

Earth Systems, an Earth Science Course

Abstract:

The following collection contains assignments and analysis for an Open Source Earth Science course for grades 9 - 10. The collection has been prepared from resources contributed by teachers and partner educational organizations on Curriki, an online community for creating and sharing open source curricula.

The Open Source Earth Science course has been organized to meet the CA Science Standards for Earth Sciences in grades 9 - 10, as adopted by the California State Board of Education. This course is part of a set of collections that contain additional Earth Science resources on Curriki that can be accessed at www.curriki.org

This open source textbook and additional resources have been carefully collected into an Earth Science group on Curriki - CLRN - Open Source Earth Science Course. You can access these resources by joining Curriki at → <https://www.curriki.org/xwiki/bin/view/Main/JoinCurriki>

Once a member you can access and join the group, **CLRN- Open Source Earth Science Course** at→

http://www.curriki.org/xwiki/bin/view/Group_CLRN-OpenSourceEarthScienceCourse/

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Curriki is an online environment created to support the development and free distribution of world-class educational materials to anyone who needs them. Our name is a play on the combination of 'curriculum' and 'wiki' which is the technology we're using to make education universally accessible.

Curriki is built on the XWiki platform, an open source development platform and "Next Generation Wiki" application developed in Java and released the LGPL open source license.

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INTRODUCTION TO EARTH SYSTEMS COURSE
GRADES: 9-10 / AGES: 14-16
SUBJECT: EARTH SCIENCE

SYLLABUS

Ninth Grade Integrated Science focuses on the theme of "Earth Systems." Earth, physical, space, and life science content are integrated in a curriculum with two primary goals.

Special emphasis in the Core is given to the effects of biological processes on Earth systems. Three major concepts underlying the operation of Earth systems may be summarized as matter cycles, energy flows, and life webs. The web of life is intertwined with Earth's energy flows and matter cycles. Emphasis is placed on the inter-connections among Earth's systems and on understanding how alterations in one part may affect the system as a whole.

This course consists of seven units, each with several assignments. You can find the introductory material for each unit by clicking on the "course materials" button. You can also find the assignments for each unit by clicking on the "assignments" button.

Quarter 1

1.1 “GETTING TO KNOW YOU”

Hi! Your first assignment is to introduce yourself to me I want to know who you are and what you like. But wait!! I don't want you to tell me. I want to hear what your pet would say about you. Introduce yourself through the eyes of your pet. That's right! Give voice to your pet and let him/her introduce you to me. If your pet could talk, what would it say about you? Tell me! If you do not have a pet, let your room introduce you. You can include information about where you live, your school and schooling, and what your personal interests and hobbies are.

Let me introduce myself through the eyes of my chickens.

There you have it: The Teacher as seen through the eyes of her chickens. I taught high school biology for five years. Now I teach this online Earth Systems course. I love to run, read, and haul hot water to the chickens. Most of all I love my adorable husband and four charming children.

I look forward to working with you,
The Teacher

Assignment:

1. Write a paragraph introducing yourself through the eyes of your pet (or your room if you do not have a pet.)
2. Be sure to label your assignment (Assignment 1.1) and put your first and last name on it.
3. Submit your assignment.
4. Have a great day!!

1.2 STAYING ON COURSE!!

Assignment 1.2

Have you ever noticed that every teacher has different rules and expectations? It is so easy to get confused and “off course” when trying to navigate different classes in this “river” we call the Electronic High School. This assignment is designed to help you “stay on course” in Earth Systems.

Assignment:

1. What is the name of the textbook for the course?
 - a. Earth Systems Science
 - b. Getting to Know the Earth as a System
 - c. Eating Elephants for Energy
 - d. There is no official textbook.

2. During this Earth Systems science course, I will be:
 - a. Taking field trips
 - b. Doing experiments
 - c. Reading and writing
 - d. All of the above

3. In order to receive credit, I must:
 - a. Do all of the assignments. I will not receive credit unless I satisfactorily complete ALL of the assignments.
 - b. Earn at least 60% of the possible points.
 - c. Send The Teacher chocolate.
 - d. Complete as many assignments as I need to in order to earn the grade that I want.

4. All assignments are labeled. Assignment 1.4 means:
 - a. First quarter, fourth assignment
 - b. Fourth quarter, first assignment
 - c. Fourth inning of the first game in the play-offs
 - d. Part four of assignment one

5. To find out my grades, I:
 - a. Click on Student Tools on the left side bar and then click on “My grades”.
 - b. Click on Information on the left side bar and then enter my name.
 - c. Email The Teacher and ask her to look up my grade.
 - d. Click on Groups, enter my name, and then record whatever grade I think that I earned on the assignment.

6. To submit an assignment, I:
 - a. Email the assignment to The Teacher at address provided by instructor
 - b. Send the assignment to the office.
 - c. Give the assignment to one of the science teachers at my school.
 - d. Decide not to do the assignment and tell The Teacher that I sent it to her but it must have got lost in cyber space.

7. If I submit an assignment that is incomplete or unacceptable, then The Teacher will:
 - a. Return the assignment to me with instructions on what needs to be done in order to earn credit for the assignment.
 - b. Return the assignment with a big fat LOSER written on it and drop me from the course

- c. Give me a failing grade on the assignment.
 - d. Contact my parents.
8. If I get a low score on an assignment and I want to improve my score, I should:
- a. Contact the Electronic principal.
 - b. Whine and complain to my friends.
 - c. Ask my parents to write The Teacher a note explaining why I should get a better score.
 - d. Make the suggested corrections on the assignment and re-submit it for a better score. I can always correct and re-submit assignments.
9. All assignments are worth:
- a. 10 points
 - b. 100 points
 - c. 5,000,000,000,000,000,000,000,000,000 points
 - d. The point value of each assignment varies depending on how hard the assignment is.
10. If I submit an assignment to The Teacher and it somehow gets lost in cyber space (i.e. for some reason she does not receive my assignment) then I do not have to worry about it because:
- a. The Teacher is very nice. She will understand and will give me credit for the assignment even though she has not seen it.
 - b. Things like that happen all the time so it is okay if I do not turn in one or two assignments.
 - c. Superman will rescue my assignment from the vast voids of cyber space and will submit it for me.

d. I have followed the advice to ALWAYS keep a back up copy of my work. I can simply access my back up copy and re-send the lost assignment.

11. Which of the following assignments would earn a score of 10/10, A?

a. I did MORE than was required by the assignment. For example, I wrote longer answers than necessary or I included graphics or I used some extra creativity.

b. I wrote a correct answer for every question.

c. I sent The Teacher pizza AND told her that her children are adorable.

d. I copied the essay from a friend who got a score of 10/10, A, on the assignment.

12. When doing assignments:

a. I can do the assignments in any order that I wish.

b. I must do the assignments in numerical order.

c. I have to sit in a dark corner and chant "The Teacher is the greatest teacher in the world" ten times. It is better if I do the chant in Latin.

d. All of the above.

13. If I have a question I can:

a. Email The Teacher at the address to be provided. She is very willing to help me.

b. Ask my parents, friends, or a teacher at school for help. They can help me but I will do the actual work myself.

c. Search online for information.

d. All of the above.

Excellent!! Please submit your answers to me.

GOOD LUCK and HAVE FUN! - The Teacher

1.3 LOOKING AT SYSTEMS

You have heard the word “system” most of your life and have probably even used the word once or twice. Have you ever thought about what the word “system” means? What is a system? Read on for the answer to this and other fascinating questions.

Assignment:

Answer the questions as you read through the following paragraphs.

In the introduction I posed the question, “What is a system?” What do you think?

1. Write down, in your own words, your definition of a system.

A system has two distinguishing characteristics. The first is that it has SYNERGY. Synergy means that the whole is greater than the sum of the parts. This sounds a lot more complicated than it is. What it means is that when all of the pieces of a system are put together they are more valuable than all of the pieces would be if they were considered separately. A home is a good example. If you were to lay all the pieces and parts of your home in a pile you would have a big pile of wood, insulation, pipes, wires, drywall, etc. Your pile of “house stuff” would be worth something but not nearly as much as your home is worth when all the “house stuff” is organized into a system.

The second distinguishing characteristic of a system is that it has EMERGENT PROPERTIES. Emergent properties are properties that emerge as a result of how the system works together; properties that do not exist without the system. In other words, emergent properties are characteristics that are unique to the system as a whole. Let us consider the example of your home once again. Some emergent properties of your home may be its comfort and its safety. The comfort of your home is a function of the materials used to build it, the architectural design, and the furniture inside. The home’s safety is a property dependent on the design, the strength and location of its doors and windows, and the neighborhood in which it was built. Both the safety and comfort of your home are properties of the home that are a result of the “home system”; they are not dependent on just one aspect of the home.

2. Give two examples of systems.

3. Identify an emergent property for each of the systems you gave as an example.

To better understand systems, it is useful to ask three questions about them. The three-question approach to studying systems is:

1. What are the parts of the system?
2. What are the properties of the system as a whole?
3. How is the system part of a larger system?

In our example of a home we have already identified the parts; wood, drywall, wires, pipes, etc. We have also already described a few of its properties; safety, comfort, beauty. That leaves only one question remaining. How is the home part of a larger system? The home is part of a neighborhood, which is part of a city, which is part of a state, which is part of a nation and so on.

4. How are the two systems you gave as examples part of a larger system?

So how does all this relate to a science course? In the past scientists have studied the various parts of the Earth. They have looked at botany (how plants work), zoology (animals), geology (rocks), and physics (forces) but few have studied how all of these work together. Now we are discovering that the Earth is much more than a bunch of parts. It is a whole. The Earth is a whole system that works together. This means that there is an interconnection between all of Earth's living and non-living parts. Everything works together in important ways. The wind, rain, bacteria, insects, deserts, and forests all work together as parts of the Earth System. Let us now apply the three-question approach to studying systems to Earth's System.

5. What are the parts of Earth's System?

6. What are the properties of the Earth's System?

7. How is the Earth's System part of a larger system?

Scientists divide the Earth's System into four sub-systems: biosphere (life), lithosphere (rocks and stuff), hydrosphere (water), and atmosphere (air).

While studying the parts of the Earth System it is important to look for the emergent properties of the Earth System. How do the parts of the Earth System come together to form a sum that is greater than the sum of its parts? This question is best answered by focusing on the Earth's matter, energy, and life.

Think back to your seventh grade science days. What is matter? Matter is stuff. Anything that has mass and volume (weighs something and takes up space) is matter. What happens to the matter on Earth?

MATTER CYCLES. Essentially all the matter on Earth has been here since the Earth was formed. It does not go away and we do not get new matter. Earth recycles. We get rain year after year, century after century, eon after eon, because Earth recycles water. Living organisms can breathe in oxygen and exhale carbon dioxide forever because the hydrogen, carbon, and oxygen molecules on Earth are used over and over again in the Earth System.

8. What does the term "matter cycles" mean?

9. Give an example of how matter cycles.

While matter cycles round and round in the Earth System, **ENERGY FLOWS** through the Earth System. The vast majority of Earth's energy comes from the sun, flows into the Earth's System, and flows out of the Earth's System into space. If all the energy that comes to Earth from the sun were to stay on Earth, the Earth would melt away. But the energy that comes to Earth from the sun does not stay. Eventually it radiates back out to space as heat. We know this because the average temperature of the Earth has remained relatively constant. If the energy from the sun were to stay on Earth, the Earth's average temperature would rise. Some of the sun's energy is reflected by the atmosphere, some is absorbed by the Earth and re-radiated as heat, some evaporates water and powers the water cycle, some is captured by plants and used to make sugars, and some powers the wind but eventually **ALL** of the energy that comes to the Earth from the sun leaves the Earth and flows into space. For this reason we say that energy flows through the Earth System.

10. What does the term "energy flows" mean?

11. Give an example of how energy flows through a part of the Earth System.

A web is a complex structure with multiple interconnecting parts. We say that LIFE WEBS in the Earth System because life has multiple interconnecting parts both with matter cycles and energy flows as well as with other life. Life is connected with matter cycles in many ways. Plants capture carbon from the air and use it to make food. Animals eat plants as food and release carbon (in the form of carbon dioxide) back into the air. . Decomposers break down both plants and animals and also release carbon. Life also participates in the flow of energy through the Earth System. Plants capture the sun's energy through photosynthesis and animals that eat the plants release that energy through respiration. The energy flows to the plants, through the animals and out into space. Life is also very connected to other life. All of Earth's life depends on other forms of life. Animals depend on plants for food and oxygen. Plants depend on animals for carbon dioxide. Decomposers depend on plants and animals as an energy source and plants and animals depend on decomposers to break down and release important mineral components. A change in one part of life's web has far-reaching and often unanticipated consequences on other parts of the life web.

12. What is meant by the term "life webs"?

13. Explain how a change in one aspect of the life web might affect other parts of the web? (For example, how would killing off the grasshoppers in a meadow affect the other members of the meadow community?)

The notions that MATTER CYCLES, ENERGY FLOWS, and LIFE WEBS are the most important concepts you will get from this course. As you proceed through the course, look for examples of these three emergent properties of Earth's System.

When you have completed the 13 questions in this assignment, send them to me. If you have read the material and thoughtfully answered questions 1-13 you will easily pass this assignment.

1.4 TAKE A WALK!!!

Introduction:

Welcome to your first real assignment in your online Earth Systems class! And welcome to your first field trip!! Yes, for this, the first assignment, you must take a field trip. YIPPEE!

For this little field trip, you need only to take a short walk outside. Just get up and go.....but not yet! First I need to give you a few instructions.

Assignment:

In our attempt to understand our wide and wonderful world, we classify things. One of the ways we classify the matter around us is by dividing it into two categories: abiotic and biotic.

The physical aspects of the environment, such as land forms, soil type and pH, temperature, amount and kind of precipitation, wind, air supply, and amount of sunlight, are considered *abiotic *factors. They influence the kind and number of living things found in a particular area. Many of these things act as limiting factors because their quality and quantity determine the survival of living things in an ecosystem.

Biotic factors in an environment are those things that are living, were once living or are made from living things. Trees (living), fallen leaves (were once living) and paper (made from living things) are examples of biotic factors.

Biotic and abiotic factors are very closely interrelated. Abiotic factors influence biotic factors and visa versa. Water, for example, is an abiotic factor that has a giant influence on the biotic elements found in an area. Cattails and beaver, sage brush and lizards are residents of very different habitats yet they can be separated by less than 100 yards if one is looking near the edge of a river. Abiotic water is the factor that determines what biotic factors, like lizards or beaver, live in a certain area.

