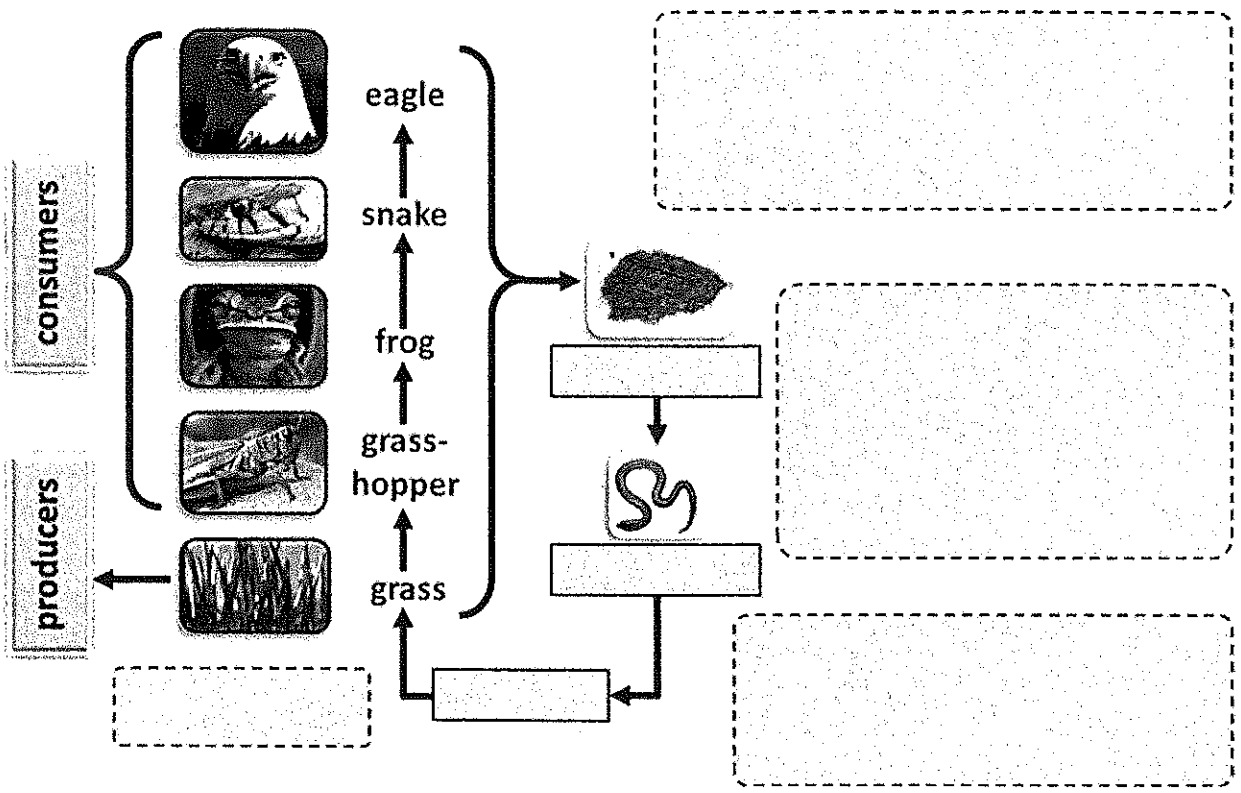


a) THINK What is the main difference between a producer and a consumer?

b) THINK What is the main difference between a primary consumer and a secondary consumer?

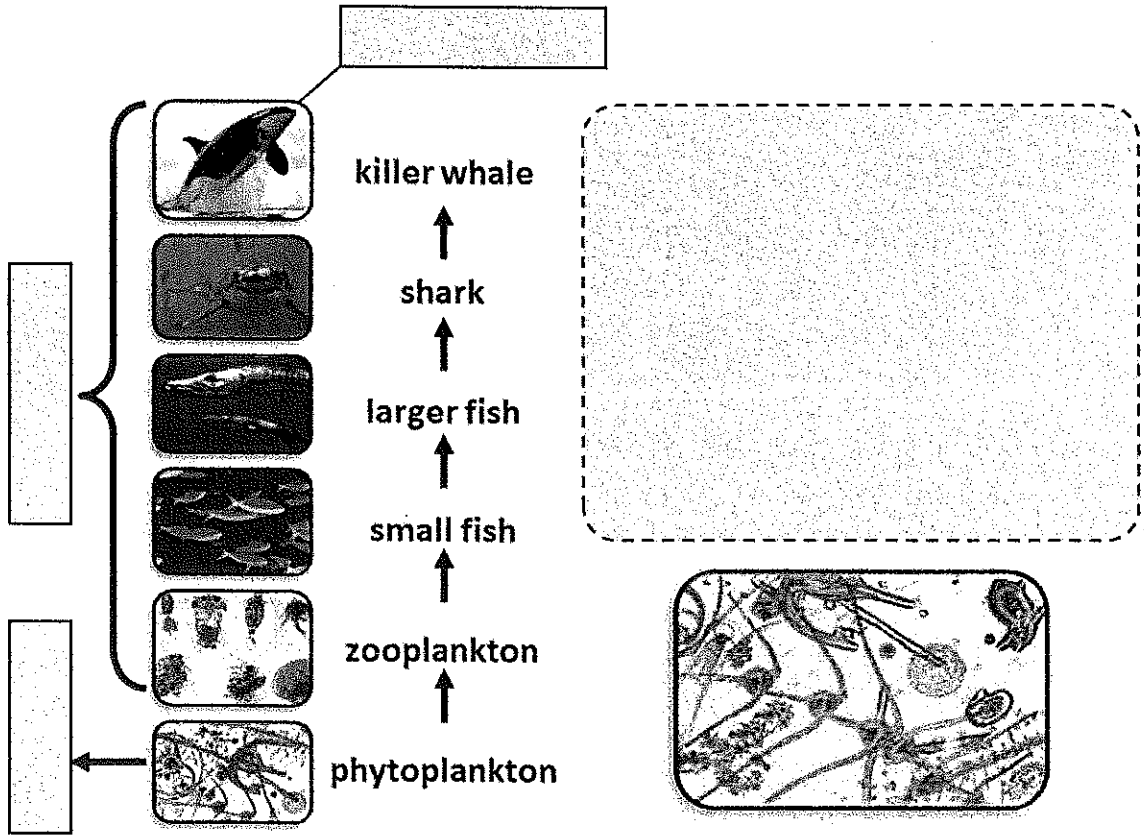
c) THINK Name two other organisms you think are top carnivores in other food chains.

5. **LABEL DIAGRAM:** Label and write descriptions on the following diagram and answer the questions below.



a) THINK What would happen if there were no decomposers?

6. **LABEL DIAGRAM:** Label and write descriptions on the following diagram and answer the questions below.



a) THINK What is the difference between the term ***terrestrial*** and ***aquatic***?

b) THINK What differences are there between ***terrestrial producers*** and ***aquatic producers***?

7. Why don't ***hydrothermal vent food chains*** have photosynthetic producers to form the base of their food chains?

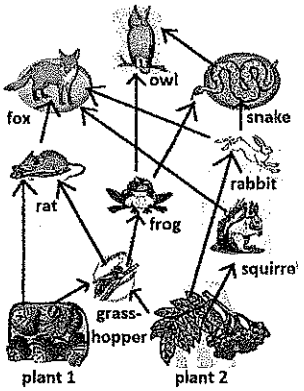
8. What organisms form the base of hydrothermal vent food chains and how do they get their energy?

HUMANS AND FOOD CHAINS

9. Where would humans be on any food chain that includes them?

10. In which situations are humans ***primary consumers***?

11. In which situations are humans ***secondary consumers***?



FOOD WEBS

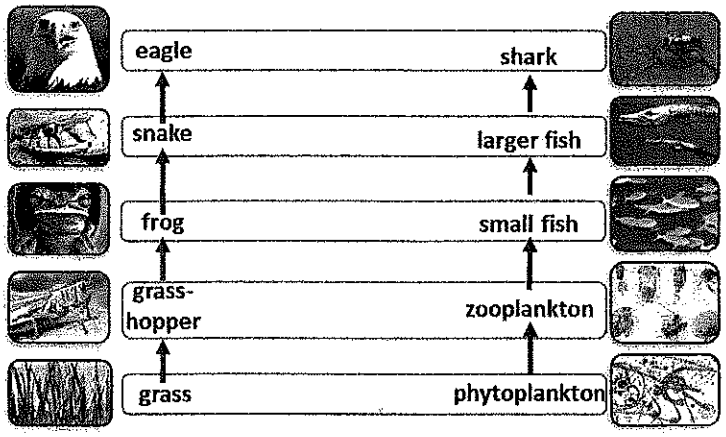
12. What is a ***food web***?

TROPHIC LEVELS

13. What is a ***trophic level***?

14. What organism occupies the first trophic level in ***terrestrial*** food chains, and what organism occupies the first trophic level in ***aquatic*** food chains?

15. **LABEL DIAGRAM**: Label the diagram on the right.



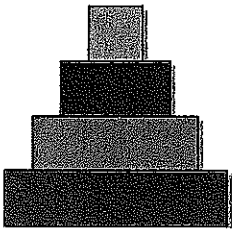
16. When energy is transferred up trophic levels ___% of it is passed on and used to build _____ and to fuel _____, while ___% of it is lost in the form of _____ and _____.

ECOLOGICAL PYRAMIDS

17. What are ***ecological pyramids***?

18. What is a ***pyramid of energy***?

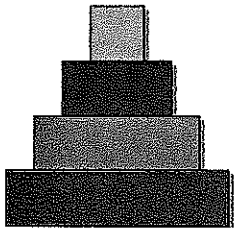
19. What is always true about a pyramid of energy?



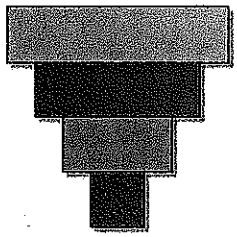
Pyramid of Energy

20. What is a ***pyramid of biomass***?

21. How is a pyramid of biomass different ***on the land*** versus ***in the water***?



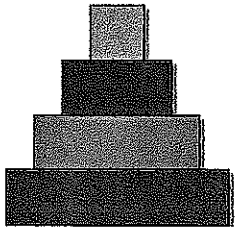
Pyramid of Biomass on Land



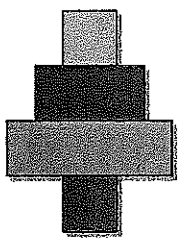
Pyramid of Biomass in the Water

22. What is a ***pyramid of numbers***?

23. In which situation would you get ***Pyramid of Numbers A*** and in which situation would you get ***Pyramid of Numbers B***?



Pyramid of Numbers A



Pyramid of Numbers B

What's For Dinner?

We've learned that all living things need food, water, a habitat, and to maintain homeostasis. For each of these four basic needs of living things, tell how the trout's need is met. These are prediction, not a research questions.

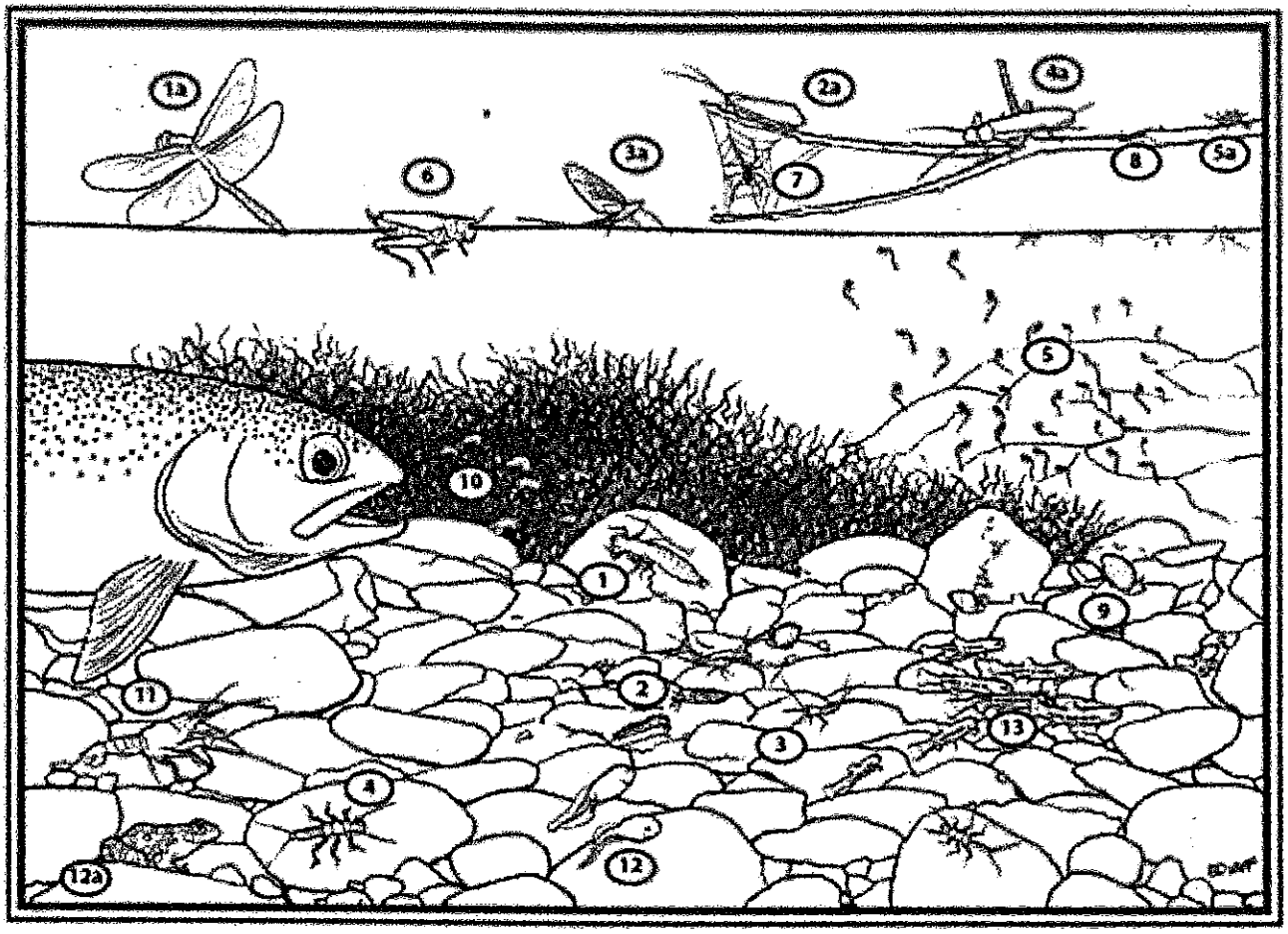
1. What does a trout eat and how does it get its food?

2. How does a trout get the water it needs?

3. What is a trout's habitat?

4. What methods does a trout use to maintain homeostasis?

A Trout's Diet
- What Trout Eat -



This poster shows an underwater scene with a trout in his holding lie and a number of examples of different foods a trout might eat. Trout are carnivores and will eat almost any animal they can catch that will fit into their mouths. Only a small number of the many animals a trout will eat are shown.

Each animal shown on this poster is identified with a number. A corresponding number is listed below to help with identification. Trout in streams occupy a space called a "holding lie". This is a position in the stream that can give them protection from predators, access to food, or a combination of the two. The trout in this illustration has positioned itself in a prime holding lie where any animal unlucky enough to be swept up in the current could be carried into the path of this feeding trout. The prime positions (those that provide the best feeding opportunities or best protection) are occupied by the dominant trout. This hierarchy is maintained by threats and displays and rarely results in actual combat.

Aquatic Insects - Shown are only a few of the many aquatic insects that make up a part of a trout's diet. For their own protection some of these animals are difficult to see. There are 5 different species shown. These animals are members of a family called arthropods. Arthropoda means "jointed foot". Over half of the animals on earth are arthropods.

Insects, arachnids (spiders) and crustaceans are all arthropods. All insects have three body parts; a head, thorax and abdomen. They also have three pairs of legs, which are attached at the thorax. Aquatic insects spend the greater part of their lives in the water which makes them available to trout in their nymphal, larval or pupal stages. As aquatic animals they appear quite different in appearance when compared to their adult, terrestrial form. Shown are both the nymph or larval form as well as the adult form. On a predetermined schedule, they emerge from the water and shed their outer covering and become adults. It is during the adult stage that they mate and lay eggs. During their emerging and egg laying they become readily available to the trout as a food source.

1 - **Dragonfly Nymph** - The dragonfly nymph is the aquatic stage of the dragonfly. A feeding trout will seldom pass up the opportunity to make a meal of a dragonfly nymph. The 42 species of dragonflies in California spend up to two years in the water before emerging as adults. As nymphs, dragonflies are predators themselves and are capable of catching and eating small fish.

1a - **Adult Dragonfly** - These colorful insects spend only about 2 months as flying adults. Male and females often look like completely different species with widely contrasting colors. Adults are sometimes caught by trout as they skim over the water laying eggs or actually competing with the trout for other insects which they both eat.

2 - **Caddis Fly Larva** - Many caddis flies create a protective case for themselves while in their larval stage. The case is comprised of small stones and sticks. This case provides both protection and camouflage.

2a - **Adult Caddis Fly** - When the mature caddis pupa swims or crawls to the surface, it sheds its pupal membrane and emerges as an adult. While the wings stiffen to prepare for flight the caddis is particularly vulnerable to trout. When the fertilized female returns to deposit her eggs in the water, sometimes swimming or crawling underwater, she's also exposed to feeding trout.

3 - **Mayfly Nymph** - Mayflies also have both a nymphal stage and adult stage and are eagerly sought after by trout. They are one of the insects most often imitated by fly fishermen.

3a - **Adult Mayfly** - The adults are very short lived, as they swim to the surface or crawl out of the water onto rocks or plants they are vulnerable to trout. When the adult female returns to the water to lay her eggs, she's also available to trout. When they die a day or so after mating and egg laying, the females, and sometimes the males, fall to the surface of the water as "spinners" and are taken by feeding trout.

4 - Stone Fly Nymph - The stone fly nymph is the aquatic stage of the stone fly. They are often swept loose from the rocks and are eagerly snapped up by feeding trout while they drift along.

4a - Adult Stone Fly - As stone fly nymphs near maturity, they move to the edge of the stream and crawl out on rocks or structures where they hatch into adults. After mating the female deposits her eggs by either dropping them from just above the water surface, dipping the tip of her abdomen into the water, or crawling down rocks into the water, all of which exposes her to trout.

5 - Midge Larva - The midge larva is the aquatic stage of a tiny insect called a Chironomid. Midges are quite prolific; they hatch out in the millions and provide a good food source for trout. In streams midges are often very tiny, but in lakes are usually larger.

5a - Adult Midge - This small flying insect looks like a mosquito, but doesn't bite. After swimming to the surface and hatching from the pupa stage, the adult midge sits on the water prior to becoming airborne and searching for a mate. It is during these swimming, hatching and resting stages that it is available to trout, who sip them in by the hundreds.

Terrestrial Insects - Shown are only a few of the many terrestrial animals that are available to trout as a food source. Terrestrial animals are those which spend their lives above the water. Other examples might be bees, beetles or butterflies. Terrestrial insects fall or are blown into the water from adjacent grasses, trees or rocks.

6 - Grasshoppers - These sometimes get blown by summer winds, or hop or fly accidentally into a stream or lake, where they become a big, tasty treat for trout.

7 - Spiders - Although not insects, these arachnids sometimes find themselves on a trout's menu. They often migrate by spinning a length of spider silk and drifting on air currents. Sometimes these migrations carry the spider out over water and into the path of a feeding trout.