Assignment:

Now for your task. Go outside and look around.

1. Make a list of TEN biotic factors that you see. Be as specific as possible. For example, instead of writing, “flower”, write “dandelion”, “rose”, and “daisy”.
2. Make a list of TEN abiotic factors. Again, be as specific as possible.
3. Write down FIVE ways the abiotic and biotic factors influence each other. For example: The shade (abiotic) next to the house allows moss (biotic) to grow on the foundation.
4. Describe a four-step energy pathway. Remember in Assignment 1.2 we discussed the concept of “Energy flows”. (Re-read it if you do not remember.) This is your chance to apply the concept. Show where the energy comes from, at least two organisms that capture and/or use the energy, and where the energy eventually goes. HINT: Most of the Earth’s energy comes from the sun. Plants, through a process called photosynthesis, capture the sun’s energy and make it usable to other living things. Here is an example of a four-step energy pathway. (You may NOT use my example!)

1. Energy from the sun is captured by the bean plant through photosynthesis
2. Energy is transferred from the bean leaf to the grasshopper when the grasshopper eats the bean.
3. A robin gets energy from the grasshopper when it eats it.
4. When the robin flies energy is lost in the form of heat. The heat dissipates to space.

Now describe your own 4-step energy pathway using organisms found on your walk.

Send your list of TEN biotic factors, TEN abiotic factors, FIVE interactions and ONE four step energy pathway to me. Be sure to label the assignment and put your first and last name on it.

1.5 ABC PROFILE

When you tell someone where you live, you often tell him or her about the area in which your home is located before you mention the specific address. You may say “near the mountains”, “on the mesa”, “in the desert”, or “by the river bottom.” By saying this you are furnishing important clues about the unique characteristics of your local environment: the climate, soil, vegetation, animal life, and even human’s use of where you call home. All of these factors form what are sometimes called the “ABC’s of the environment.”

In the ABC’s of the environment, “A” refers to the abiotic (physical, non-living) features of the area. “B” identifies the biotic (plant and animal) component of the environment. “C” is the cultural (human) influences. Some ecologists think of the ABC’s as forming a triangle with inter-relating sides. In a civilization as complex as ours, no single side can exist uninfluenced by others.

Your task is to create an ABC PROFILE and to ANALYZE the data you collect in your profile.

Assignment:

Your ABC Profile will identify the ABC’s of a natural environment near you. To make your ABC profile, follow the instructions below.

1. Select an area that is undeveloped (i.e. no buildings, no pavement, no bulldozing, no spraying of pesticides, no farming, no grazing, etc...). Your area must be at least the size of a football field. For some this will be an easy walk from their homes. Others will have to travel quite a distance--lucky you!! You can think of it as a field trip. Make a map of Your State and show, approximately, where your area is located.

2. Identify the at least 10 “A” (abiotic) features of your area, including: (Estimates are acceptable.) Consider things such as:

- * Landforms (mesa, mountain, valley, bench, etc..)
- * Altitude

3. Identify at least 15 “B” (biotic) features of the area. (You may use common names.) Consider things such as:

- * Plants (trees, shrubs, grasses, flowers, etc.)

- * Insects (ants, bees, praying mantis, etc.)
- * Amphibians, reptiles, and/or fish

4. Identify at least 3 “C” (cultural) components. Look for evidence of man’s influence. Consider things such as:

- *Recycling, conservation efforts
- *Pollution
- *Introduced species

ANALYSIS

Examine the data you collected when making your ABC profile. Use your collected data to answer the following questions. **USE COMPLETE SENTENCES TO ANSWER ALL THE QUESTIONS!**

A. What effect does the environment (abiotic) have on the organisms (biotic) living there? Give FIVE specific examples from your profile. [For example: Lily pads (biotic) are able to grow in my area because it is a natural wetland that has standing, stagnant water (abiotic) all year long.]

B. What effect do the organisms (biotic) have on the environment (abiotic)? Give THREE specific examples from your profile. [For example: The area is heavily shaded by spruce trees (biotic). The shade keeps the soil moist (abiotic) and reduces the air temperature.]

C. How do natural forces affect the area? Give ONE specific example from your profile. Consider the direction of the prevailing winds, the direction from which the sun’s rays come, gravity (if you are on a slope), etc...

D. How have humans affected your area? Give ONE specific example.

E. Predict how your area would change if the amount of rainfall doubled. Be sure to mention how this increase in rainfall would affect the abiotic and biotic factors.

F. Diagram the path of energy through the ecosystem you studied. Remember in Assignment 1.3 we discussed the concept of “Energy flows”. (Re-read it if you do not remember.) This is your chance to apply the concept. Show where the energy comes from, at least two organisms that capture and/or use the energy, and where the energy eventually goes. HINT: Most of the Earth’s energy comes from the sun. Plants, through a process called photosynthesis, capture the sun’s

energy and make it usable to other living things. Here is an example of a four-step energy pathway. (You may NOT use my example!)

1. Energy from the sun is captured by the bean plant through photosynthesis
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3. A robin gets energy from the grasshopper when it eats it.
4. When the robin flies energy is lost in the form of heat. The heat dissipates to space.

Now describe your own 4-step energy pathway using organisms found in the area you studied.

Send the completed ABC Profile and the Analysis to me. If you have completed the Profile as outlined and have used complete sentences to adequately answer all the analysis questions, you will receive a good grade.

1.6 FROM YOUR BIOME TO MINE

In your last assignment, you described a portion of the biome in which you live. A biome is a major biotic community that is classified by its predominant vegetation and it characterized by organisms adapted to its particular environment. Basically what that means is that a biome is an area that has certain types of plants and animals that are adapted to its climate.

Most of the Southwest US is classified as a semiarid desert biome. What plants are typically found in Your State? What animals are native to Your State? (Native means that they were here naturally and were not imported to the area by mankind.) How are Your State's native animals adapted to its environment?

As I am the teacher of this course, I am going to ask you a few questions about biomes. And, as you are the student, you get to answer them. Isn't this fun?

I lived for a time on the Oregon coast. There I was close to two very different biomes, an ocean biome and a temperate forest biome. In this assignment you will compare your biome to mine. Look closely at three biomes: semiarid desert, ocean, and temperate forest.

For each of the three biomes (DESERT, FOREST, OCEAN), describe the following:

1. Predominant plants

2. Characteristic animals

3. Relative biomass (Biomass is the mass of the biotic factors in an area. Areas with huge numbers of plants generally have a high biomass; areas with low numbers of plants have a lower biomass. This is a comparison only. State whether the relative biomass is low, medium, or high.)

4. Path of energy flow through each biome. Your energy path must have at least five steps. For example, the following is an energy pathway through a grasslands biome:

- Energy from the sun enters grass through photosynthesis.
- Energy from grass goes to grasshopper when hopper eats grass.
- Energy from grasshopper goes to seagull when gull eats hopper.
- Energy from gull goes to hawk when hawk eats gull.

· Energy from hawk dissipates to space in the form of heat when hawk uses energy to fly.

You are supposed to describe all three biomes---ocean, temperate forest, and desert. Please describe the plants, animals, biomass, and energy path for all three biomes.

You may create a chart to display the information you find, you may list it in columns, or you may write it out in paragraph form. The precise format of your assignment does not matter. The information you include DOES matter. Include the four pieces of information listed above for each of the three biomes and you will earn a good grade.

The World's Biomes → <http://www.worldbiomes.com>, is a great site to use for information about biomes.

1.7 INTERACTIONS

Introduction:

We have looked at abiotic and biotic factors and have identified their interactions. We have looked at various plant and animal communities (biomes) and have traced how energy flows through a biome. Now it is time to experiment with how biotic factors interact with abiotic factors. That's right! This assignment is an experiment.

We use many chemicals that affect the Earth's spheres. Simple things like the Miracle-Gro that you spray on your flowers may be affecting nearby streams or even far-off lakes. How does fertilizer affect our lakes and streams? Finding out is your task.

Materials:

- Sample of water that is NOT drinkable. The water may come from a pond, creek, stream, canal, reservoir, river or puddle.
- Fertilizer (any type will work)
- Available light source for algae growth (anything light that could make a plant grow)

Assignment:

1. Determine what you want to find out when you do your experiment. Do you want to know the effect of fertilizer on algae growth in pond water? Write down the QUESTION that you are trying to answer.
2. Predict what you think the outcome of your experiment will be.
3. Design an experiment to test your prediction.

There are a couple of things about designing experiments that you need to keep in mind.

First, you must have a CONTROL. A control is the part of the experiment that you do NOT change. For example, suppose you decide you want to find out what the effect of fertilizer is on the growth of algae in pond water. So you must get TWO identical samples of pond water. You will add fertilizer to one. The fertilizer is your variable. You will leave the other alone. The one that you left alone is the control. A control is necessary so that you can compare the results of your experimental variable, the fertilizer in this case, to what happens without the variable. Let us pretend for a moment that you did not use a control. You put fertilizer in the water, put it in the sunlight and checked it everyday for five days.

Nothing happened. You don't know if the fertilizer killed the algae or if the algae were never there to grow in the first place. If you have a control and the algae in the control grew, then you can probably conclude that the fertilizer killed the algae. Remember to use a CONTROL in your experiment.

Second, you need to know that most pond water, if left in a sunny location, will show increased algae growth in about five days. The water will become greener and murkier. Use this fact when you are planning your experiment.

Now, design your experiment. Be very specific. Tell me exactly what you plan to do. Tell me how much of everything you plan on using. Tell me how long you plan on running the experiment and how often you will check it. Tell me how you will record your data. I want details!!!

4. STOP!!! Submit your experimental design to me via email before going any further. My I promise to give you feedback on your design within three days. If the design is scientifically sound, you may go ahead and conduct your experiment. If it has flaws, we will work together until you have designed a valid, reliable experiment---then you may go ahead and conduct your experiment.

5. AFTER you have received my go-ahead, conduct your experiment. Be sure to keep detailed lab notes. Your lab notes should contain a record of everything you did as well as all the data you collected.

6. When you are done collecting your data, answer the analysis questions below.

ANALYSIS

A. Re-send me your original question, your hypothesis, and your experimental plan.

B. Send me your lab notes. I want to the observations that you recorded. Do not simply send me a summary of your results. I want to see a record of your daily observations.

C. Based on your observations, write a conclusion. What does your data tell you? What did you learn from your experimental results?

D. What kind of relationships did you find between biotic and abiotic factors?

E. Do your findings support your hypothesis? Why or why not?

F. If you were to do this again, what would you change? Why?

G. What additional experiments could be performed?

H. What effects would a dairy farm have on a pond downstream?

1.8 MORE INTERACTIONS

Introduction:

You have just completed an experiment that explored the interaction between an abiotic factor (fertilizer) and a biotic factor (algae). Now your task is to design and conduct an experiment that explores the interaction between an abiotic and biotic factor of your choice. WOW! How exciting is that! You get to choose. And the world is your laboratory.

The options are limitless. All you have to do is choose an abiotic factor and a biotic factor and design an experiment that tests how they interact.

I will give you an example of an experiment that explores the relationship between the abiotic factor sunlight and biotic plants. **THIS IS ONLY AN EXAMPLE.** You may NOT use this experiment for this assignment. [Most of you did this experiment in second grade!]

The question might be “What is the effect of sunlight on pansies?”

The hypothesis might be “If I put pansies in a dark closet then they will not grow as well as pansies put in a lighted windowsill.”

The experimental plan could be:

1. Get six pansies (a type of flowering plant) that are the same species and as close to the same size as possible.
2. Put three pansies in the closet and three pansies on the windowsill in the sunlight.
3. Water all six plants the same.
4. Visually inspect the plants once a day for 14 days.
5. Record observations.

See how easy it is! Remember, you cannot**do an experiment with sunlight and plants for two reasons. One, you already know what the result will be. You did this already in second grade! Two, I have already outlined the experiment. Part of what you need to learn in this class is how to design your own experiment. You cannot learn that by doing an experiment that I have already designed! So, off you go. Be creative. Design your own experiment. But wait! Be sure to read the directions below before you do anything!!!!

Materials:

· Whatever you decide

Assignment:

1. Determine what you want to find out when you do your experiment. Write down the QUESTION that you are trying to answer. If you are having trouble coming up with a question, look outside. Make a list of 10 biotic factors and 10 abiotic factors. Then think of ways that the biotic things interact with the abiotic things. Think of experiments you could do to test how the factors interact.
2. Predict what you think the outcome of your experiment will be. (Hypothesis)
3. Design an experiment to test your prediction. Remember to include a control. Be very specific. Tell me exactly what you plan to do. Tell me how much of everything you plan on using. Tell me how long you plan on running the experiment and how often you will check it. Tell me how you will record your data. I want details!!!
4. STOP!!!**Submit your experimental design to me via email before going any further. I promise to give you feedback on your design within three days. If the design is scientifically sound, you may go ahead and conduct your experiment. If it has flaws, we will work together until you have designed a valid, reliable experiment---then you may go ahead and conduct your experiment.
5. AFTER you have received my go-ahead, conduct your experiment. Be sure to keep detailed lab notes. Your lab notes should contain a record of everything you did as well as all the data you collected. Each entry on your lab notes should be dated. (Month/day/year)
6. Follow the directions below to submit your assignment.

ANALYSIS

- A. Re-send me your original question, your hypothesis, and your experimental plan.
- B. Send me your lab notes. I want to the observations that you recorded. Do not simply send me a summary of your results. I want to see a record of your observations.
- C. Based on your observations, write a conclusion. What does your data tell you? What did you learn from your experimental results?
- D. What kind of relationships did you find between biotic and abiotic factors?
- E. Do your findings support your hypothesis? Why or why not?

F. If you were to do this again, what would you change? Why?

G. What additional experiments could be performed?

Please, send me the information requested in analysis questions A-G.

1.9 BIODIVERSITY: WHO CARES?

Introduction:

Biodiversity is a word that one hears a lot these days---if one listens to nature shows or reads scientific magazines. The word is not used as often on MTV.

Anyhow, biodiversity is a very important concept in science. Just what does it mean? Look at the word. The prefix "bio" means life. Diversity means "variety". So, biodiversity means a variety of life forms. In science biodiversity refers to the types of different species found in an area. A tropical rainforest has a tremendous amount of biodiversity. That is to say, there are many, many, MANY different species of plants and animals found in a tropical rainforest. A desert does not have as many different types of species therefore we say that a desert has less biodiversity than a tropical rainforest does.

Who cares?

You do. Or you don't. Whether you do or you don't, you get the opportunity in this assignment to evaluate the biological, esthetic, ethical, and economic reasons for maintaining biodiversity. Read on for more details about your assignment.