8 - Ants - Many types of ants undergo a flying stage and migrate in large swarms. These swarming ants are poor flyers and often find themselves in the water. Trout are quick to take advantage of these sources of food. Winds blowing up a mountain during spring or summer will often lift these light insects into the air, then deposit them on lakes or in mountain streams.

Mollusks - Mollusks are soft bodied animals with an internal or external shell. The name of the phylum is derived from Latin word molluscus meaning soft. Examples of mollusks are snails, clams, slugs and octopus.

9 - Snails - Snails are most available to trout as they drift in the surface film. They will generate a bubble of air inside their shells which buoys them to the surface where they are dispersed by the movement of

current and wind. Drifting snails eat the algae and plankton that concentrate in the surface film.

Crustaceans - Members of the crustacean family are arthropods that have an exoskeleton which they need to molt (shed) in order to grow. Examples of crustaceans are crayfish, scuds, shrimp and lobsters.

10 - Scuds - Scuds are aquatic arthropods that spend their entire life in the water. They are distantly related to the common "pill bugs" often found in gardens.

11 - Crayfish - Crayfish are a big meal for a hungry trout. These crustaceans are normally protected by a hard outer shell called an exoskeleton. They have to shed this hard exoskeleton periodically in order to grow. During the time it takes the new shell to harden they become easy prey for a hungry trout.

Amphibians - Most amphibians lay their eggs in water. When the young hatch they undergo a metamorphosis from juveniles with gills to adults that breathe air. Examples are frogs, toads and salamanders.

12 - Tadpoles - These aquatic animals are the larva of frogs. They are commonly called tadpoles or pollywogs. They have gills and tails to allow them to mature in an aquatic environment. Within one to two years they lose their tails, grow legs and develop into frogs.

12a - Frogs - The skin of the frog is permeable and very sensitive to any toxic substances in their water. In the spring, rising water signals frogs to lay their eggs which become millions of tadpoles, a trout feast.

Fish - Trout will consume any small fish they can catch, including their own young.

13Trout Fry - Because they are carnivorous, adult trout are also sometimes cannibalistic, and will eat their own fry if they find them. The fry's only defense is to hide among algae or structure in the stream. Adult trout will also eat eggs from other spawning trout which have been washed out of the spawning areas. These spawning areas are called redds.

Journal Entry

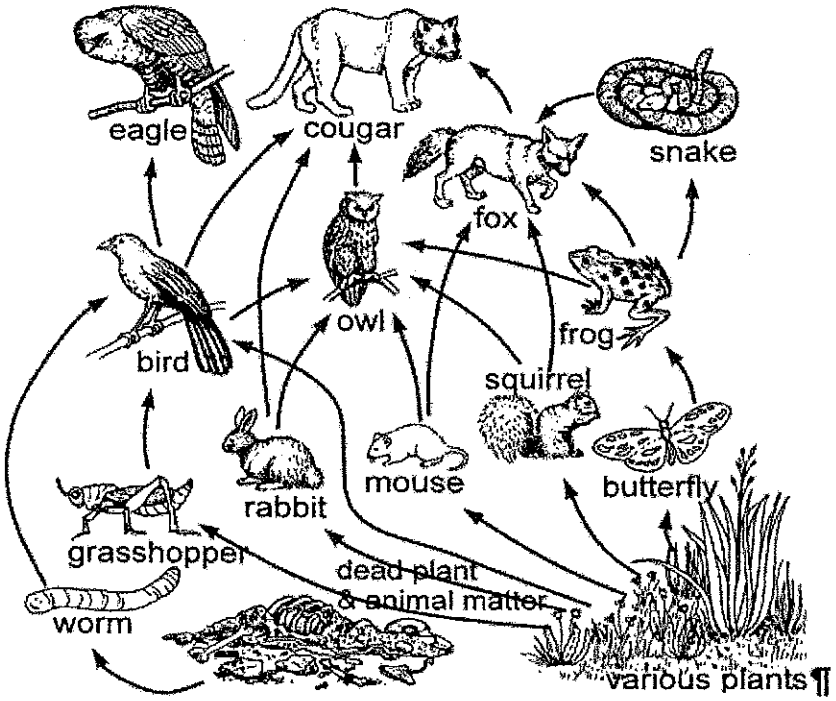
Date: _____

Topic

Prompt:

Food Web Task Card Activity

Study the diagram below before answering the task cards.



Task Card #	Answer	Task Card #	Answer
1		13	
2		14	
3		15	
4		16	
5		17	
6		18	
7		19	
8		20	
9		21	
10		22	
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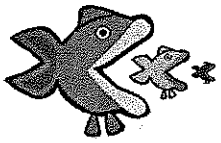
12		24	



Name: _____

Date: _____

YOU AND FOOD CHAINS

ASSIGNMENT

ASSIGNMENT OBJECTIVE

To analyze your meals in order to make a map of all the food chains that connect you to your meals.

INTRODUCTION

Humans are consumers. No consumer can survive without eating other living things. Every day we have breakfast, lunch and dinner and eat numerous numbers of organisms during these meals though we barely stop to think about them. The vegetables and fruits you eat are made from plants. Any animal or animal products you eat are made from animals AND the plants or animals they ate in order to make their own bodies. By eating these organisms we become links in many food chains.

INSTRUCTIONS

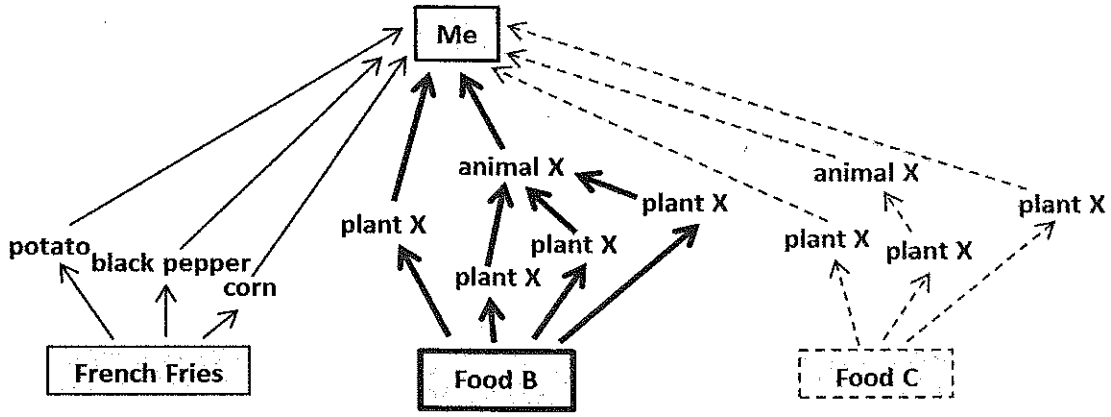
1. FOOD LIST Make a list of all the **food** – including the **drinks** – you ate in your *last two meals*. Choose 3 of these foods (e.g. tandoori chicken with rice, Greek salad and strawberry smoothie). **Do not choose highly processed foods** (e.g. candy bars, sodas, store bought cookies). Choose only foods made primarily from whole ingredients that you can recognize.

2. FOOD SOURCE CHART For each food (e.g. French fries), make a food source chart to list all of the plant and animals sources that went into making the food (e.g. potatoes, black pepper and corn – include corn because of the corn oil used to fry the potatoes but leave out the salt because it does not come from a living source). By the way, you cannot use French fries as one of your foods.

Example: Food Source Charts

Food 1: *French fries*		**Food 2:**		**Food 3:**	
Plant Source	Animal Source	Plant Source	Animal Source	Plant Source	Animal Source
potato					
corn					
black pepper					

3. <u>FOOD CHAINS MAP</u> After making your charts, make a personal food chains map to link your foods to you using food chains constructed from the food sources you listed in your chart. Remember, for the animals that you eat, you will have to include their food sources as well. Below is an example to guide you. Draw each group of food chains from one food in a different color than the group of food chains from the other foods. Your food chains map should be organized like the one below, though it will probably look much more complicated.



Example: Food Chains Map

DISCUSSION QUESTIONS

Complete the following discussion questions and hand them in with your food chain charts and food chain maps.

a) What types of organisms are at the start of every food chain?
b) Are you mostly a primary consumer, or a secondary consumer? Explain your answer.
c) In your food choices, were you ever a tertiary consumer? If your answer is yes, explain in what situation this was the case. If your answer is no, then propose a food source that would make you a tertiary consumer if you were to eat it.
d) Explain this statement using your knowledge of food chains: *"Humans are powered by the Sun."*
e) Explain this statement using your knowledge of food chains: *"It is more energetically efficient for humans to be vegetarians than for them to eat meat in their diet."*

CHOCOLATE BAR EXTRA CREDIT BONUS

1. Choose a chocolate bar to analyze. Make sure to keep the wrapper clean and in good condition.

2. Make a **<u>Food Source Chart</u>** for as many of the ingredients in the chocolate bar as possible. Some of the ingredients will be unfamiliar to you. In order to know what plant or animal source they come from you will have to do some research. Some ingredients sound like chemical names, but may still come from a plant or animal source (e.g. lecithin is an emulsifying substance that comes from the soy beans of the soy bean plant). Some other ingredients with unfamiliar names will be entirely synthetic or not come from any animal or plant source (e.g. salt). Only your research will allow you to know the difference.

3. Make a **<u>Food Chain Map</u>** to show how all the plant and animal sources in the chocolate bar lead to you. **Note:** Include the chocolate bar wrapper in your report. Make sure the ingredients list on the wrapper is facing up and clearly visible.

FOOD WEB BUILDING

ACTIVITY

ACTIVITY OBJECTIVE

To construct a food web using what you know about producers and the different types of consumers found in ecosystems.

INTRODUCTION

You have learned about **food chains**, however, in a real **ecosystem**, there are always many food chains which are all interconnected. Members of one food chain will be a part of another food chain, thus creating a **food web**. Decomposers are essential in cycling all the nutrients from organisms back to the plants. The Sun is the source of energy for all the plants that are the basis of the vast majority of terrestrial food webs.

MATERIALS PER GROUP

- **this handout**
- **2-3 pair of scissors**
- **1 pencil and eraser**
- **1 large piece of construction paper**
- **1 markers**
- **1 glue**

PROCEDURE

1. Before you start, read the following steps of the procedure and then turn over the page and carefully look over the rubric Mrs. L will give you.
2. Collect all the materials in the list above except for the glue stick and marker.
3. Cut out each of the diagrams on the following piece of paper given to your by Mrs. L.
4. Arrange the diagrams into a food web on the construction paper. Leave room for a title at the top of the paper. Put the producers on the bottom, and anything you think may be a top carnivore on top. Think carefully about the role of the Sun during your arrangement of the pieces.
5. **Using pencil, draw arrows** to connect the members of your food web (remember the tip of the arrow always points towards the organism doing the eating or the direction of the flow of energy). Start with one food chain at a time. Remember to include the Sun and connect it to the food web with arrows. You may have to rearrange and erase some of your lines if you think a different combination of food chains makes more sense.

6. Once you have come up with a final draft of your food web, you should call your teacher over to check it out. **Glue down** your diagrams and darken your arrows with a **marker**.
7. Come up with a **title** for your food web and put it on the top of the paper.
8. Put your **names** and the **date** at the bottom right-hand corner before handing in your assignment to the teacher.
9. Attach the rubric at the back of this page to the back of your food web. Be sure to write the names of the members of your group at the top of the rubric.

Group member names:

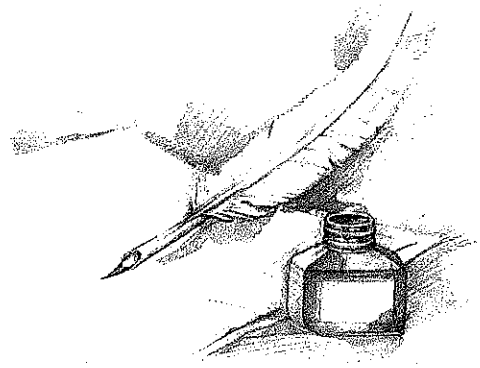
_____

Date submitted: _____

FOOD WEB BUILDING ACTIVITY – Sample Rubric

CRITERIA	MARKS			
Correct Food Web Connections (8 marks)				
• The Sun is connected to the right places.	0	1		
• Producers form the basis of the food web.	0	1		
• The connections linking producers and primary consumers are accurate.	0	1	2	
• The connections linking different consumers to each other are accurate.	0	1	2	3
• Top carnivores are correctly positioned.	0	1		
Presentation (7 marks)				
• The pieces have been cut out neatly.	0	1		
• The pieces are glued down firmly.	0	1	2	
• Neatly drawn arrows connect members of the food web clearly.	0	1		
• The food web components are evenly spaced apart.	0	1	2	
• A neatly drawn and eye catching title is included.	0	1		

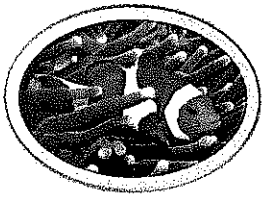
Journal Entry



Date: _____

Topic

Prompt:



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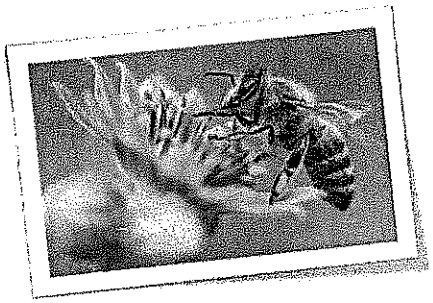
Date: _____

BIOTIC INTERACTIONS

BIOTIC INTERACTIONS

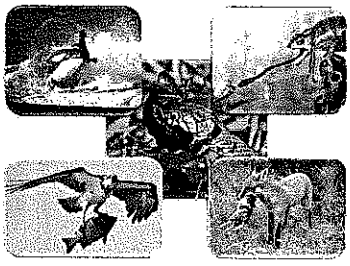
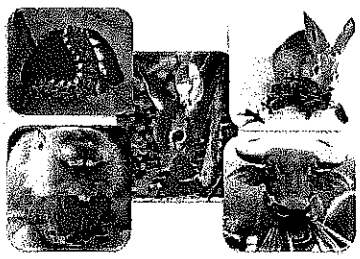
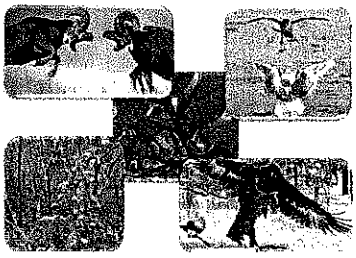


1. What is a **biotic interaction?**

2. What are the **4 types of biotic interactions?**

4 TYPES OF BIOTIC INTERACTIONS

3. **Fill in the Chart** below.

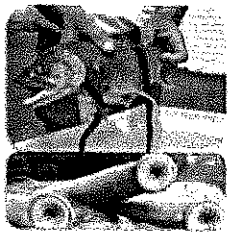
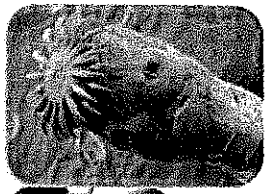
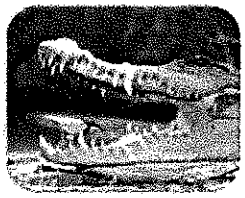
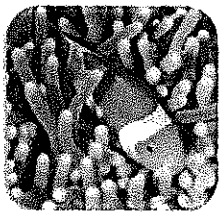
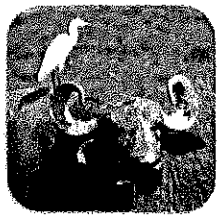
Type of Biotic Interaction			
Definition			
Who benefits, is harmed or is unaffected?			
Examples			

4. The fourth type of biotic interaction is called SYMBIOSIS. **Define symbiosis.**

5. What are the **three types of symbiosis**?

3 TYPES OF SYMBIOSIS

6. **Fill in the Chart** below.

Type of Symbiosis			
Definition			
Who benefits, is harmed or is unaffected?			
Examples	   	   	   

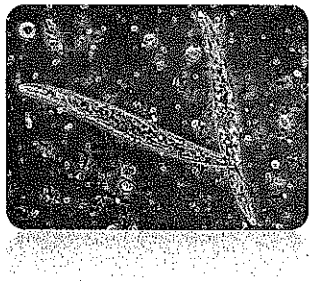
Name: _____ Date: _____

THE WATER CYCLE

THE IMPORTANCE OF WATER

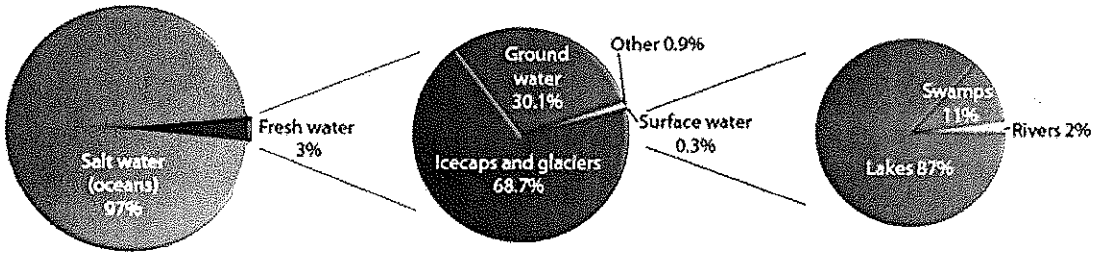
1. How much of the Earth is covered in water?