Assignment:

Write a 500-700 word essay that evaluates the biological, aesthetic, ethical, and economic reasons for maintaining biodiversity.

* You must put the quote in quotation marks.

I will not accept the paper if you list only your own opinions. You MUST include a quote in every section.

1. First section: Biological reasons to maintain biodiversity. Is maintaining biodiversity important for the biosphere? Why or why not?
2. Second section: Aesthetic reasons to maintain biodiversity. Aesthetic refers to beauty. Is maintaining biodiversity important for aesthetic reasons? Why or why not?
3. Third section: Ethical reasons for maintaining biodiversity. Ethical arguments refer to what is right and what is wrong. Is it ethical to reduce biodiversity? Why or why not?
4. Fourth section: Economic reasons for maintaining biodiversity. Economics deal with money. Is it economical to maintain biodiversity?

5. Fifth section: What is your opinion? Should we maintain biodiversity? Should we maintain biodiversity at all costs, no matter what? Should we maintain biodiversity in some cases and not others? When should biodiversity be maintained? When is biodiversity to be sacrificed to other considerations? Should biodiversity be ignored when making decisions about land use? What do you think? Why? Be sure to include reasons for your opinion.

The following Internet sites may be useful in writing this paper. You will probably want to find sites of your own also.

Biodiversity Hotspots → <http://www.biodiversityhotspots.org>

Biodiversity--Wikipedia entry → <http://en.wikipedia.org/wiki/Biodiversity>

Why Conserve Biodiversity → <http://www.nhm.ac.uk/nature-online/biodiversity/why-protect-biodiversity/index.html>

Scientific Facts on Biodiversity and Human Health → <http://www.greenfacts.org/en/biodiversity/1-3/6-protect-biodiversity.htm>

When you have completed the entire assignment, send it to me. If you have followed the instructions, you will receive a good grade.

1.10 PLATE TECTONICS

Before you start this assignment, it is important that I introduce the some new ideas. Read on for important information.

We have looked at the Earth's Biosphere. Remember, the biosphere is the area in, on, and around the Earth that contains living things. Now we are going to investigate the Geosphere or Earth's Geologic System.

Geology has to do with rocks, rock cycles, and rock formation. We use the word GEOSPHERE to describe all systems and parts of systems dealing with the solid portion of the Earth. This includes rocks of all sizes, the Earth's crust and the inner parts of the Earth (some of which are not solid!).

The other Earth systems have names as well. In the previous assignments you studied the BIOSPHERE. The biosphere encompasses all life on Earth. In subsequent quarters you will study the ATMOSPHERE and the HYDROSPHERE as well. The atmosphere describes the Earth's gases, particularly those that form a "blanket" covering the Earth's surface. The hydrosphere refers to the Earth's water and all of its associated systems.

There you have it! The four major Earth systems: biosphere, Geosphere, atmosphere, and hydrosphere. Now we will begin our exploration of the Geosphere.

Introduction:

Many people view science as cold, hard facts that are indisputable. In reality, there is a lot more to science than cold, hard fact. In fact, many of science facts are not cold, hard truths. Scientific knowledge often is the best explanation we have at the time for what we see. As we learn more and are better able to see things, scientific explanations may, and often do, change. Science claims are tentative.

The goal of science is to produce a systematized body of knowledge that has explanatory and predictive power. We want to understand things. We seek understanding by observing natural phenomena but, because scientists are human (believe it or not, science teachers are human also!), their observations are influenced by their prior knowledge, experience, and beliefs. Also, because they are human and because science is always seeking new understandings, the problems that science investigates, the methods they use, and the way they interpret evidence changes from time to time.

Just what does all this have to do with plate tectonics you ask? Plate tectonics is a theory that has explanatory and predictive powers. It has been developed and

modified over the centuries by scientists whose observations and explanations were influenced by their personal beliefs and prior knowledge. The story of the development of the theory of plate tectonics is a story of science in action.

Science in action---this is the object of our study. In this assignment you will see that scientists do not always agree, that explanations change as more information becomes available, that creative thinking and imagination are vital to scientific endeavors, and that science produces a growing, changing body of knowledge. In the process, you will also learn about the theory of plate tectonics. Sounds fun, doesn't it?

Assignment:

- Go to This Dynamic Earth: the Story of Plate Tectonics at: →
<http://pubs.usgs.gov/gip/dynamic/dynamic.html>
- Complete the questions below in the Plate Tectonics Worksheet .
- The following web site also has some excellent, easy to understand information on plate tectonics →
<http://www.ucmp.berkeley.edu/geology/tectonics.html>

PLATE TECTONICS WORKSHEET--Use complete sentences to answer the questions.

1. What is the theory of continental drift?
2. Who proposed the theory? When?
3. What scientific data was used to support the theory of continental drift? Identify and explain at least four types of evidence.
4. What were the problems with the theory of continental drift?
5. Imagine that you are a scientist living at the time that Wagner proposed his theory. What might you have thought of his theory? What biases might you have had that would influence your acceptance of the theory?
6. What proposed explanations overcame the problem of how the continents moved?
7. How does the presence of ocean ridges and trenches support the theory that the continentals move?
8. How does sea floor spreading support the theory that continentals move?

9. How was sea floor spreading tested as a hypothesis?
10. How does the fossil record support the theory of plate tectonics?
11. How does the distribution and pattern of earthquakes support the theory?
12. In your own words, state the theory of plate tectonics.
13. How does the development of the theory of plate tectonics illustrate the changing nature of scientific knowledge?
14. How was the scientific method used to establish the theory of plate tectonics?
15. In your mind, what is a theory? Can theories change? Who makes theories? What has to happen to a scientific explanation for it to become a theory?

Grading

Send me your answers to the worksheet questions. If your answers are written in complete sentences, are accurate, and reflect good thinking then you will receive a good grade.

1.11 WHAT'S HAPPENING ON YOUR PLATE?

Introduction:

So, the globe is covered with plates! (See assignment 1.10) How many plates are there? What is happening on your plate? What is happening on other plates? Keep reading for the answers to these and other exciting questions.

Assignment:

Use complete sentences to answer ALL questions. If you do not use complete sentences, I will probably return the assignment to you and ask you to re-do it.

The following Internet sites will be of great use to you in completing the assignment below, but feel free to find other resources and cite them in your responses.

This Dynamic Earth: the Story of Plate Tectonics →
<http://pubs.usgs.gov/gip/dynamic/dynamic.html>

Volcanic World → <http://volcano.oregonstate.edu/education/index.html>

Plate Tectonics, the Cause of Earthquakes →
<http://www.seismo.unr.edu/ftp/pub/louie/class/100/plate-tectonics.html>

And here is the actual assignment! Have fun!

1. What are the names of the seven major plates?

Send the answers to ALL of these questions to me. You do NOT have to send me the questions but you DO have to use complete sentences to answer all the questions.

GOOD LUCK AND HAVE FUN!

1.12 MODELING THE EARTH'S MOVEMENT

Hello! I hope you are feeling creative because this assignment will tap your creative powers. Your task is to make a model. And how does one make a model and show it to a teacher via the Internet? That is where you must get creative!

Assignment

There are two tasks in this assignment:

1. Make a model of the movement of materials within the Earth. Show how convection currents move materials within the Earth.
2. Make a model of the movement and interaction of the plates.
 - Show a convergent plate boundary.
 - Show a divergent plate boundary.
 - Show a transform plate boundary.

You must figure out a way to show me your model. Following are a few suggestions:

Take a hard-boiled egg and crack its shell. Does the egg remind you of anything? The Earth, perhaps? The egg could be seen as a tiny model of the Earth. The thin shell represents the Earth's crust, divided into plates; within the shell is the firm but slippery mantle. Move the pieces of shell around. Notice how the shell buckles in some places and exposes "mantle" in other places. The same thing happens on Earth, but on Earth, this activity results in the formation of mountains, earthquakes, and new ocean floor.

1.13 VOLCANOES AND YOU

Introduction:

Hopefully by now you are getting the idea that all these systems are connected. It is now time to study how geologic systems affect other systems. In the assignment that follows, I suggest that you study the effect volcanoes have on other Earth systems. You do not have to use volcanoes to study the effect of geologic process on other Earth systems. If you are more interested in other geologic processes, such as earthquakes, sedimentation, pond succession, or something else, you may study a different geologic process. If you chose an alternative process, make sure that you clear it with me first. (An email message will work fine.) If volcanoes interest you, read on!

Assignment:

You are to make a presentation about the effect that volcanoes have on other Earth systems. You chose how you want to make the presentation. Because we are dealing with the electronic high school, writing a report will probably be the easiest format however it is not necessarily the best. [In fact, I prefer that you present the information in some way other than writing a report.] You may make a video, a poster, write a poem, compose a song, or something else that would convey the necessary information. You decide how you want to present the information. All I require is that the required information is present in your presentation.

Required information:

1. How do volcanoes beneficially affect man? Identify at least eight.
2. What are volcanoes detrimental effects on man? Identify at least four.
3. How do volcanoes affect other Earth systems, particularly climate? Explain in detail.

Grading:

Originality will help you score points with this assignment. The more original your presentation is, the better your score will be. If you chose to write a paper, you can still get a good grade but your paper must be very comprehensive (i.e. include a lot of information, many examples, and a lot of detail). If your presentation is original and includes the required information you will get a good grade.

1.14 PREDICTING THE FUTURE

Systems, systems, systems! Is that all we ever talk about in this class? Almost!! Once again we are going to examine the Earth's systems. This time we are going to do so from a geologic perspective. How does the movement of the Earth's plates affect the other Earth systems?

Assignment:

Pretend to look into the future.

Looking into the future, pretend to witness the movement of the Earth's plates. What would you see? Use what you know to predict how plate movement will affect other Earth systems.

Write a short paragraph (2 to 3 sentences) to describe what would happen in the EACH of the following scenarios. You need to write a paragraph for each scenario.

1. How do volcanic eruptions affect the weather? [NOTE: Weather is the day-to-day condition of the atmosphere. For example the weather may be rainy one day and sunny the next.]
2. How do volcanic eruptions affect the climate? [NOTE: Climate is a long-term description of the average temperature and precipitation of an area. For example, much of the Southwest US has a desert climate because it is usually hot and dry.]
3. How does mountain building affect waterways and drainage patterns? [NOTE: Mountain building is when forces within the Earth, usually convergent margins, build up mountains.]
4. How might uplift affect species diversity? [NOTE: Uplift is when forces inside the Earth cause massive pieces of the Earth's crust to be lifted up. Uplift causes mountains or high plateaus to exist where there was previously low ground.]
5. How might upwelling (the rising of super heated water) from ocean vents affect the ocean biome?
6. Identify AND explain how the movement of the plates affects a matter cycle.
7. Identify AND explain how the movement of the plates affects energy flow in the Earth.

WOW! That was easy--only seven questions. If you answered all seven questions correctly and used complete sentences, you will earn a GREAT grade.

1.15 The End

You have done it!! Congratulations! You are done with all of the assignments. (If you are not done with all of the assignments, please go back and finish them BEFORE you do this assignment.) You have nearly earned your .25 first quarter credit.

All that remains is a final course evaluation, a practice exam, and the final itself. Please complete the final course evaluation and the practice exam below. DO NOT DO THIS UNTIL YOU HAVE COMPLETED ALL OF THE PREVIOUS ASSIGNMENTS 1.1-1.14.

PART ONE:

1. What things (if any) did you like about the course?
2. What things (if any) need to be changed?

PART TWO:

Please complete the practice exam below. I will correct it and send you the results. This practice exam will be very helpful for you in taking the final.

Practice Exam

FIRST QUARTER:

1. Which of the following is an abiotic factor?
 - a. Cat
 - b. Wood
 - c. Daisy
 - d. Sunshine

2. In a lake organisms die and decompose. Decomposition uses large amounts of oxygen that was dissolved in the lake's water. The reduced level of oxygen in the lake would determine which of the following?
 - a. The number of trees living around the lake
 - b. The amount of rainwater reaching the lake
 - c. The amount of clouds covering the lake

- d. The kinds of water beetles living in the lake
3. You want to design an experiment that tests the influence of biotic factors on plant growth. Which biotic factor could you test?
- a. Types of insects infecting the plant
 - b. Amount of water the plant gets
 - c. Intensity of sunlight reaching the plant
 - d. Amounts of nitrogen that fertilizer the plant.
4. In an investigation on potato bug habitat sites, Juan's hypothesis was "There will be more salamanders found under rocks than on the bottom of the pond in the water." Juan lifted up all the rocks in a pond and found 13 salamanders. In the water, on the bottom of the pond, he found 33 salamanders.
- a. The location salamanders prefer.
 - b. The relative water temperature of the pond.
 - c. Salamander eating preferences.
 - d. The relationship between light levels and rock types at the bottom of a pond.
5. A farmer wants to know how to get more ears of corn from his land. You are going to conduct an experiment to help him. You decide to plant 10 corn seeds in 10 different pots. You fertilize 5 plants with a 100 ml of 5% fertilizer solution once weekly and 5 plants with 100 ml of a 25% fertilizer solution once weekly.
- a. How do you keep the deer from eating the corn?
 - b. How tall can a corn stalk grow?
 - c. How can you get more ears of corn?
 - d. How can you get more plants on his land?

6. Consider the claim “All life is interdependent.” What would be at least one thing that would have to happen for this claim to be called a theory?
 - a. It would have to be supported by a lot of data that had been tested repeatedly.
 - b. The claim would have to be proven to be true by the scientific community.
 - c. Ecosystems would have to depend on biodiversity.
 - d. Science would have to start accepting new theories.

7. How does energy flow through an ecosystem?
 - a. The sun’s energy is captured by plants during photosynthesis and eventually returns to space as heat.
 - b. Energy from the sun is used in the ecosystem and then it returns to the sun.
 - c. Energy from the sun is captured by animals to make sugars and fats.
 - d. The sun’s energy is captured by oxygen molecules, which causes respiration.

8. Explain how the energy you use to dance at the Prom originally came from the sun. Be specific in describing how the energy flows from the sun to you on the dance floor. Use at least four steps.

Once I have received the above information, I will correct your practice exam and will give you feedback.

PROCTORED EXAM: QUARTER 1

1. Which of the following is an abiotic factor?

- a. cat
- b. dog
- c. person
- *d. weather

2. What is the purpose of including a control in a scientific investigation? To provide:

- *a. a basis for comparison
- b. a correction for experimental errors
- c. a preliminary trial of the methods
- d. an opportunity for repetition of the experiment.