2. What is special about Earth's aquatic ecosystems?



3. What is phytoplankton and why is it important?

THE DISTRIBUTION OF EARTH'S WATER

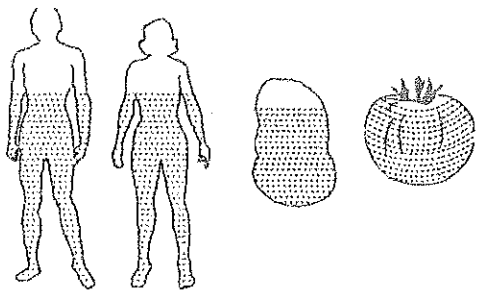


Earth's total water | Freshwater | Surface water

4. What is the distribution of the salt water and fresh water on this planet?

5. How much fresh water is easily available to be used?

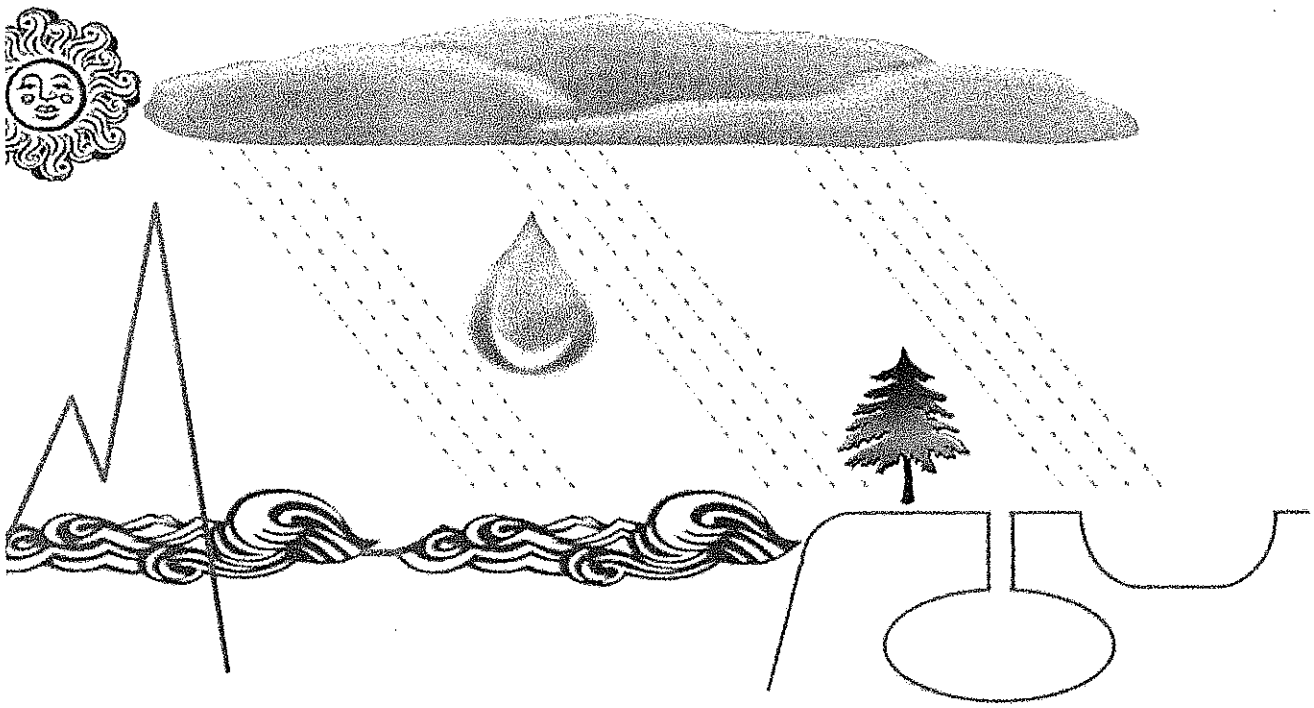
WATER WITHIN LIVING THINGS



6. How much water is found in each of the following organisms?
   a) human ___ %
   b) potato ___ %
   c) tomato ___ %

THE WATER CYCLE DIAGRAM

7. **Label** the components and processes in the **water cycle diagram** below.



8. What is a **glacier**?

9. What is an **iceberg**? Describe one interesting fact about icebergs.

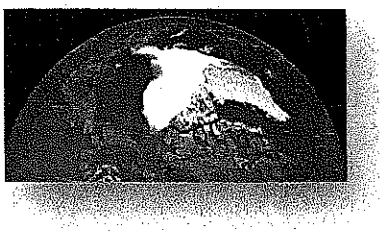
10. What is an **aquifer**? Describe two ways the water from aquifers can be accessed.

2. Define each of the following **processes** in the water cycle and answer the questions for the processes.

Processes	Definitions and Questions
a) evaporation	*Definition:*
b) melting	*Definition:*
c) freezing	*Definition:*

Processes	Definitions and Questions
d) sublimation	*Definition:* • How is wet laundry able to dry outside in the winter time?
e) deposition	*Definition:*
f) condensation	*Definition:* • Why can you see your breath in the winter time but not in the summer time?
g) transpiration	*Definition:* • How is transpiration involved in cloud formation?
h) precipitation	*Definition:* • Which form of precipitation is the largest?
i) percolation	*Definition:* • How would deforestation effect percolation?
j) run-off	*Definition:* • *What are three destructive effects of run-off?*

HUMAN IMPACT ON THE WATER CYCLE



GLOBAL WARMING

3. What is **global warming**?

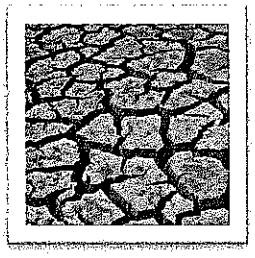
4. How do the melting icecaps and glaciers lead to **more global warming**?

5. How do the melting icecaps and glaciers lead to a change in **ocean currents**?

DEFORESTATION

6. What is **deforestation**?

7. What effect does deforestation have in **drier climates**?



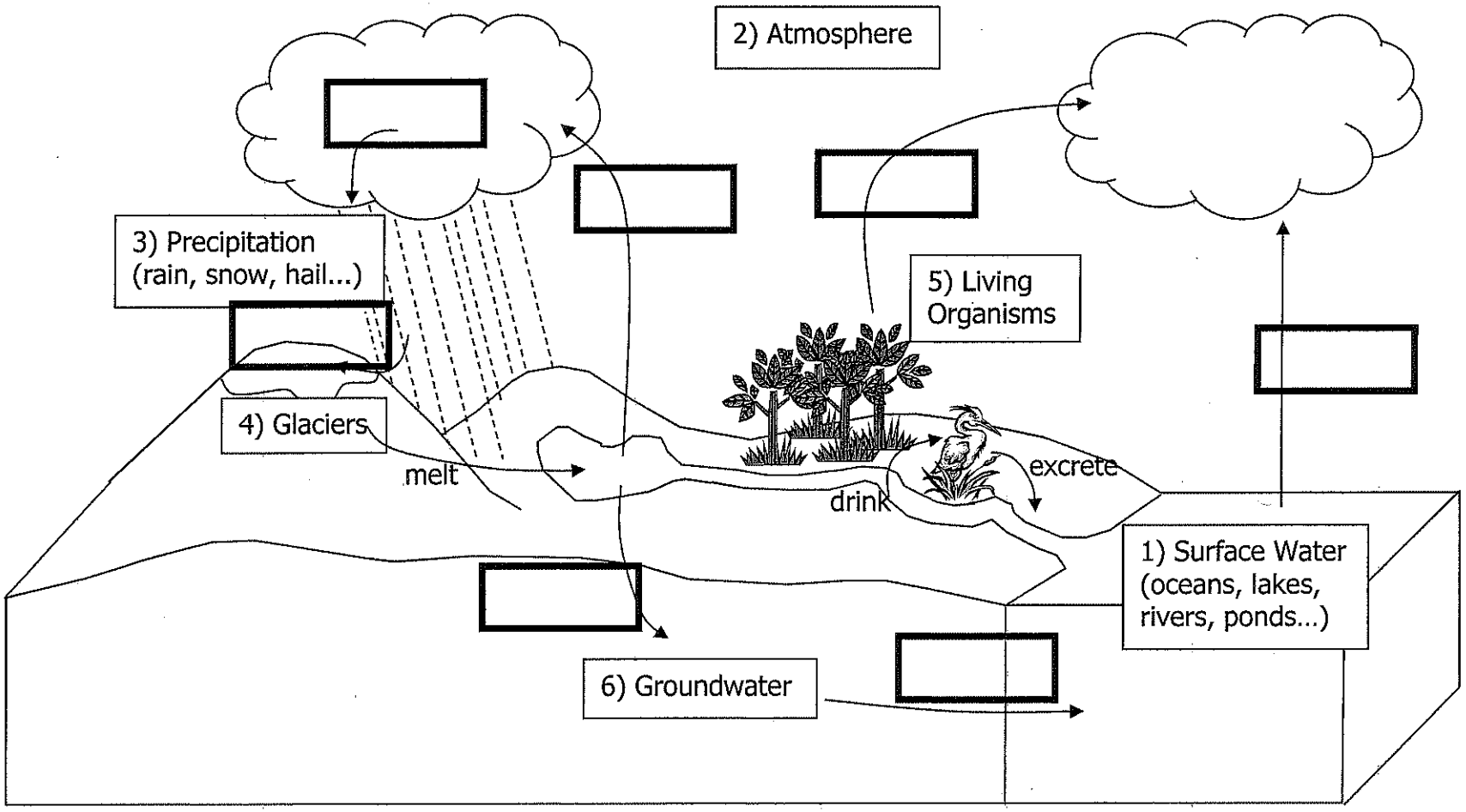
8. What effect does deforestation have in **wetter climates**?

CLIMATE CHANGE

9. What is **climate change**?

10. Describe <u>two ways</u> that climate change can affect **precipitation.**

The Water Cycle:



Journal Entry

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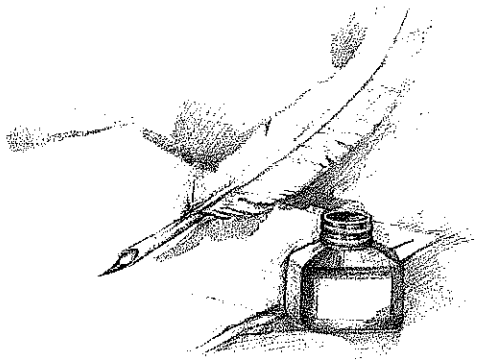


Topic

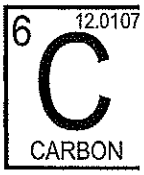
Prompt:

Name: _____ Date: _____

THE CARBON CYCLE

CARBON AS A CYCLE

1. Carbon needs to be _____ through the different components of our environment. It needs to be cycled through the living components as well as the non-living components.
   a) What is another term that means *"living"*? _____
   b) What is another term that means *"non-living"*? _____



2. Why is the carbon cycle a BIOGEOCHEMICAL cycle?

3. Why is carbon important to living things?

4. What are all living things on Earth called? _____

CARBON RESERVOIRS

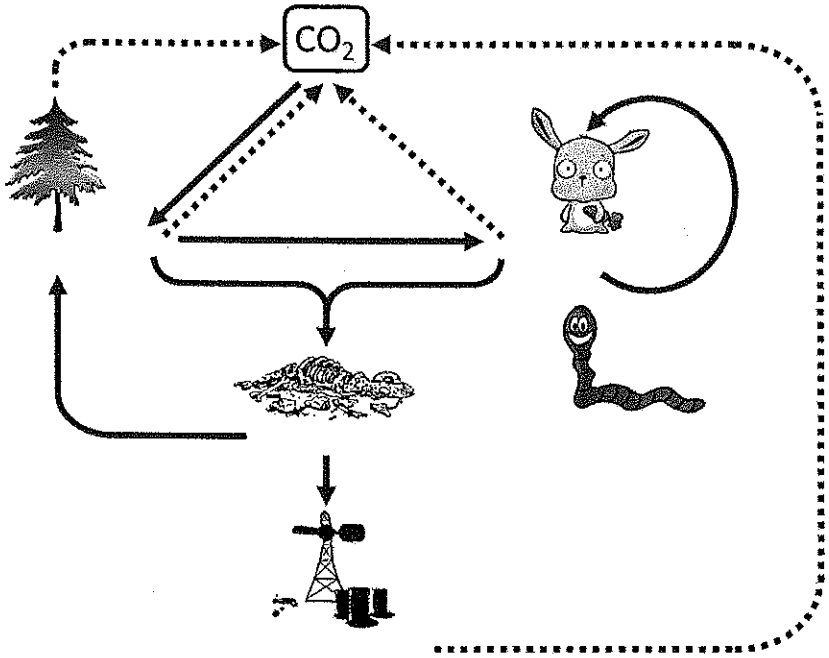
5. What is a *carbon reservoir*?

6. **Describe** where each of the following sources of carbon can be found.

	Process	Description
Abiotic	1) Carbon Dioxide (CO_2)	
	2) Carbonate (CO_3^{2-}) Bicarbonate (HCO_3^-)	
	3) Calcium Carbonate	
	4) Carbon in molecules of once living things.	
Biotic	5) Carbon in molecules of living things.	

THE CARBON CYCLE

7. **Label** the *components* of the carbon cycle in the diagram. In the chart below the diagram, write a description of the components.

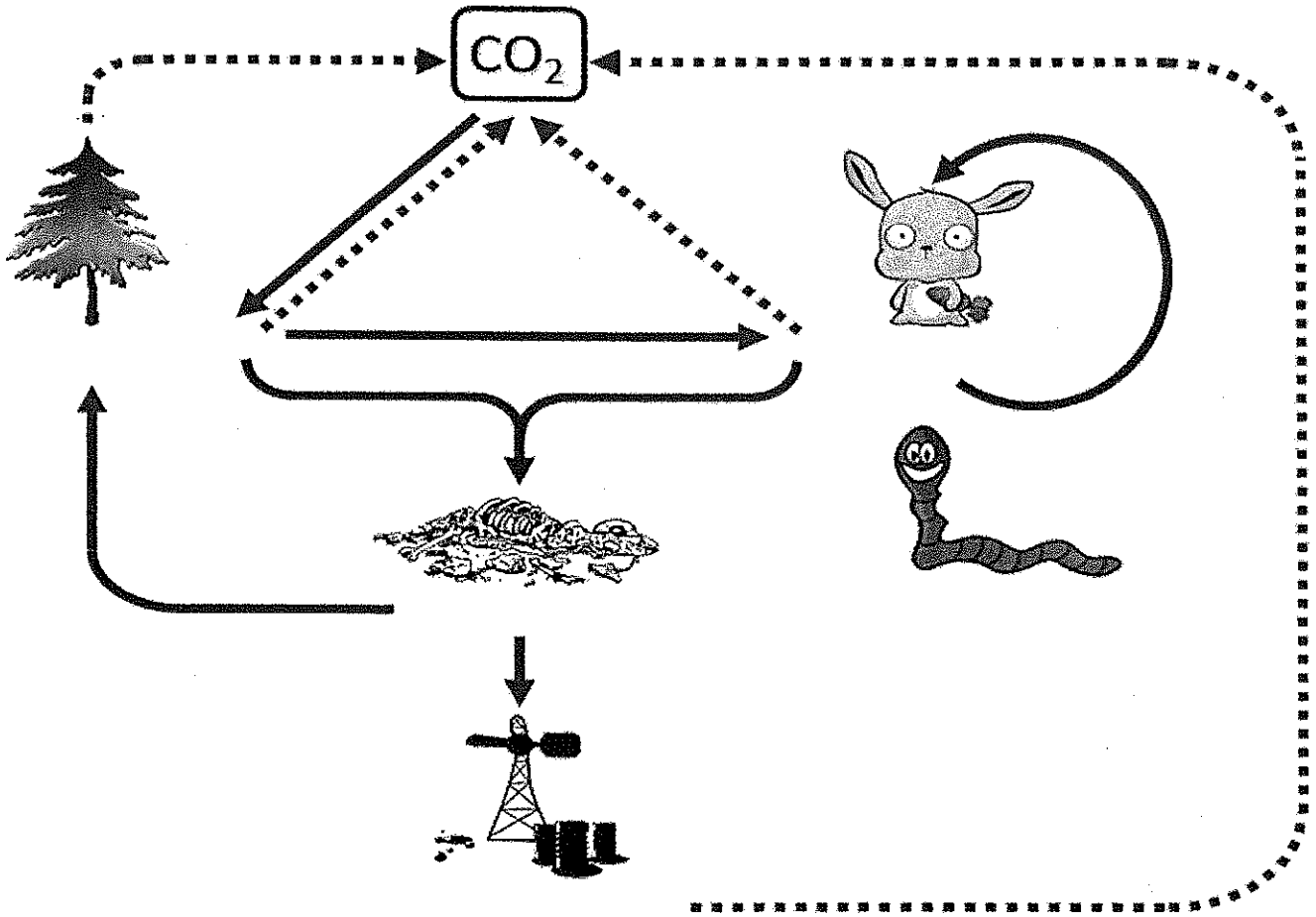


COMPONENTS	DESCRIPTION
Carbon dioxide	
	Describe how carbon dioxide increases the greenhouse effect.
Producers, Consumers, Decomposers	
Detritus	
Fossil Fuels	

8. Name all the *short-term* carbon reservoirs. _____

9. Name all the *long-term* carbon reservoirs. _____

10. **Label** the *components* of the carbon cycle in the diagram like you did before. Now label the *processes* in the carbon cycle as well.



PHOTOSYNTHESIS

11. What types of *organisms* performs photosynthesis? _____

12. What is the function of *chlorophyll* in photosynthesis?

13. Write the *chemical equation* for photosynthesis.

14. What is the *glucose* used for?

15. What happens to the *oxygen* produced in photosynthesis?

CELLULAR RESPIRATION

16. What types of *organisms* perform cellular respiration? _____

17. Write the *chemical equation* for cellular respiration.

18. What is the *energy* used for?

19. What happens to the *carbon dioxide* and why?

20. What happens to the *water*?

ASSIMILATION

21. Describe what happens during the *assimilation* of carbon.

DEATH AND DECOMPOSITION

22. What are the two components of *detritus*?

23. What are the two different paths that detritus can take?

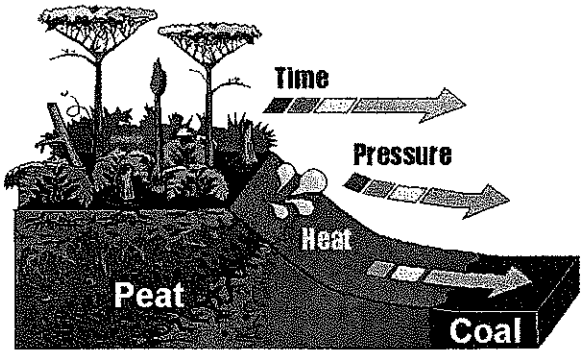
    1)

    2)

FOSSILIZATION

24. What does *fossilization* involve?

25. How is *peat* and *coal* formed?



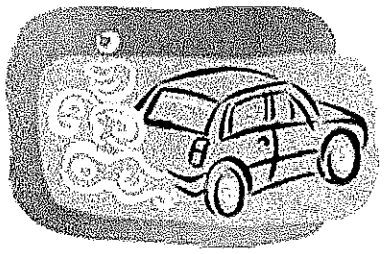
1)

2)

3)