3. In a lake organisms die and decompose. Decomposition uses large amounts of oxygen that was dissolved in the lake's water. The reduced level of oxygen in the lake would determine which of the following?

- a. the number of birds living around the lake
- b. the amount of run-off reaching the lake
- c. the amount of sunlight reaching the lake
- * d. the kinds of fish living in the lake

4. You want to design an experiment that tests the influence of abiotic factors on plant growth. Which abiotic factor could you test?

- * a. acidity of the soil
- b. insects infecting the plant
- c. species of plants grown
- d. plant height

5. Andrew did a study on the relationship between the age of trees and the number of sparrow nest sites. He hypothesized that he would find more nests in older trees than he would in younger trees. He found 355 sparrow nesting sites in trees over 50 years old and no nests in trees less than 50 years old. Andrew's

conclusion was “Sparrows never nest in trees under 50 years old.” Which of the following statements best describes Andrew’s conclusion?

- * a. The statement is invalid because Andrew did not examine every sparrow-nesting site worldwide.
- b. The statement is invalid because it is difficult to determine the exact age of a tree without killing it.
- c. The statement is valid because Andrew did not find any nests in trees less than 50 years old.
- d. The statement is valid because Andrew had a large sample size.
- e. The statement is valid because Andrew’s hypothesis matched his conclusion.

6. Joseph wanted to analyze the relationship between biotic and abiotic factors in a forest meadow. Which of the following would be suitable subjects for study?

- a. The relationship between length of day and average daytime temperature.
- * b. The relationship between soil type and vegetation types.
- c. The relationship between rabbit feeding habits and number of clover plants.
- d. The relationship between number of aspen trees and sparrow nests.
- e. The relationship between rainfall and stream volume.

In an investigation on potato bug habitat sites, Graciella’s hypothesis was “There will be more potato bugs found in moist, dark areas than will be found in dry, dark areas.” When Graciella collected data she found 172 potato bugs under rocks in dry, dark areas and 42 potato bugs under rocks in moist, dark areas.

7. What variable was Graciella testing?

- * a. The relative moisture level of potato bug habitat.
- b. the relative light level of potato bug habitat.
- c. Potato bug preference for hiding under rocks versus other habitat options.
- d. The relationship between light levels and moisture content in potato bug habitats.
- e. Where potato bugs live.

8. Graciella’s conclusion, based on her data, was that more potato bugs are found in dry, dark areas than are found in moist, dark areas. Which of the following statements about her conclusion is right?

- a. The conclusion is invalid because it disagrees with the hypothesis.
- b. The conclusion is invalid because potato bugs prefer moist environments.
- * c. The conclusion is valid because there were significantly more potato bugs found in dry, dark areas than moist, dark areas.
- d. The conclusion is valid because invertebrates prefer dry, dark areas.
- e. The experiment is a failure because the hypothesis was wrong.

9. A farmer wants to know how to get more ears of corn from his land. His field is fenced and he has planted his plants as close together as possible. You are going to conduct an experiment to help him. You decide to plant 10m corn seeds in 10 different pots. You water 5 plants with 100 ml of water a day and 5 plants with 1000 ml of water a day.

10. Which of the following is a research question about the farmer's problem?

- a. How do you keep the deer from eating the corn?
- b. How tall can a corn stalk grow?
- * c. How can you get more ears per corn plant?
- d. How can you get more plants on his land?

11. Which of the following hypothesis are you testing with your experiment?

- a. If you fertilize the plant more than you will get more corn.
- * b. If you water the plant more then you will get more corn.
- c. If you spread out the plants more you will get more corn.
- d. If you give the plant more light you will get more corn.

12. Consider the claim "Biodiversity is essential to maintain a functioning ecosystem." What would be at least one thing that would have to happen for this claim to be called a theory?

- * a. It would have to be supported by a lot of data that had been tested repeatedly.
- b. The claim would have to be proven to be true by the scientific community.
- c. Ecosystems would have to depend on biodiversity.
- d. Science would have to start accepting new theories.

13. Which biome has the greatest biomass in a given area?

- a. Coniferous forest
- * b. Tropical rain forest
- c. Desert
- d. Grassland

14. What kind of evidence do scientists use to locate boundaries of plates and interpret what type of boundary is present?

- a. matching fossil records
- b. similar rock layers
- * c. distribution of earthquakes and volcanoes
- d. the way the continental coastlines fit together like a puzzle.

15. What kind of movement on a plate boundary causes mountain building?

- a. Divergent movement
- * b. Convergent movement
- c. Transform movement
- d. Biome movement

16. Which of the following discoveries caused science to re-evaluate its opinion of Wagner's hypothesis about continental drift?

- * a. Sea floor spreading in the Atlantic Ocean.
- b. Valley and delta land forms on Mars
- c. The coastlines of Africa and South America have similar fossils.
- d. The global rate of volcanic activity has changed over time.

17. Where are earthquakes most likely to occur on Earth?

- a. They are spread evenly around the globe.
- * b. On plate boundaries.
- c. On continents.
- d. On the sea floor.
- e. In mountains.

18. How does energy flow through an ecosystem?

- * a. The sun's energy is captured by plants, used by animals, and eventually returns to space as heat.

- b. Energy from the sun is recycled over and over again in the ecosystem.
- c. Energy from the sun is captured by animals to make sugars and fats.
- d. The sun's energy is captured by oxygen molecules, which causes photosynthesis.

19. Tess designed an experiment to measure how color affects the absorption of solar energy. She covered one Styrofoam cup with a black, nylon sock and another Styrofoam cup with a white, cotton sock. She left a third cup uncovered. She filled all three cups with 100 ml of room temperature water and set them in the sun. After 60 minutes, she measured the temperature of each of the cups. Which of the following statements accurately describes Tess's experimental design?

- a. The design was valid because Tess measured the absorption of solar energy.
- b. The design is valid because she used two variables; different materials as well as different colors.
- * c. The design is flawed because she used two variables; different materials as well as different colors.
- d. The design is flawed because water temperature cannot be used as an indicator of the absorption of solar energy.
- e. The design is flawed because 60 minutes is not long enough to measure the absorption of solar energy.

20. Hans designed an experiment to measure the effect of color on the absorption of solar energy. He put a 3m x 3m black plastic tarp and a 3m x 3m clear plastic tarp over a snow bank that was 1m deep. At 4:00 pm each day for a week he measured the amount of snow remaining under the tarps. Which of the following statements accurately describes Hans's experimental design?

- * a. The design was valid because Hans measured the effect of color on the absorption of solar energy.
- b. The design is flawed because the results cannot be quantified.
- c. The design is flawed because it tests two variables.
- d. The design is flawed because it has two controls.
- e. The design is flawed because it has no controls.

21. Explain how the energy you use to pedal a bicycle originally came from the sun. Be specific in describing how the energy flows from the sun to you on the bike. Use at least four steps.

Correct Answer:

The sun's energy is converted to chemical energy by a plant. An animal gets energy when it eats the plant. The student gets energy when it eats the animal. The boy's energy is used to pedal the bike.

Quarter 2

2.1 “GETTING TO KNOW YOU”

Hi! Your first assignment is to introduce yourself to me I want to know who you are and what you like. But wait!! I don't want you to tell me. I want to hear what your pet would say about you. Introduce yourself through the eyes of your pet. That's right! Give voice to your pet and let him/her introduce you to me. If your pet could talk, what would it say about you? Tell me! If you do not have a pet, let your room introduce you. You can include information about where you live, your school and schooling, and what your personal interests and hobbies are.

Let me introduce myself through the eyes of my dog.

Have a great day!!

There you have it: The Teacher as seen through the eyes of her dog. I taught high school biology for five years. Now I teach this online Earth Systems course. I love to run, read, and camp in the mountains. Most of all I love my adorable husband and four charming children.

I look forward to working with you,
The Teacher

Assignment:

1. Write a paragraph introducing yourself through the eyes of your pet (or your room if you do not have a pet.)
2. Be sure to label your assignment (Assignment 2.1) and put your first and last name on it.
3. Submit your assignment.
4. Have a great day!

2.2 STAYING ON COURSE!!

Have you ever noticed that every teacher has different rules and expectations? It is so easy to get confused and “off course” when trying to navigate different classes in this “river” we call the Electronic. This assignment is designed to help you “stay on course” in Earth Systems.

Assignment:

1. What is the name of the textbook for the course?
 - a. Earth Systems Science
 - b. Getting to Know the Earth as a System
 - c. Eating Elephants for Energy
 - d. There is no official textbook.

2. During this Earth Systems science course, I will be:
 - a. Taking field trips
 - b. Doing experiments
 - c. Reading and writing
 - d. All of the above

3. In order to receive credit, I must:
 - a. Do all of the assignments. I will not receive credit unless I satisfactorily complete ALL of the assignments.
 - b. Earn at least 60% of the possible points.
 - c. Send The Teacher chocolate.
 - d. Complete as many assignments as I need to in order to earn the grade that I want.

4. All assignments are labeled. Assignment 1.4 means:
 - a. First quarter, fourth assignment
 - b. Fourth quarter, first assignment
 - c. Fourth inning of the first game in the play-offs
 - d. Part four of assignment one

5. To find out my grades, I:
 - a. Click on Student Tools on the left side bar and then click on “My grades”.
 - b. Click on Information on the left side bar and then enter my name.
 - c. Email The Teacher and ask her to look up my grade.
 - d. Click on Groups, enter my name, and then record whatever grade I think that I earned on the assignment.

6. To submit an assignment, I:
 - a. Email the assignment to The Teacher at the address provided
 - b. Send the assignment to the office.
 - c. Give the assignment to one of the science teachers at my school.
 - d. Decide not to do the assignment and tell The Teacher that I sent it to her but it must have got lost in cyber space.

7. If I submit an assignment that is incomplete or unacceptable, then The Teacher will:
 - a. Return the assignment to me with instructions on what needs to be done in order to earn credit for the assignment.

- b. Return the assignment with a big fat LOSER written on it and drop me from the course
 - c. Give me a failing grade on the assignment.
 - d. Contact my parents.
8. If I get a low score on an assignment and I want to improve my score, I should:
- a. Contact the Electronic principal.
 - b. Whine and complain to my friends.
 - c. Ask my parents to write The Teacher a note explaining why I should get a better score.
 - d. Make the suggested corrections on the assignment and re-submit it for a better score. I can always correct and re-submit assignments.
9. All assignments are worth:
- a. 10 points
 - b. 100 points
 - c. 5,000,000,000,000,000,000,000,000 points
 - d. The point value of each assignment varies depending on how hard the assignment is.
10. If I submit an assignment to The Teacher and it somehow gets lost in cyber space (i.e. for some reason she does not receive my assignment) then I do not have to worry about it because:
- a. The Teacher is very nice. She will understand and will give me credit for the assignment even though she has not seen it.
 - b. Things like that happen all the time so it is okay if I do not turn in one or two assignments.

c. Superman will rescue my assignment from the vast voids of cyber space and will submit it for me.

d. I have followed the advice to ALWAYS keep a back up copy of my work. I can simply access my back up copy and re-send the lost assignment.

11. Which of the following assignments would earn a score of 10/10, A?

a. I did MORE than was required by the assignment. For example, I wrote longer answers than necessary or I included graphics or I used some extra creativity.

b. I wrote a correct answer for every question.

c. I sent The Teacher pizza AND told her that her children are adorable.

d. I copied the essay from a friend who got a score of 10/10, A, on the assignment.

12. When doing assignments:

a. I can do the assignments in any order that I wish.

b. I must do the assignments in numerical order.

c. I have to sit in a dark corner and chant "The Teacher is the greatest teacher in the world" ten times. It is better if I do the chant in Latin.

d. All of the above.

13. If I have a question I can:

a. Email The Teacher at the address provided. She is very willing to help me.

b. Ask my parents, friends, or a teacher at school for help. They can help me but I will do the actual work myself.

- c. Search online for information.
- d. All of the above.

2.3 WATER YOU KNOW ABOUT THAT?

Introduction:

Welcome to the Hydrosphere.

The Hydrosphere is a sphere that flows cyclically (in cycles, that is!) from the lithosphere through the biosphere to the atmosphere. Often in a fluid form, it contains all the water on Earth. As groundwater, the hydrosphere penetrates the soil as far down as bedrock, mostly limestone, or other impermeable layers. It is found in aquifers as groundwater and also between soil particles. As surface water, it is found in wetlands, marshes, estuaries, lakes, streams, rivers, lakes, seas, and oceans. In the atmosphere, water is found as a gas throughout the different regions. Water appears to permeate all the other spheres.

The Hydrosphere extends upward to about 15 kilometers in the Earth's atmosphere and downward to depths on the order of five kilometers in its crust. Indeed, the abundance of water on Earth is a unique feature that clearly distinguishes our "Blue Planet" from others in the solar system. Not a drop of liquid water can be found anywhere else in the solar system.

Though it cannot be found on any other planet, water is the most abundant inorganic substance at the surface of the Earth. About 1.4 billion cubic kilometers (326 million cubic miles) of water in liquid and frozen form make up the oceans, lakes, rivers, streams, glaciers, and groundwater.

There you have it—water is a completely amazing molecule! The article that follows tells about some of water's amazing characteristics. Next time you take a drink or a dip, I hope you appreciate just what a miraculous substance you are dealing with!

Assignment:

This is probably the most classroom-like assignment you will do during this course. It is simple really. All you have to do is read the following article and answer the questions.

WATER READING ASSIGNMENT:

Even though water is a familiar substance it is a very peculiar compound. Water has some exceptional qualities that will be examined in the following paragraphs.

When electrons are not shared equally in a covalent bond, the molecule is described as polar. This means that while water molecules are neutral as a whole, one end of the water molecule tends to have a positive charge while the other has a negative charge. Each end of a water molecule is attracted to the

opposite charged end of another water molecule. Consequently, water's polarity is responsible for the "stickiness" or cohesion between the molecules.

Cohesion of water causes capillary attraction, which is the ability of water to move uphill in small spaces. Water will move up the fibers of a plant because of cohesion. This force helps plants get the water they need to survive. In addition, it moves water upwards in soil. Cohesion of water also causes surface tension, water's invisible skin that allows water striders to walk on water.

Polarity is also related to solubility. Polar substances can dissolve other polar substances. Non-polar substances dissolve other non-polar substances. Polar substances and non-polar substances, however, do not mix. Dirt sticks to clothes and skin because it is combined with a thin layer of oil. Because water is polar and oil is non-polar, washing clothes in water alone does not remove all the dirt. Soap weakens the surface tension of water and increases the solubility of oils. This is why soap is used to clean clothes.

While one end of a soap molecule dissolves in water, the other dissolves in oil. This special dual ability of soap permits it to break up dirt so it can be removed easily. The polar end of the soap molecule dissolves in the water while the non-polar end dissolves in the oil. In this way, the oil is broken into droplets, surrounded by soap molecules, and dispersed. The droplets of oil do not merge together because the polar ends of the soap molecules have similar charges and repel each other. Because soap does not work very well in hard water, phosphates are often added to laundry detergents. The addition of phosphates to lakes can initiate the process of eutrophication.

Phosphates and nitrates are nutrients that algae use for growth. When these nutrients are available in abundance, algae may undergo explosive growth: an algae bloom. Eventually the bloom will die off and sink. Bacteria will then break down the dead plant material. These bacteria use up most of the oxygen dissolved in the water, leaving fish and other animals that live near the lake bottom to suffocate. This process, called eutrophication, is set in motion when excessive amounts of phosphates and nitrates enter the natural ecosystem. Some sources of these dissolved nutrients include raw sewage, fertilizer run off, detergents, and animal wastes.

When the algae bloom dies off, it will sink to the bottom of the lake because it is denser than water. In the same way cold water and salty water tend to sink to the bottom of a body of water. Cold water and salt water are denser than fresh water of normal temperature, therefore cold and salt water sink in a body of water. This is a major cause of deep ocean currents. When ice freezes near the poles, the salt concentrates in the liquid water of the ocean. The remaining water becomes more salty and therefore denser. The dense, salty water sinks deep into the ocean. As the salty, dense water sinks down and other, less salty water flows in on top of it, a current is created. The density of water increases with depth.

Some animals change their depth by changing their density. Recall that things that are denser than their surroundings sink while those that are less dense than their surroundings float. Most fish have a swim bladder, a special sac that is filled with gases from their blood. When the fish's swim bladder is full, it is less dense than the surrounding water and the fish will rise towards the surface.

Another property of water that affects lakes is the unique changes in density during phase changes. The density of most substances increases when a liquid becomes a solid. This is not so for water: Solid water is actually less dense than liquid water. It is for this reason that ice floats. Can you imagine a world where ice sank? Lakes would freeze from the bottom up, killing many fish. Frozen water in the Polar Regions would sink and change the ocean levels. The fact that ice floats is essential for the survival of many aquatic ecosystems and ultimately life on Earth.

Besides the changes in density, there are other ways in which the phase changes of water have significant impacts. When water is trapped in small cracks in rocks, it will expand as it freezes and break up the rock causing weathering. The transpiration (evaporation) of water from a good-sized tree can move 1800 liters of water out of the ground in a single day. Sublimation, the phase change between solid and gas, is responsible for the formation of frost.

As you can see, water has many special properties that make its role in nature unique. It is considered the "universal solvent" because its bipolar molecule enables it to dissolve a wide variety of substances. Water is the only substance that occurs naturally in all three states; solid, liquid, and gas. Water is truly a miracle for life!

QUESTIONS:

1. Explain polarity.
2. How is polarity related to surface tension?
3. What does soap do to the surface tension of water?
4. How is polarity related to capillary attraction?
5. Give two examples of places where water moves upward by capillary attraction in nature.
6. Why does water rise higher in thinner capillary tubes?

7. How does polarity affect solubility?
8. Give examples of nutrients that are dissolved in lakes, rivers, and the ocean.
9. Describe a soap molecule's ability to dissolve water and oil.
10. Describe the phase changes that occur in the water cycle
11. Define density.
12. What causes ocean currents?
13. How does a fish's swim bladder affect its ability to change depths?
14. Why does ice float?
15. In which phase is water the most dense? The least dense?
16. Explain how detergents are related to eutrophication.
17. Why is water called the “universal solvent”?

2.4 WATER FUN

Introduction:

Water is a miraculous compound. There is nothing else in the world like it. Not only does it taste good after a tough hike, look good when falling from cliffs, and feel good on a hot summer's day, it also makes the miracle of life (yours and mine!) possible. In this assignment you will see water in action and, no doubt, some of its actions will seem miraculous.

Assignment:

Do the following demonstrations, either to yourself or with your family. After each demonstration answer the analysis questions. If you are unsure of the answers to the questions, refer to the previous assignment (Assignment 2.3, "Water You Know About That") or to the notes at the end of this assignment.

1. Demonstration: BOAT DRIVE

- Materials: paper or transparency plastic, scissors, water, tray, eyedropper, dish detergent.
- Procedure: Cut a thick arrow out of paper or a plastic overhead sheet. Cut a circle out of the tail of the arrow. This is the "boat". Fill the tray with water and place the boat on the surface of the water in the tray. Using an eyedropper, place a single drop of detergent in the circle at the end of the arrow. Watch what happens to the boat.

Analysis

- a. What made the boat move?
- b. Was the boat pulled or pushed across the surface? Explain.
- c. What did the detergent do to the surface of the water?

2. Demonstration: QUICK PEPPER

- Materials: ground pepper, water, bowl, eyedropper, dish detergent, peppercorn, and clear drinking glass
- Procedure: Sprinkle some ground pepper on the surface of the water in the bowl. Is the pepper truly floating or just sitting on the surface. To find out, drop the peppercorn in the glass. Next use the eyedropper to place a single drop of detergent in the center of the bowl. Observe what happens.

Next, add a little more soap to the dish and watch what happens to the pepper.

Analysis:

- a. Did the peppercorn float on the water? The pepper flakes?
- b. What did the detergent do to the surface of the water?
- c. Why did the pepper sink at the end?

3. Demonstration: PENNIES

- Materials: 2 drinking glasses, water, pennies, and detergent
- Procedure: Fill each glass exactly to the brim with water. Pour a drop or two of detergent in one of the glasses. Add pennies to each glass, counting the number of pennies each glass will hold until water begins to overflow the glass. Observe what happens.

Analysis:

- a. What is the shape of the surface of the water before it overflows? Describe what you see.
- b. How many pennies were put in each glass?
- c. Why did fewer pennies fit into one of the glasses?
- d. What do you think the soap does to the molecules at the surface of the water?

4. Demonstration: COLORFUL CARNATION

- Materials: white carnation, red and blue food coloring, two small glasses or jars, scalpel or sharp knife
- Procedure: Cut the stem of a white carnation so that it is about 10 cm long. Carefully split the stem in half, lengthwise, cutting up towards the flower. Place one half of the stem in red food coloring and the other half of the stem in blue food coloring. Leave it over night.

Note: Use caution when cutting with the knife or scalpel.

Analysis:

- a. Why did the carnation change colors?
- b. Would it be possible to make a carnation turn three or four colors? How?
- c. If the water is not colored, does it move up the same way? How do you know?

5. Demonstration: TOWEL CLIMB

- Materials: two identical buckets, cloth towel, water
- Procedure: Fill one bucket with water and leave the other one empty. Put the two buckets side by side on a table or on the floor. Place a towel in the wet bucket and drape one corner of the towel in the dry bucket. Leave the set up over night.

Note: This set-up will work faster if a wet towel is used.

Analysis:

- a. Explain what happened.
- b. Is it possible for all the water to move to the second bucket? How?
- c. Will the water stop transferring itself at any point?
- d. What would happen if the empty bucket were higher? Lower?

6. Demonstration: LAYERING

- Materials: tall, clear vase or jar, water, oil, rubbing alcohol, food coloring
- Procedure: Pour blue colored water into the jar. Carefully and slowly pour oil down the inside of the jar so that it floats on top of the water. Next carefully and slowly pour red colored alcohol down the inside of the jar so that it floats on top of the oil. Observe the layers.

Analysis:

- a. Why don't the three layers mix together?
- b. Why factor determines the order in which the layers sit?
- c. What would happen if you put the liquids into the jar in a different order?

7. Demonstration: DIFFERENT SIZE CANDLES

· Materials: two jars, rubbing alcohol, water, two pieces of candle wax (one large and one small)

· Procedure: This is another great one for your friends, family, or siblings. Prepare two identical jars. Put water in one jar and alcohol in the other. Be sure to put the same amount of liquid in each jar. (Do not tell your family that one beaker does not have water in it.) Prepare two pieces of candle wax: one small and one large. Put the small one in the water and the large one in the alcohol. Ask for explanations of what happens to the different pieces of wax. Next switch the pieces of wax, putting the small one in the alcohol and the large one in the water. Observe what happens.

Analysis:

- a. Does the size of the candle piece make a difference?
- b. What characteristic of the candle determined whether or not it would float?
- c. Why did the wax float in one substance and not the other?

8. Demonstration: DISSOLVING SALT

* Procedure: Fill one small jar about half full of water, the other about half full of oil. Put 5 grams (about 1 teaspoon) of salt in each jar.

Analysis:

- a. What happens to the salt in water?
- b. What happens to the salt in oil?

c. How do you explain the difference?

NOTES:

SURFACE TENSION (Demonstrations 1, 2, and 3)

- * Cohesion -Is the tendency for molecules of the same substance to stick together.
- * Water's Invisible Skin -Below the surface all cohesive forces are balanced -At the surface, molecules are only attracted by other water molecules beside and below -This causes molecules at the surface to bunch together and form a "skin" on water.
- * Soap and Surface Tension -Soap reduces surface tension by breaking the cohesive forces of water.

CAPILLARY ATTRACTION (Demonstrations 4, 5, and 6)

- *Adhesion -Is the attraction between molecules of two different substances. -Some forms are more obvious: tape + skin, glue + paper, but also: water + skin
- *Capillary attraction -When the adhesive forces between the glass and the water are stronger than the cohesive forces between the individual water molecules, water will be more attracted to the glass -Water will then rise up the glass sides.
- *In a smaller glass tube, there is more glass compared to the amount of water in the tube and so the water rises up the tube. -
- *Capillary attraction is the rising of water up small openings -This permits water to rise up the spaces between threads in a dishcloth and cells in a plant stem.

SOLUBILITY (Demonstration 8)

Terms -

- * Solution =mixture combined on a molecular level
- * Suspension =mixture combined at a particulate level
- * Solvent =Substance in greater quantity that takes in the other ex water

* Solute = Substance in lesser quantity that is taken in by the other substance
ex sugar

* Solubility = how readily a substance will dissolve in a solvent

* Water is known as the "universal solvent"

* Polarity - Solubility depends on polarity - Polarity means that one end of the molecule tends to be negative while the other is positive. - Water, on the whole, is a neutral molecule. The charges are not evenly distributed. - Polar substances will dissolve in polar substances - Non-polar substances will dissolve in non-polar substances -

* They will not dissolve in the opposite - ex of polar: water, alcohol - ex. of non-polar: oil, benzene

DENSITY (Demonstrations 7)

* What is Density? - Measurement of the amount of matter contained in a given volume.

Density = $\frac{\text{Mass}}{\text{Volume}}$ = grams / cubic centimeter - Because one cubic centimeter = one gram of water, the density of one gram of water is: 1 gram = 1 cm³ - Density of water is 1g/cm³. Materials with a density smaller than 1 will float.

2.5 WATER WORLD

Introduction:

Ours is a water world. And thank heavens it is because if it were not a water world, we would not be able to survive here. The hydrosphere interacts with and influences all the other spheres in many, many ways

Assignment:

You have just completed demonstrations that explored many of the unique characteristics of water. Now your task is to design and conduct an experiment that investigates the interaction between water and an aspect of any other sphere. WOW! How exciting is that! You get to choose. And the world is your laboratory.

The options are limitless. All you have to do is choose something from another sphere (biosphere, atmosphere, or Geosphere) and design an experiment that explores how water interacts with something from that sphere.

I will give you an example of an experiment that explores the relationship between water and plants (a part of the biosphere). THIS IS ONLY AN EXAMPLE. You may NOT use this experiment for this assignment. [Most of you did this experiment in elementary school!]

The question might be “What is the effect of water on bean plants?”

The hypothesis might be “If I do not water bean plants then they will die.”

The experimental plan could be:

1. Get six bean plants that are the same species and as close to the same size as possible.
2. Put all the bean plants on the windowsill in the sunlight.
3. Give three bean plants a cup of water every other day. Do not give any water to the other three bean plants.
4. Visually inspect the plants once a day for 14 days.
5. Record observations on a data sheet.

See how easy it is! Remember, you cannot**do an experiment with water and plants for two reasons. One, you already know what the result will be. You probably did this already in second grade! Two, I have already outlined the experiment. Part of what you need to learn in this class is how to design your

own experiment. You cannot learn that by doing an experiment that I have already designed! So, off you go. Be creative. Design your own experiment. But wait! Be sure to read the directions below before you do anything!!!!

Materials:

- Whatever you decide

Assignment:

1. Determine what you want to find out when you do your experiment. Write down the QUESTION that you are trying to answer.

If you are having trouble coming up with a question, think of the various characteristics of water that you read about in Assignment 2.3 or explored in Assignment 2.4.

- Surface tension
- Solubility
- Density
- Capillary attraction
- Evaporation/transpiration
- Condensation
- Melting point
- Boiling point

Once you have decided on which characteristic of water that you would like to investigate, then start brainstorming about things that would influence that characteristic. For example, you could explore how the adding various substances (from other spheres) to water affects solubility, evaporation rates, or boiling point. Or ask if air temperatures affect transpiration rates, which types of soils hold the most water, or which types of fabric experience the greatest capillary attraction. Try to think of your own question. The possibilities are limitless.

2. Predict what you think the outcome of your experiment will be. (Hypothesis)

3. Design an experiment to test your prediction. Remember to include a control. Be very specific. Tell me exactly what you plan to do. Tell me how much of

everything you plan on using. Tell me how long you plan on running the experiment and how often you will check it. Tell me how you will record your data. I want details!!!

4. Submit your experimental design to me via email before going any further. I promise to give you feedback on your design within three days. If the design is scientifically sound, you may go ahead and conduct your experiment. If it has flaws, we will work together until you have designed a valid, reliable experiment--then you may go ahead and conduct your experiment.

5. AFTER you have received my go-ahead, conduct your experiment. Be sure to keep detailed lab notes. Your lab notes should contain a record of everything you did as well as all the data you collected. Each entry should have a date on it (month/day/year).

6. Follow the directions below to submit your assignment.

ANALYSIS

A. Re-send me your original question, your hypothesis, and your experimental plan.

B. Send me your lab notes. I want to the observations that you recorded. Do not simply send me a summary of your results. I want to see a record of your observations.

C. Based on your observations, write a conclusion. What does your data tell you? What did you learn from your experimental results?

D. What kind of relationships did you find between water and the aspect of the sphere you studied?

E. Do your findings support your hypothesis? Why or why not?

F. If you were to do this again, what would you change? Why?

G. What additional experiments could be performed?

2.6 WHERE IN THE WORLD IS OUR WATER?

Introduction:

Help! We're surrounded! Water, water everywhere! You cannot get away from it. Fortunately there is no need to escape. As you know from the previous assignments and from your own experience, water is very user friendly. In fact, water is very necessary for life.

Because water is so important for our existence, it important that we know where it is and how much there is. You may be surprised by what you find. For example, did you know that there is 100 times more water found in the atmosphere than there is in all the rivers of the world combined? WOW!!

Assignment:

- Identify the major reservoirs of Earth's water
- You must identify at least 8 reservoirs.
- Make a chart, a bar graph, or a pie graph showing how much of Earth's water is stored in the ocean and how much is fresh water.
- Make another chart, bar graph, or pie graph showing how much water is stored in each of the different types of fresh water reservoirs.
- Do NOT copy the graphs directly off the Internet.

[NOTE: A reservoir stores stuff. The Earth's largest water reservoir is the ocean. Other of Earth's water reservoirs include the atmosphere, ice caps, rivers, and so forth.]

There you go! That is it. Simply make TWO charts or graphs and you are done with the assignment. Send your work to me. If you can attach it to an email message, GREAT! If you cannot, send it to me via the postal service. (My address is on the INFORMATION page.)

2.7 I'M GOING IN CIRCLES! (OR IS THAT CYCLES?)

Introduction:

As you learned in the first quarter, matter cycles. That is, matter is continually re-used or recycled. Water is matter. It has been used over and over again. And it will be used over and over again as long as the sun shines.....which should be a very, very long time!

Water moves through different holding places (reservoirs) in the hydrosphere. Then energy from the sun moves water from one reservoir to another resulting in the water cycle.

The water we use has been cycled and recycled thousands, maybe millions of times. Take a glass of water. Inside that glass are more than ten million water molecules that once passed through the body of bison on the mid-western plains of the U.S. Also in that glass are more than ten million water molecules that passed once or twice through a dinosaur. Chances are good that you are drinking water used by Martin Luther King, George Washington, Napoleon, or Socrates. Imagine!

And, for this assignment, imagination is what you need, coupled with facts of course! Imagine you are a water molecule traveling through the water cycle. Write about your adventures.

Assignment:

Pretend you are a water molecule. Write about your adventures as you move through the water cycle. Your story MUST:

Water Cycle → <http://ga.water.usgs.gov/edu/watercycle.html>

Use your imagination! Send me the finished product. I look forward to reading about your adventures.

2.8 DON'T EAT YELLOW SNOW

Introduction:

Sometime in your life, someone (probably your mother) told you not to eat yellow snow. If you have ever hiked in the mountains, you should have been warned not to drink out of the streams unless the water has been filtered, boiled, or treated in some way. If you have traveled out of our country, you were probably advised to drink only bottled water. So, why all these warnings about water? Because many, maybe even most, of our water sources are polluted in some way or another. In this assignment you are going to examine and analyze data about water pollution.

Assignment:

PART ONE:

1. How do scientists measure the quality of our waters?
2. Give two reasons why scientists measure water's temperature.
3. What is D.O.?
4. Why is D.O. important in measuring water quality?
5. What affects the D.O. of a stream?
6. What is the pH range of "healthy" water?
7. Why is the pH of a stream important?
8. Identify four things that can happen if there are too many nutrients in the water.
9. Identify three toxic substances that scientists test for.
10. What is turbidity?
11. Why do scientists test water's turbidity?
12. Why are scientists concerned about the presence of fecal coli forms in a stream or lake?
13. How does a visual survey help a scientist determine water quality?
14. What is biological sampling?

15. How does biological sampling help a scientist to determine water quality?
16. Write a paragraph describing three big pollutants. Explain why each is a pollution problem.
17. Where are the majority of our pollutants coming from?
18. How does pavement increase water pollution problems?
19. How do straightened streams and cement-lined canals increase water pollution problems?

PART TWO: The first part of this assignment was a simple “read-and-write” exercise. The answers to the questions were all found in the reading material. The next part of this assignment requires you to think and analyze. Use the information you learned above to answer the following questions. Be sure to use COMPLETE SENTENCES to answer the questions.

1. Water released from a dam comes from the bottom of the reservoir, which means that it is VERY cold. Why would colder-than-normal water be considered a water pollution problem?
2. To build a housing development, engineers changed the path of a local stream. As a result the stream flowed more slowly than usual so the sun had more time to warm the stream waters. As a consequence the water temperature in the stream increased ten degrees Celsius. Why would warm water be considered a water pollution problem?
3. You test the D.O. in a local stream and find that it is much lower than normal. What conclusions can you draw from this data?
4. You test the pH of a local stream and find that it is 5.5. What does this data tell you?
5. You want your lawn to be extra green for an upcoming party so you double the recommended amount of fertilizer you apply to your lawn. What water pollution problem could occur as a result of your action? [Fertilizer is a plant nutrient. Think what would happen to local streams, rivers, and lakes if extra plant nutrients were added.]

6. Lead is found in your water supply. Why is this a problem?
7. A lake you love to visit is usually very clear. Road construction upstream has caused the lake to be very turbid. Give two reasons why this is a water pollution problem.
8. Cattle are grazed on the mountainside. Give two reasons why this might be a water pollution problem for the streams in the area.
9. You love to fish and have found that, by turning over rocks in the streams where you fish, you can find “rock rollers” (little worm-like insect larvae) that work well as bait. This year, when you go to fish, you find that, where there once were hundreds of “rock rollers”, now there are very few. Why does this indicate a water pollution problem?
10. How are water temperature and D.O. related?

2.9 WHERE DOES YOUR WATER COME FROM?

Introduction:

Ask some children where milk comes from and they will tell you “the store”. However, being the bright, intelligent, educated person that you are, you know that milk comes from a cow before it arrives in the dairy section of the local grocery store.

Where does your water come from? Some would say, “from the tap”, however, being the bright, intelligent, educated person that you are; you know that water does not originate at your faucet. But where, exactly, does your water come from? Finding out is the task of this assignment.

Assignment:

ANY STATE* Water Supply *

This assignment has TWO parts. Part One is a “read-and-regurgitate” assignment. You will read the information from Internet resources to answer the designated questions. Part Two is an investigative assignment. You will make a phone call or two and find out exactly where in YOUR STATE your water comes from. You must do BOTH parts to receive credit for the assignment.

Part One:

1. In YOUR STATE, when does the majority of the precipitation occur?
2. In YOUR STATE, what is the fall precipitation mostly used for?
3. In YOUR STATE, in which month does the most snowfall occur?
4. From which month to which month is considered a water year?
5. Where does the majority of YOUR STATE’s precipitation come in the winter?
6. Where does the majority of YOUR STATE’s precipitation come from in the summer?
7. What is the name of a reservoir that is relatively close to where you live?
8. What is the total capacity of that reservoir?

9. What is the average amount of water in that reservoir on Sept 30 of any year?

10. What is the current amount of water in reservoir?

Part Two:

A. What is the name of the water district that services your home?

B. What is the phone number of your local water district?

Call the phone number and ask the person who answers if you can interview them about water usage in your water district. You may have to make several phone calls. Do NOT give up until you have the required information. I know the information is available and will not accept excuses for not getting it. It may require some extensive effort but it can be done. Do it!

C. What is the name of the person with whom you spoke?

D. Where does culinary (the water that comes to the tap in your home) come from in your local district? Find out the specific name of the river, reservoir, or well that your water comes from. Do NOT just give the name of a water district.

E. Where does secondary (irrigation) water come from in your area? Find out the specific name of the river, reservoir, or well. Do NOT just give the name of a water district.

F. How does your water district deal with water shortages and drought?

G. How does your water district ensure that water is safe to drink?

H. What is the greatest water pollution issue locally?

FANTASTIC!! Now you are bright, intelligent, AND educated about where your local water comes from. Congratulations!

Send me your assignment. Be sure to include BOTH Part One and Part Two. If you do not send Part One and Two at the same time I will return the assignment to you. If you do send Parts One and Two and if you satisfactorily respond to all of the questions, then you will earn a great grade.

2.10 HOW MUCH WATER DO YOU USE?

Introduction:

What is with this “Don’t waste water!!!” stuff? Everyone always says, “Don’t waste water. Don’t waste water. Don’t waste water.”—Especially in times of reduced rain and snowfall. If water is matter, which it is, and if matter cycles, which it does, then why do we have to save water? Water will continue to cycle and cycle and cycle so we will never run out. What is the big deal? HUH???????

The big deal is that USABLE water may run out. It is true that water is matter. It is also true that water cycles and that it will never run out. The amount of water on the earth today is exactly the same as it was billions of years ago. Also true is the fact that water covers more than two-thirds of the earth. So, why not waste water? It is critical that we use water sparingly because less than one percent of Earth’s water is usable for drinking, agriculture, manufacturing, food processing, recreation, sanitation, and similar needs. The other 99 percent is in oceans and polar ice caps, generally inaccessible and/or unsuitable for human and animal needs. We should not waste water because the amount of usable water on Earth may run out.

So, how much water do you use? Find out!

Assignment:

Water Use in your State, Municipalities (cities), industries, and agriculture generally deplete less than half of the water that is diverted with the remaining water returning to streams or groundwater reservoirs. Instream flows for recreation, fisheries, and hydroelectric power generation use almost no water at all.

For 24 hours keep a log of the activities you do and the each activity requires. Send me the log of your activities and the total amount of water you used for one day.

HOW MUCH WATER DO WE USE?

Gallons per Day

Taking a bath or shower (per 5 minutes) 15-30

Washing dishes 15-60

Washing clothes 30

Cooking 10

Drinking 1/2

Toilets (per flush) 4-7

Washing the car 100

Water lawn and yard 180

Dripping faucet (1 drop per second) 4

2.11 EL NIÑO

Introduction:

Consider the physical dynamics of the oceans. WOW! That sounds like trouble! What do “physical dynamics” mean? It sounds hard and boring. Not to fear. Though it may be boring to some of you, it should not be too hard.

What is meant by “physical dynamics”? Physical refers to something that is observable and measurable. Dynamics are the way things work. So, the physical dynamics of the ocean refer to the measurable, observable ways that the ocean works. Not so bad, right? The physical dynamics of the ocean include things like tides, temperature, wave action, ocean currents, salinity (concentration of salt), and ocean depth.

The physical dynamics of the ocean are all abiotic factors. It should not be surprising to you that the abiotic ocean factors (the physical dynamics) affect the ocean’s biotic factors, i.e. the organisms that live in and around the ocean.

We often hear the term "El Nino" but few of us really understand what it means or how it affects us. El Nino is a physical phenomenon of the ocean that has a significant impact on both ocean life and human life. In this assignment you will describe El Nino and its impact on the Earth’s biosphere.

Assignment:

Using the Internet, find information related to El Nino. There are a multitude of Internet sources; you will probably find more information than you can possibly use. Using the information from at least THREE different Internet sources, write a THREE page, type written, double spaced essay that answers the following FOUR questions:

1. What are oceans currents? What are tides? Describe the ocean currents and tides, what they are; what causes them, where they normally flow, etc...
2. What is El Nino? Describe what it is and what causes it. How does it affect ocean currents and tides? Water temperature? Other abiotic factors?
3. How does El Nino affect ocean life in general?
4. How does El Nino affect us in Your State?

Write the essay using your own words and identify the Internet sites you used. Believe me, I will recognize the difference between your writing and the writing used by those who publish on the Internet. Also, since you are going to identify the sites you used, I can easily check and see if you used your own words or merely copied theirs!

Use good grammar, punctuation, and spelling. With spell check on most computers, there is no excuse for sloppy work. Grammar, punctuation, and spelling will count as part of the grade. It is very wise to have someone else proofread your work.

Grading:

Send your assignment to me. If your essay is written in your own words, if you have identified your Internet sites, and if your essay is at least three pages and adequately answers the four questions posed, you will receive a good grade.

2.12 QUESTIONS ABOUT SEA LEVEL

Introduction:

These days one hears a lot about rising sea levels. Alarmists predict that New York City and Los Angeles will soon be under water as warming temperatures melt the polar ice caps and cause the ocean levels to rise.

This may happen and it may not. Who knows what the future will bring?

While we cannot be certain about what will happen in the future, we are relatively certain about what happened in the past. Geologic records and fossil remnants offer strong evidence that shows how sea levels have changed over the history of the Earth. So what happened? In this assignment, you will be asking the questions.

Assignment:

Go to the following web site and read the information.

Sea Level and Climate

Based on what you have read, write questions for the answers below. That is right! You are to WRITE QUESTIONS. I have written answers below. Write questions for each answer. The answers I write will be in complete sentences. I expect you to write complete questions. Don't forget to include the question mark!

It is possible to write questions that match my answers that have nothing to do with changing sea levels. Do not expect to get credit for questions not relating to changing sea levels.

1. They are closely related.
2. A recent cold period in the 19th century.
3. It was about 125 meters below today's sea level.

HINT: The remaining answers are answers to analysis-type questions. The answers are not found in the reading. You will need to read the answers and figure out what type of analysis questions would result in the answers given. In other words, you will have to THINK!

There you have it! You are done with this assignment. Send me your questions. If you have written complete questions that relate to changing sea levels over geologic time, you will receive a good grade.

2.13 SEA CREATURE

Introduction:

The ocean holds a mysterious fascination. There are thousands of incredible creatures in our oceans—some of them seem too fantastic to be true. If you have always wondered about an ocean critter—and even if you haven't—now is your chance to make an in-depth (pun intended....in depth....bottom of the ocean....deep.....get it?) exploration of an ocean animal and the physical factors of the ocean that affect it.

Assignment:

Salinity

Depth

Wave action

Ocean currents

Tides

Water temperature

* *Predators—What eats it?

BE CREATIVE!

Use your creativity to convey your information to me. You may:

- * Do a PowerPoint Presentation.
- * Make a diorama and send me pictures of it.

Send the required information to me.

2.14 THE END

You have done it!! Congratulations! You are done with all of the assignments. (If you are not done with all of the assignments, please go back and finish them BEFORE you do this assignment.) You have nearly earned your .25 second quarter credit.

All that remains is a final course evaluation, a practice exam, and the final itself. Please complete the final course evaluation and the practice exam below. DO NOT DO THIS UNTIL YOU HAVE COMPLETED ALL OF THE PREVIOUS ASSIGNMENTS 2.1-2.13.

PART ONE:

1. What things (if any) did you like about the course?
2. What things (if any) need to be changed?

PART TWO:

Please complete the practice exam below. I will correct it and send you the results. This practice exam will be very helpful for you in taking the final.

Practice Exam

- a. To find out what effect changing something will have
 - b. A correction for experimental errors
 - c. A preliminary trial of the methods
 - d. An opportunity for repetition of the experiment.
-
1. In a lake organisms die and decompose. Decomposition uses large amounts of oxygen that was dissolved in the lake's water. The reduced level of oxygen in the lake would determine which of the following?
 - a. The number of trees living around the lake
 - b. The amount of rain water reaching the lake
 - c. The amount of clouds covering the lake
 - d. The kinds of water beetles living in the lake

2. In an investigation on salamander habitat sites, Juan's hypothesis was "There will be more salamanders found under rocks than on the bottom of the pond in the water." Juan lifted up all the rocks in a pond and found 13 salamanders. In the water, on the bottom of the pond, he found 33 salamanders.

1. What variable was Juan testing?

- a. The location salamanders prefer.
- b. The relative water temperature of the pond.
- c. Salamander eating preferences.
- d. The relationship between light levels and rock types at the bottom of a pond.

3. Water is a bipolar molecule. What does this enable it to do?

- a. It can solve any problem
- b. It can dissolve many substances
- c. It is found many places in the universe
- d. It is part of most living things

4. What is upwelling?

- a. When water, instead of oil, comes out of an oil well.
- b. When currents bring nutrients from the ocean floor to the ocean's surface
- c. The exchange of currents at the mouth of a river.
- d. Currents created by undersea volcanoes

5. What is the main cause of ocean currents?

- a. Tides

- b. Temperature differences
 - c. Waves
 - d. Wind
6. Temperature changes in the surface waters of the Pacific Ocean that cause changes in weather patterns around the world are caused by a phenomenon called:
- a. El Nino
 - b. Global warming
 - c. The Greenhouse Effect.
 - d. Ozone depletion.
7. Which of the following is the most direct effect of El Nino?
- a. Increased amounts of skin cancer
 - b. The greenhouse effect
 - c. Ozone depletion
 - d. Changes in ocean currents
8. Where is the most nutrient-rich water that is best suited for fish to find food?
- a. In deep-sea trenches
 - b. Where the tides are at their lowest
 - c. In areas of upwelling
 - d. Where currents collide and form whirlpools

Once I have received the above information, I will correct your practice exam and will give you feedback.

1. What is the purpose of including a control in a scientific investigation? To provide:

- * a. a basis for comparison
- b. a correction for experimental errors
- c. a preliminary trial of the methods
- d. an opportunity for repetition of the experiment.

2. In a lake organisms die and decompose. Decomposition uses large amounts of oxygen that was dissolved in the lake's water. The reduced level of oxygen in the lake would determine which of the following?

- a. the number of birds living around the lake
- b. the amount of run-off reaching the lake
- c. the amount of sunlight reaching the lake
- * d. the kinds of fish living in the lake

3. Where is the majority of the Earth's water found?

- a. In rivers
- b. In lakes
- * c. In oceans
- d. In wetlands

4. Why is water called the universal solvent?

- a. it can solve any problem
- * b. it can dissolve many substances
- c. it is found many places in the universe
- d. it is part of most living things

5. Which of the following aspects of stream water would NOT affect the types of life that could live in the stream?

- a. temperature
- b. turbidity

- c. dissolved oxygen content
- * d. molecular composition of water

6. What property of water allows ice to float at the North and South poles?

- * a. Liquid water is more dense than ice.
- b. Large pieces of ice float better than small ones.
- c. Water changes color when it changes from ice to liquid water.
- d. Water changes temperature when it changes from solid to liquid.
- e. Ice at low latitudes is more dense than ice at higher latitudes.

7. Water moves against gravity up a tree stem and upwards through soil. What property of water allows this to happen?

- a. density
- b. solubility
- c. color
- * d. capillary attraction
- e. taste

8. Water expands when it freezes. What would happen if water did NOT expand when frozen?

- * a. Ice would sink, ponds would freeze from the bottom up, and many aquatic plants and animals would die.
- b. Water would be more dense than wood therefore wood would not float. Beavers would be adversely affected.
- c. The surface tension would be destroyed. Water striders and other creatures that walk on the water's surface would sink.
- d. Water would not evaporate therefore clouds would not form. There would be no snow or rain.
- e. Water would not dissolve many substances. It would be impossible to make root beer or clean bathrooms.

9. Where in the ocean would large schools of fish most likely be found?

- a. in deep water
- * b. in areas of up welling
- c. near river mouths
- d. near undersea volcanoes

10. What is the main cause of ocean tides?

- a. currents
- * b. the sun and the moon
- c. waves
- d. wind

11. Ocean organisms have adapted to live in salty water. Chin Li is curious about what range of salinity ocean organisms can tolerate. Which of the following field studies could she conduct to satisfy her curiosity?

- * a. Expose sea urchin eggs to saline solutions of varying concentrations and collect data on egg survival rates.
- b. Expose sea urchin eggs to salt water of varying temperatures and collect data on egg survival rates.
- c. Expose goldfish eggs to saline of varying concentrations and collect data on egg survival rates.
- d. Expose sea urchin and goldfish eggs to fresh and salt water and collect data on egg survival rates.
- e. Expose sea urchin eggs to solutions of varying saline concentrations and temperatures and collect data on egg survival rates.

12. What is El Nino?

- * a. Temperature changes in the surface waters of the Pacific Ocean causing weather changes around the world.
- b. An increase in temperatures around the world caused by increased amounts of CO₂ in the atmosphere.
- c. An increase in the amount of ultraviolet radiation that comes to the earth caused by CFC's.
- d. World wide reversals of tidal patterns caused by solar flares.

13. Which of the following is the most direct effect of El Nino?

- a. Increased amounts of skin cancer
- b. The greenhouse effect
- c. Ozone depletion
- * d. Reduced upwelling in costal areas

14. Match the following properties of water with their corresponding role in Earth's Systems. Properties may be used more than once.

- [b] 1. Fish can breathe under water because water carries dissolved oxygen.
- [f] 2. The change of water from liquid to gas helps your body cool down when you sweat.
- [b] 3. Water removes salt from rocks as it flows over and through them.
- [c] 4. Water moves up the stems of plants and trunks of trees.
- [a] 5. Water striders can “walk” on the surface of water
- [d] 6. Polar ice caps float on the ocean surface.
- [e] 7. Oil floats on top of water
- [e] 8. Wax floats in water but not in alcohol.
- [b] 9. Sugar dissolves in water but not in oil.
- [f] 10. Liquid water quickly disappears from rock cavities in hot, dry climates.
- [a] 11. Water forms “piles up” when dropped on the top of a penny.
- a. surface tension
 - b. universal solvent
 - c. capillary attraction
 - d. expands when frozen
 - e. density
 - f. evaporation

15. When do areas of upwelling in the ocean occur?

- a. When fish gather for feeding
- b. When the tides are at their lowest
- * c. When surface water is replaced by deep water
- d. When currents collide and form whirlpools

Quarter 3

3.1 “GETTING TO KNOW YOU”**

Hi! Your first assignment is to introduce yourself to me I want to know who you are and what you like. But wait!! I don't want you to tell me. I want to hear what your pet would say about you. Introduce yourself through the eyes of your pet. That's right! Give voice to your pet and let him/her introduce you to me. If your pet could talk, what would it say about you? Tell me! If you do not have a pet, let your room introduce you. You can include information about where you live, your school and schooling, and what your personal interests and hobbies are.

Let me introduce myself through the eyes of my ram lamb. [A ram lamb is a young male sheep.]

There you have it: The Teacher as seen through the eyes of her ram lamb. I taught high school biology for five years. Now I teach this online Earth Systems course. I love to run, read, and camp in the mountains...and I really don't use 2 x 4's on anything but ram lambs!! Most of all I love my adorable husband and four charming children.

Assignment:

1. Write a paragraph introducing yourself through the eyes of your pet (or your room if you do not have a pet.)
2. Be sure to label your assignment (Assignment 3.1) and put your first and last name on it.
3. Submit your assignment.
4. Have a great day!!

3.2 STAYING ON COURSE!!

Have you ever noticed that every teacher has different rules and expectations? It is so easy to get confused and “off course” when trying to navigate different classes in this “river” we call the Electronic. This assignment is designed to help you “stay on course” in Earth Systems.

Assignment:

1. What is the name of the textbook for the course?
 - a. Earth Systems Science
 - b. Getting to Know the Earth as a System
 - c. Eating Elephants for Energy
 - d. There is no official textbook.

2. During this Earth Systems science course, I will be:
 - a. Taking field trips
 - b. Doing experiments
 - c. Reading and writing
 - d. All of the above

3. In order to receive credit, I must:
 - a. Do all of the assignments. I will not receive credit unless I satisfactorily complete ALL of the assignments.
 - b. Earn at least 60% of the possible points.
 - c. Send The Teacher chocolate.
 - d. Complete as many assignments as I need to in order to earn the grade that I want.

4. All assignments are labeled. Assignment 1.4 means:
 - a. First quarter, fourth assignment
 - b. Fourth quarter, first assignment
 - c. Fourth inning of the first game in the play-offs
 - d. Part four of assignment one

5. To find out my grades I:
 - a. Click on Student Tools on the left side bar and then click on “My grades”.
 - b. Click on Information on the left side bar and then enter my name.
 - c. Email The Teacher and ask her to look up my grade.
 - d. Click on Groups, enter my name, and then record whatever grade I think that I earned on the assignment.

6. To submit an assignment, I:
 - a. Email the assignment to The Teacher to the address provided
 - b. Send the assignment to the office.
 - c. Give the assignment to one of the science teachers at my school.
 - d. Decide not to do the assignment and tell The Teacher that I sent it to her but it must have got lost in cyber space.

7. If I submit an assignment that is incomplete or unacceptable, then The Teacher will:
 - a. Return the assignment to me with instructions on what needs to be done in order to earn credit for the assignment.

- b. Return the assignment with a big fat LOSER written on it and drop me from the course
 - c. Give me a failing grade on the assignment.
 - d. Contact my parents.
8. If I get a low score on an assignment and I want to improve my score, I should:
- a. Contact the Electronic principal.
 - b. Whine and complain to my friends.
 - c. Ask my parents to write The Teacher a note explaining why I should get a better score.
 - d. Make the suggested corrections on the assignment and re-submit it for a better score. I can always correct and re-submit assignments.
9. All assignments are worth:
- a. 10 points
 - b. 100 points
 - c. 5,000,000,000,000,000,000,000,000 points
 - d. The point value of each assignment varies depending on how hard the assignment is.
10. If I submit an assignment to The Teacher and it somehow gets lost in cyber space (i.e. for some reason she does not receive my assignment) then I do not have to worry about it because:
- a. The Teacher is very nice. She will understand and will give me credit for the assignment even though she has not seen it.

b. Things like that happen all the time so it is okay if I do not turn in one or two assignments.

c. Superman will rescue my assignment from the vast voids of cyber space and will submit it for me.

d. I have followed the advice to ALWAYS keep a back up copy of my work. I can simply access my back up copy and re-send the lost assignment.

11. Which of the following assignments would earn a score of 10/10, A?

a. I did MORE than was required by the assignment. For example, I wrote longer answers than necessary or I included graphics or I used some extra creativity.

b. I wrote a correct answer for every question.

c. I sent The Teacher pizza AND told her that her children are adorable.

d. I copied the essay from a friend who got a score of 10/10, A, on the assignment.

12. When doing assignments:

a. I can do the assignments in any order that I wish.

b. I must do the assignments in numerical order.

c. I have to sit in a dark corner and chant "The Teacher is the greatest teacher in the world" ten times. It is better if I do the chant in Latin.

d. All of the above.

13. If I have a question I can:

a. Email The Teacher at the address provided. She is very willing to help me.

- b. Ask my parents, friends, or a teacher at school for help. They can help me but I will do the actual work myself.
- c. Search online for information.
- d. All of the above.

3.3 THE CARBON CYCLE

Welcome to THIRD QUARTER! In this quarter we will examine the atmosphere and its interactions with the other spheres.

Earth's atmosphere interacts with and is changed by the Geosphere, hydrosphere, and the biosphere. The atmosphere changes rapidly compared to the other spheres. Atmospheric changes affect climate and life over short and long periods of time.

In your first assignments, you will describe how matter in the atmosphere cycles through the other Earth systems.

What is matter? We reviewed matter in the first quarter of this course. What did you learn? Hopefully, you recall that matter is anything that occupies volume and has mass, i.e. anything that has weight and takes up space.

Does the atmosphere take up space and have weight? Is air matter? The answer is YES to both questions. Think about a tire. When the tire is flat it weighs much less than when it is filled. It also takes up less space when it is empty. It is air that makes tires bigger and weighs more. Air is matter.

Introduction:

Carbon is a vital element in your life. Every cell in your body contains carbon. Carbon is in the air you breathe, and the food you eat. It is everywhere---you are surrounded!!!!

In eighth grade you learned about chemical and physical change. To review: In a physical change molecules change phase (liquid, solid, or gas) but they do not change their molecular composition. The water cycle is a good example of physical change. In the water cycle, water changes form from liquid (lake) to gas (evaporates to clouds) to solid (falls as snow).

Chemical change occurs when bonds between atoms are either made or broken (or both) and molecules change composition. The carbon cycle is a good example of chemical change. For example when plants take carbon dioxide out of the air the bonds between the carbon and oxygen in carbon dioxide are broken and the carbon forms new bonds with hydrogen and oxygen to form sugar. Carbon undergoes many chemical changes as it moves through the carbon cycle.

Assignment:

Your task is to trace the movement of a carbon atom

- * from the atmosphere,
- * through a plant,
- * animal, and
- * a decomposer, and
- * back into the atmosphere.

You may write a story, compose a poem, make a power point presentation, or construct a diagram. Whatever for you chose to use, you MUST trace a carbon atom through the above five steps. You also MUST correctly use the following words in your presentation:

- * carbon dioxide
- * photosynthesis
- * sugar
- * respiration
- * decomposition

The following web sites may be useful to you:

[Woods Carbon Cycle](http://www.whrc.org/carbon/index.htm) - <http://www.whrc.org/carbon/index.htm>

[Wheeling Carbon Cycle](http://library.thinkquest.org/11226/why.htm) - <http://library.thinkquest.org/11226/why.htm>

[The Carbon Cycle](http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/C/CarbonCycle.html) -

<http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/C/CarbonCycle.html>

When you have completed the assignment, send it to me. If you can send it electronically, do so. If not, send it via regular mail. (My address is in the INFORMATION section.)

3.4 NITROGEN: RUNNING IN CYCLES

Introduction:

In the previous assignment, you studied the carbon cycle. In a previous unit, you described the water cycle. Carbon and water are matter. As you learned in the first unit, matter cycles. Nitrogen is another form of matter that cycles. Like water and carbon, nitrogen is essential to life. Also, like water and carbon, its cycles affect you. Therefore it is important that you learn about the nitrogen cycle, how it affects you, and how you affect it.

Assignment:

There are three parts to this assignment. You must complete all three parts to receive credit for the assignment. Be sure to turn in all three parts at the same time. I will not correct partial assignments. THANKS!

PART ONE:

1. Describe the nitrogen cycle. Describe how nitrogen goes from the atmosphere to a form usable to plants, how it is used and excreted by animals, and how it returns to the atmosphere. In your description be sure to explain the words:

- * decay
- * denitrification

PART TWO:

Write a short paragraph describing at least two ways the nitrogen cycle affects you. Why is nitrogen important to you? How is it used in your body? How is it used in your community? BE SPECIFIC. At least one of the ways you identify must be a way that nitrogen is used in your body.

PART THREE:

Identify and describe at least two ways that you and other humans affect the nitrogen cycle. Provide examples of how human activities affect the nitrogen cycle.

When you have complete all three parts of the assignment, label it, put your name in it, and submit it to me.

3.5 EVIDENCE, INFERENCE, AND THE CARBON CYCLE

Introduction:

Evidence. What is it? The dictionary defines evidence as the means of proving or disproving something. In other words, evidence is used as proof. In science evidence is something that has been observed and measured. If you looked at a thermometer placed on a tree outside and observed that it read 7 degrees Celsius, then you could say "The outside temperature is 7 degrees Celsius" and it would be considered evidence.

Inferences. What are they? The dictionary says that an inference is a statement that is derived from evidence. It is a product of reasoning. It is not a result of direct observation or measurement. From the fact that it is 7 degrees Celsius outside, you could infer that it is winter. Or you could infer that the person making the observation lives in Alaska. Both of these possible inferences would be based on the evidence (7 degrees Celsius outside) and would be a result of you using your reasoning skills to make a conclusion.

The cyclic movement of carbon atoms in the biosphere has a tremendous impact on your life, whether you are aware of it or not. Were it not for the carbon cycle you would have no food to eat, no gasoline for your car, and no paper to write on. In fact, you would not exist. The carbon cycle impacts your life in a "big way".

Just as the carbon cycle impacts your life, you also have an impact on it. The fuels you use, the products you buy, and the legislation you support all influence the carbon cycle. In the assignment that follows you will learn how people in general and you in particular, affect the carbon cycle. You will do so by identifying evidence and stating inferences.

Learning the difference between evidence and inference is difficult at first so let's practice. Read the paragraph below:

The carbon dioxide content of the atmosphere is gradually and steadily increasing. The increase in CO₂ probably began with the start of the industrial revolution. Samples of air trapped over the centuries in the glacial ice of Greenland show no change in CO₂ content until 300 years ago. The concentration of carbon dioxide in the atmosphere continues to increase. The CO₂ concentration at the summit of Mauna Loa in Hawaii from was about 318 part per million (ppm) 1958. In 1999 it was approximately 371 ppm. . Since measurements of atmospheric CO₂ began late in the nineteenth century, its concentration has risen over 20%. This increase is surely "anthropogenic"; that is, caused by human activities.

Look at the first sentence. Is it evidence or inference? Measurements of the Earth's atmosphere indicate that the carbon dioxide content of the atmosphere is

indeed increasing. Because the statement is based on measurements, it is considered EVIDENCE.

Look at the second sentence now. Is it evidence or inference? The sentence seeks to explain the increase in atmospheric carbon dioxide content. It is not based on measurement. It is INFERENCE.

Take a little quiz. Identify the remaining sentences as either EVIDENCE or INFERENCE.

1. Samples of air trapped over the centuries in the glacial ice of Greenland show no change in CO₂ content until 300 years ago.”
2. The concentration of carbon dioxide in the atmosphere continues to increase. The CO₂ concentration at the summit of Mauna Loa in Hawaii from was about 318 part per million (ppm) 1958. In 1999 it was approximately 371 ppm.”
3. Since measurements of atmospheric CO₂ began late in the nineteenth century, its concentration has risen over 20%.
4. This increase is surely "anthropogenic"; that is, caused by human activities.

The answers are:

1. Evidence
2. Evidence
3. Evidence
4. Inference

How did you do? The first three statements are based on measurements. They are considered evidence. The last sentence uses reasoning to explain the evidence therefore it is inference.

SO...Let's do a little review. A statement of evidence is a statement of a measurement or direct observation. An inference explains or extrapolates conclusions from the evidence; it often tries to explain WHY the evidence is what it is or what a probable result of the evidence may be. Inferences are often accompanied by words such as:

- * ...is thought
- * ...seem
- *estimate

- *surely
- *probably
- *maybe.

3.6 WHAT'S UP WITH OZONE?

Introduction:

Earth's atmosphere interacts with and is changed by the Geosphere, hydrosphere, and the biosphere. The atmosphere changes rapidly compared to the other spheres. Atmospheric changes affect climate and life over short and long periods of time.

Ozone is an atmospheric gas. It is an excellent example of how the atmosphere interacts with and is changed by the biosphere, how the atmosphere changes rapidly compared to the other spheres, and how atmospheric changes affect climate and life over short and long periods of time.

So, what's up with ozone? You have probably heard many conflicting things about ozone. Sometimes the local news refers to ozone levels as dangerous and warns people with breathing problems to stay inside. At other times the news talks about ozone depletion and tells us that destroying ozone is a bad thing. So.....is ozone bad or good? The answer to this question is "YES". Ozone is both bad and good for us. In this assignment you will write an essay that describes both the beneficial and harmful aspects of ozone.

Assignment:

Using the Internet sites below, find information related to ozone. Write a 500-750 word, type written, double spaced essay that includes the following information:

- * Describe the ozone molecule.

Write the essay using your own words and identify the Internet sites you used. Believe me, I will recognize the difference between your writing and the writing used by those who publish on the Internet.

Use good grammar, punctuation, and spelling. With spell check on most computers, there is no excuse for sloppy work. Grammar, punctuation, and spelling will count as part of the grade. It is very wise to have someone else proofread your work.

Suggested site(s) for resources -

[Ozone Layer: Important Components of Ozone Education](http://www.umich.edu/~gs265/society/ozone.htm) -
<http://www.umich.edu/~gs265/society/ozone.htm>

[Atmospheric Chemistry: Formation of the Ozone Layer](http://atoc.colorado.edu/~fasullo/pjw_class/chem3.html) -
http://atoc.colorado.edu/~fasullo/pjw_class/chem3.html

When you have completed your essay, submit the assignment to me.

3.7 YOUR STATE'S ATMOSPHERE AND YOU

Introduction:

There are many different climates in every state and each locale has its own unique geographic features. The geographic features in your area affect your local weather in very specific ways.

Large bodies of water are slower to warm and slower to cool than landmasses thus they have a moderating effect on weather. Large bodies of water may also provide a source of water for evaporation, thus increasing precipitation (lake effect). People along the Wasatch Front experience weather inversions because they live in a bowl between two mountain ranges.

Large land areas, especially those that are not vegetation covered, may be subject to rapid, significant temperature fluctuations. Mountains may either significantly increase your precipitation or significantly decrease it, depending on which side of the mountain you live. As part of this assignment you will assess your local geography and determine how it affects your local weather.

Assignment:

Look at your area. What influences your weather locally? Describe the mountains, lakes, large areas of desert, or other geographic features that influence your weather.

Write a 200 word, double spaced, typed paper, describing the geographic features of your local area and explaining how they affect your local weather. Spelling and grammar count towards your grade.

When you have completed the assignment, submit it to me.

3.8 WORMOLOGY

Introduction:

The atmosphere surrounds us all and, consequently, affects all of us. Atmospheric conditions affect you, your family, your friends, and the maniac down the street. They also affect all the plants and animals in the area. As part of this assignment you will design and conduct an experiment that investigates the effects of a specific atmospheric conditions on worms.

Assignment:

You will design and conduct an experiment that answers the following question: How does a specific atmospheric condition affect worms (life)?

In designing and conduction your experiment, please keep the following guidelines in mind:

- Worms should not be harmed maliciously
- Be careful when handling the acid rain solution, should you decide to use it.

Materials, facilities, and resources: Materials can be added or subtracted as needed. The following are a few ideas of things you may or may not want to use. You will certainly not need to use all of them. You may want to use some items that are not listed. You should be able to borrow these materials from your local high school teacher or purchase them for a minimal amount at local stores.

- * Small paintbrushes
- * Straws
- * String
- * Colored light sources
- * Thermometers
- * UV light source
- * Wind source (fan)
- * Ice
- * Scales

1. Determine exactly, which changed atmospheric condition you would like to simulate in your experiment. For example, you may want to test the effect of acid rain on worms or global warming or increased carbon dioxide levels, etc. Decide on the specific question that you would like to test and write it down.

2. Write a hypothesis that answers your question. For example, "If earthworms are subjects to a 10 F degree increase in temperature (global warming) then they will become less active and lose weight."
3. Write a set of procedures that will test your hypothesis. Be sure to include a time line. Your experiment may last a little as 60 minutes or as long as a week. You do not need to plan an experiment that lasts longer than a week.
4. SEND your question, hypothesis, and procedures to me. You MUST get your experiment design approved before you continue. Any work done before you receive my approval may not be counted.
5. AFTER you have received my go-ahead, conduct your experiment. Be sure to keep detailed lab notes. Your lab notes should contain a record of everything you did as well as all the data you collected. Every entry on your lab notes should be dated (month/day/year)
6. Follow the directions below to submit your assignment.

ANALYSIS

- A. Re-send me your original question, your hypothesis, and your experimental plan.
- B. Send me your lab notes. I want to the observations that you recorded. Do not simply send me a summary of your results. I want to see a record of everything you did as well as the data you collected.
- C. Based on your observations, write a conclusion. What does your data tell you? What did you learn from your experimental results?
- D. What kind of relationships did you find between worms and your selected atmospheric condition?
- E. Do your findings support your hypothesis? Why or why not?
- F. If you were to do this again, what would you change? Why?
- G. What additional experiments could be performed?

3.9 COOL! WARM! HOT! FRIGID! OR.....

Introduction:

We would not survive long without air.....only about six minutes in fact. Fortunately, air is all around us so we do not have to try to survive without it. Air has a huge effect on the biosphere. It also has significant effects on the other spheres. Cool!Or warm.....Or frigid..... Or muggy.....Or super hot.....depending on the air temperature at the time.

Assignment:

You have just completed an experiment that investigated the relationship between worms and some aspect of the atmosphere. Now your task is to design and conduct an experiment that investigates the interaction between the atmosphere and an aspect of any other sphere. WOW! How exciting is that! You get to choose. And the world is your laboratory.

The options are limitless. All you have to do is choose something from another sphere (biosphere, atmosphere, or Geosphere) and design an experiment that explores how the atmosphere interacts with something from that sphere.

I will give you an example of an experiment that explores the relationship between air and water (a part of the hydrosphere). THIS IS ONLY AN EXAMPLE. You may NOT use this experiment for this assignment. [Most of you did this experiment in elementary school!]

The question might be “What is the effect of air temperature on water evaporation rates?”

The hypothesis might be “If the air temperature is warm then water will evaporate more quickly than it will in cooler air temperatures.”

The experimental plan could be:

1. Get two different containers and put 1 liter of water in each container.
2. Put one container in the closet of a warm room. Label the container and record the temperature of the room.
3. Put the second container in a closet in the cooler, un-insulated garage. Label the container and record the temperature of the garage.
4. Measure the water level in each container after seven days.

5. Subtract the amount of water left in each container from 1 liter to find out how much water evaporated from each container.

6. Record observations on a data sheet.

See how easy it is! Remember, you cannot**do an experiment with water and air for two reasons. One, you already know what the result will be. You probably did this already in elementary school. Two, I have already outlined the experiment. Part of what you need to learn in this class is how to design your own experiment. You cannot learn that by doing an experiment that I have already designed! So, off you go. Be creative. Design your own experiment. But wait! Be sure to read the directions below before you do anything!!!!

Materials:

- Whatever you decide

Assignment:

1. Determine what you want to find out when you do your experiment. Write down the QUESTION that you are trying to answer.

If you are having trouble coming up with a question, think of the many things associated with the atmosphere. Some examples include:

- Weather (wind, dew point, humidity, evaporation, transpiration)
- Pollution (car exhaust, acid rain, ozone pollution in the lower atmosphere, smoke)
- Erosion
- Oxidation (rusting or other changes that happen when things are exposed to air)

Once you have decided on which aspect of the atmosphere that you would like to investigate, then start brainstorming about things that would influence that aspect. For example, you could explore how air speed (wind) affects evaporation rates or how car exhaust affects plants or how exposure to air affects sugar. Try to think of your own question. The possibilities are limitless.

2. Predict what you think the outcome of your experiment will be. (Hypothesis)

3. Design an experiment to test your prediction. Remember to include a control. Be very specific. Tell me exactly what you plan to do. Tell me how much of everything you plan on using. Tell me how long you plan on running the

experiment and how often you will check it. Tell me how you will record your data. I want details!!!

4. Submit your experimental design to me via email before going any further. I will give you feedback on your design within three days. If the design is scientifically sound, you may go ahead and conduct your experiment. If it has flaws, we will work together until you have designed a valid, reliable experiment--then you may go ahead and conduct your experiment.

5. AFTER you have received my go-ahead, conduct your experiment. Be sure to keep detailed lab notes. Your lab notes should contain a record of everything you did as well as all the data you collected. Each entry should have a date on it (month/day/year).

6. Follow the directions below to submit your assignment.

ANALYSIS

A. Re-send me your original question, your hypothesis, and your experimental plan.

B. Send me your lab notes. I want to the observations that you recorded. Do not simply send me a summary of your results. I want to see a record of your observations. Be sure to include dates and measurements.

C. Based on your observations, write a conclusion. What does your data tell you? What did you learn from your experimental results?

D. What kind of relationships did you find between water and the aspect of the sphere you studied?

E. Do your findings support your hypothesis? Why or why not?

F. If you were to do this again, what would you change? Why?

G. What additional experiments could be performed?

3.10