26. What are the main differences between how peat and coal are formed and how *petroleum* and *natural gas* are formed?

COMBUSTION

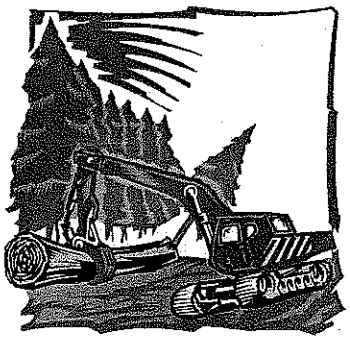


27. What does combustion involve?

28. Where does the majority of human generated combustion come from?

29. What effect does combustion have on our planet?

DEFORESTATION



30. What does *deforestation* involve?

31. How does deforestation indirectly lead to an increase in carbon dioxide in the atmosphere?

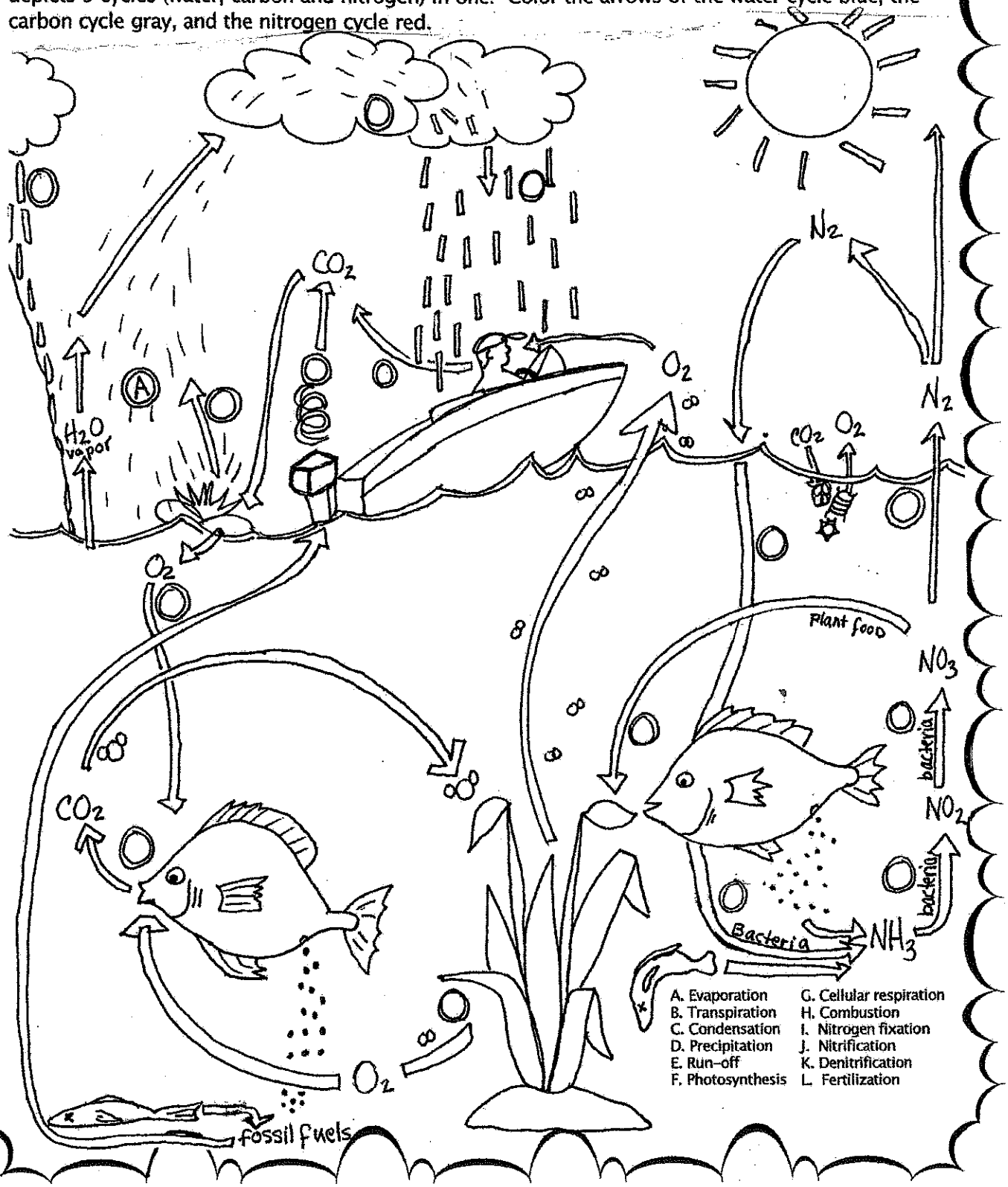
32. Name the three processes that lead to an increase in atmospheric carbon dioxide.

33. What is the only process that removes carbon dioxide from the atmosphere? _____

Biogeochemical Cycle Worksheet

name: _____ Period: ____

Directions: Use the key at the bottom to place the correct letters in the diagram below which depicts 3 cycles (water, carbon and nitrogen) in one! Color the arrows of the water cycle blue, the carbon cycle gray, and the nitrogen cycle red.



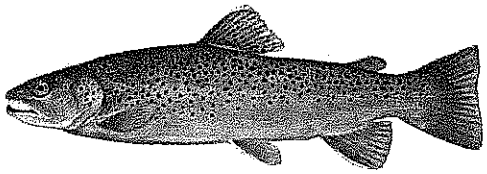
Journal Entry

Date: _____

Topic

Prompt:

Name that Fish



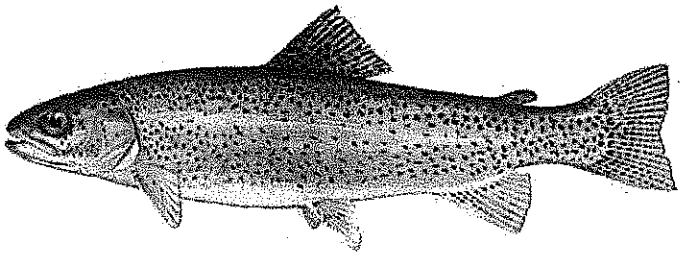
You and your classmates have been learning about the fish found in cold water streams in Maryland, especially trout. You will be taking a field trip to a stream in the Spring. How will you be able to identify the different fish you might see there? You really want to know how to tell the various species of trout apart. When you ask your Mrs. L. how you can do this, she tells you - a dichotomous key is the answer.

She explains that a dichotomous key is a way of identifying living things by looking at different characteristics. "Dichotomous" simply means "divided into two parts". Remember that from your Greek Roots? At each step in a dichotomous key you will have two choices; you will have to decide which choice best describes the fish you are trying to identify. Your decision will determine your next step.

How to use the dichotomous key:

- Before beginning, you will need to review external fish anatomy, especially the names of the fins.
- Start with the first fish. Using the key, read the first pair of statements. You will have to decide whether you think the fish has one dorsal fin or two. Once you have decided, follow the dotted line to the right to find a new number.
- Go back to the left side until you find the correct number. Again, you will have to make a decision and then follow the dotted line to the right until you find a new number or name of a fish.
    - If you see another number, go to the pair of steps with that number and continue making choices until you have identified the fish.
    - If you find the name of a fish, you have identified the fish.
- Repeat the process until you have identified all nine fish.

Dichotomous Key for Cold Water Game Fish



1a. Fish has one dorsal fin.....2
1b. Forked two dorsal fins.....4

2a. Fish is spotted.....northern pike
2b. Fish is striped.....3

3a. Fish has dark stripes.....tiger muskie
3b. Fish has light stripes.....muskellunge

4a. Fish does not have spots.....5
4b. Fish has spots.....6

5a. Fish has large first dorsal fin.....walleye
5b. Fish has large second dorsal fin.....largemouth bass

6a. Fish has light spots.....brook trout
6b. Fish has dark spots.....7

7a. Fish has more spots near or on tail.....cutthroat trout
7b. Fish does not have more spots on or near tail.....8

8a. Fish has light area in middle.....rainbow trout
8b. Fish does not have light area in middle.....brown trout

Name that fish:

#1 –

#2 –

#3 –

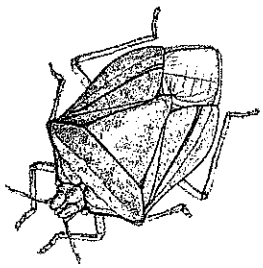
#4 –

#5 -

#7 -

#8 -

#9 -



Invasive Species – Trout vs. Aliens?

1. What do you think an "invasive" species is?

2. What is the difference between a native, non-native, and invasive species?

Native:

Non-native:

Invasive:

3. What do you know about a Stink Bug?

Research: You will be investigating this topic by choosing an "alien" species and answering these questions. Once your research is completed, chose a way to present your findings.

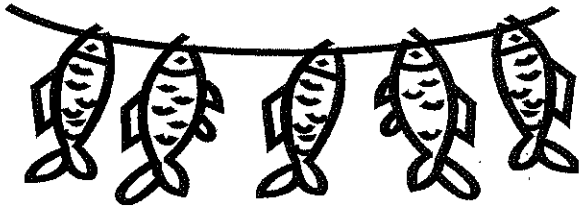
Questions to answer:

- Name of the organism
- Description (What is it?)
- Where did it originate? (Native region)
- How did it get to this country?
- Has it reached Maryland?
- What impact might this organism have on the trout population?
- Is this an invasive or just a non-native organism?
    - Why?
    - Can it be prevented?

Project Choices:

1. PowerPoint presentation
2. Poster talk
3. Rap Song
4. Prepare a handout or brochure
5. Interactive presentation - hands on

Gone Fishin'



Number of Fish Remaining

	Year 1	Year 2	Year 3	Year 4
Goldfish				
M&Ms				
Peanuts				
Peanut M&Ms				

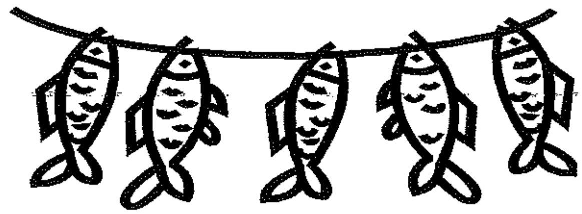
My Catch

	# Value	# Value	# Value	# Value
Goldfish ($3)				
M&Ms ($5)				
Peanuts ($5)				
Peanut M&Ms ($10)				

Other Fisher-people's Income

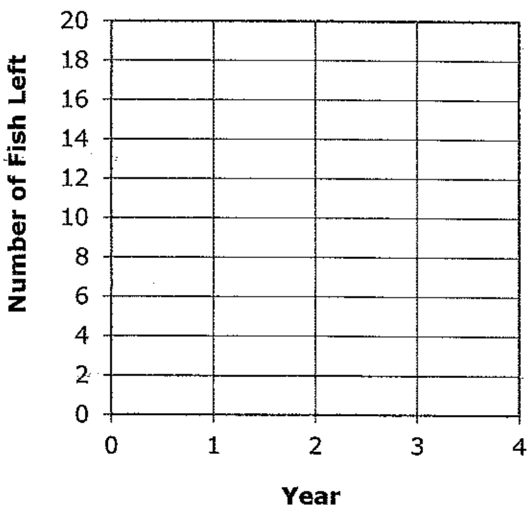
Names	Income Year 1	Income Year 2	Income Year 3	Income Year 4
My Total Income				
_____'s Income				
_____'s Income				
_____'s Income				
Ocean Total Income				

Gone Fishin'

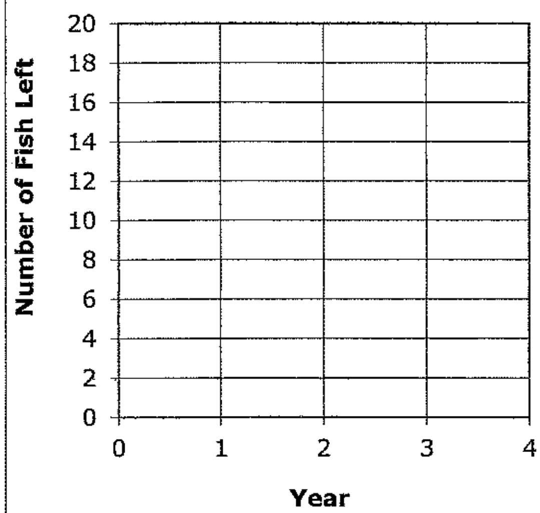


1) Below, graph the number of fish of each species over the 4 fishing seasons.

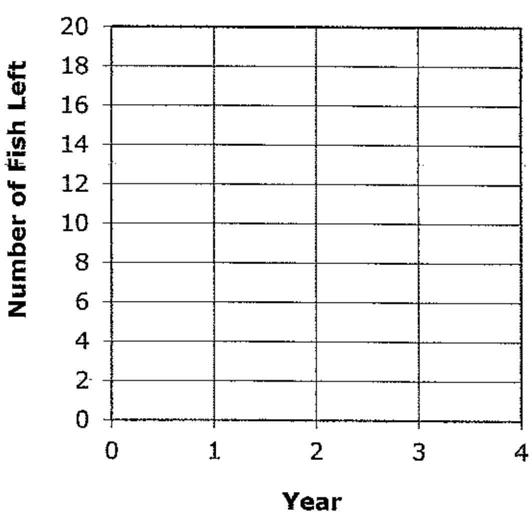
Fish: ________________



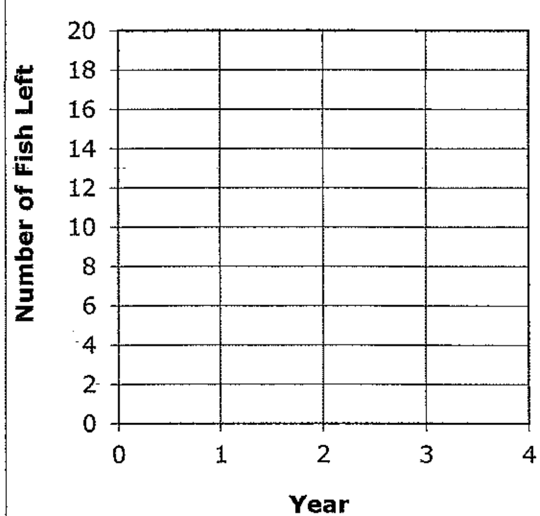
Fish: ________________



Fish: ________________



Fish: ________________



2) Describe how the fish population changes over the 4 fishing seasons.

3) Did your fishing group talk about the strategy that would be taken during each harvest? What strategies did you discuss? What strategies did you choose?

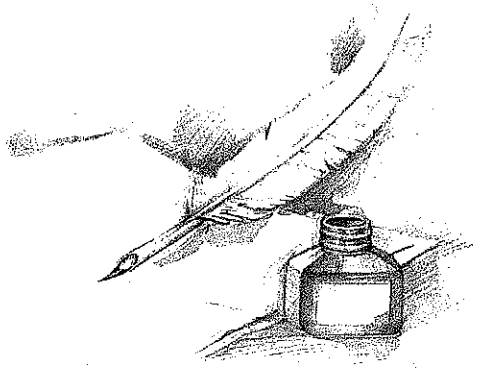
4) Compared to other groups, was your group successful in preventing the collapse of your fishery? Why or why not?

5) From a mathematical standpoint, which strategy for harvesting fish (or other common resource) is the best?

6) Why do you think there are rules about hunting and fishing? From your point of view, what should be the goal of these regulations?

Journal Entry

Date: _____



Topic

Prompt:

Caring for Our Trout - Group Tasks

All Students:

- Always wash your hands with plain water and dry them before putting your hands in the tank. Fish can die from:
  - Lotions/Creams
  - Chlorine residue on your hands from our school water
  - Jewelry contamination
- If you have a cut or bandage on your hand, have someone else in the group immerse their hands for cleaning
- NEVER put anything into the tank. Even a penny can kill the fish.
- Use goggles when doing your fish jobs.
- Wash your hands with soap and water after your fish duties.
- We will lose fish or eggs. This is natural. They must be removed and discarded in the trash.
- Dead or diseased fish can infect the entire tank. Observe carefully and remove what is obviously not healthy
- Feed carefully. More is not better. Overfeeding can lead to dangerous spikes in the ammonia levels in the tank water.
- Measure food before feeding. The fish should eat all their food within 5 minutes of feeding. If not, it is too much.
- **Water testing is vital** - make sure you use the appropriate "drops" and turn the bottle upside down so drops are the same size.
- Never get testing chemicals near the tank.
- All testing materials should be thoroughly washed and dried after use.
- **NEVER** use water straight from the tap anywhere around the fish. Always use water that has been treated and de-chlorinated.
- Any problems or questions, contact Mrs. L. right away.
- The health of the fish is your responsibility. Keep accurate records when it is your turn to care for them.

Daily (Monday thru Friday)

1. Check digital temperature of tank and record it. Average temperature should be 52-55°.
2. Feed the trout. (After eggs have hatched and the alevin begin swimming to the top of the breeder basket.)
3. Remove and dead fish or debris with either the "turkey baster" or blue net.
4. Perform the following tests of the water chemistry and record readings:
    - Ammonia
    - pH
    - nitrites
    - nitrates
5. Make sure filter is working freely with no debris or fish stuck in the intake point
6. Check for leaks in the hoses, filter, or pump.
7. Observe activity level, "breathing", and color of fish for distress.

Tuesday and Friday

Clean the tank:

a. Remove slime and dirt from the tank sides with a long handled brush
b. Remove dead fish or eggs. Observe and remove sick fish if needed.
c. Siphon through and under gravel to remove waste. Collect this water in a bucket.
d. If needed, change out 2-3 gallons of water on these days. As fish grow, you may need to change up to 5 gallons of de-chlorinated water at a time.

Wednesday - Damaging chemicals causing burns

1. Dissolved Oxygen (DO) Test - must be greater than 5ppm
2. General Hardness Test (GH)
3. Carbonate Hardness (dKH)

Water Tests – Procedures

pH Test – 7.0-7.5

1. Put 5 ml of tank water to the line in a clean testing tube.
2. Add **3 drops** from the **pH Solution** bottle
3. Cap the tube and invert it several times to mix the solution.
4. Holding the tube against a white background, match the color of the solution against the pH chart provided.
5. Record the results in the class log

Ammonia Test- 1ppm

1. Put 5ml of tank water to be tested into a clean testing tube.
2. Add **8 drops** from the **Ammonia Test Solution Bottle #1.**
3. Add **8 drops** from the **Ammonia Test Solution Bottle #2.**
4. Cap the tube and shake vigorously for **5 seconds.**
5. **Wait 5 minutes** for color to change. Timing is important on this one!
6. Hold against a white background and match the color of the solution against the chart.
7. Record the results in the class log.

Nitrite Test – 1.0 ppm

1. Put 5 ml of tank water into a clean testing tube.
2. Add **5 drops** from **the Nitrite Test Solution Bottle #1.**
3. Cap the test tube and shake it vigorously for **5 seconds.** This step is essential. Do not hold your finger over the open end or it will affect the accuracy.
4. Wait **5 minutes** for the color to change. Precise timing is important.
5. Hold the test tube against a white background and match the color of the solution to the chart.
6. Record the results in the class log.

Nitrate Test – 40 ppm

1. Put **5ml** of tank water into the testing tube.
2. Add **10 drops** of **Nitrate Test Solution Bottle #1** to the tube.
3. Cap the tube and tip it upside-down several times to mix the solution.
4. Vigorously shake the **Nitrate Test Solution Bottle #2** for at **least 30 seconds** – EXTREMELY important
5. Add **10 drops** of the **Nitrate Test Solution Bottle #2** to the test tube.
6. Cap the test tube and **shake it vigorously for 1 minute.** This step is extremely important also.
7. Wait **5 minutes** for the color to develop. Hold the test tube against a white background and match the color with the Nitrate Chart.
8. Record your results in the class log.

Carbonate Hardness dKH- 100-150 ppm

1. Fill a clean test tube with 5 ml of tank water.
2. Add **Carbonate Hardness Test Solution, one drop at a time**, holding the dropper bottle upside down for uniformity.
3. After first drop is added, solution will turn blue. If the sample contains only 1° dKH, the solution will turn from clear to its yellow endpoint.
4. Cap the tube and invert several times after each drop. Keep a careful count of drops added.
5. The test is completed when the water in the tube turns from blue to yellow.
6. The Carbonate Hardness value is determined by the number of drops of the reagent that must be added to turn the solution a bright yellow. Each drop = 1° or 17.9 ppm KH

General Hardness Test GH -100-150 ppm

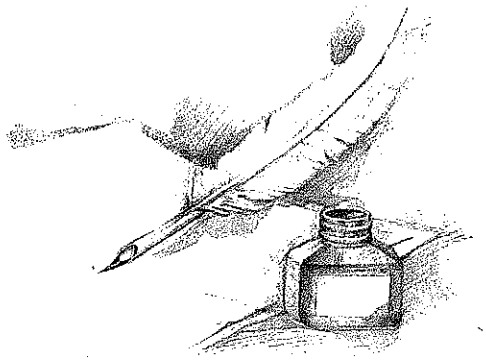
1. Fill a clean test tube with 5ml of tank water.
2. Add **General Hardness Test Solution one drop at a time**. After the first drop is added, the solution will turn orange.
3. Cap the tube and invert several times after each drop. Count the number of drops added.
4. The test is completed when the water turns from orange to green.
5. Record the number of drops of reagent that were added to produce a green color.

Dissolved Oxygen Test

1. Fill the test vial with 15 ml of tank water.
2. **Add 5 drops of Bottle #1.**
3. **Add 5 drops of Bottle #2.**
4. Press the lid immediately onto the vial and turn the vial ONCE upside down and back again.
5. Leave the vial to stand for **30 seconds.**
6. Remove the lid. **Add 5 drops from Bottle #3.**
7. Press the lid immediately onto the vial and turn the vial TWICE upside down and back again.
8. Hold the vial and color scale vertically and match the coloring of the test solution to the scale.
9. Record your reading in the class log.

Journal Entry

Date: _____



Topic

Prompt: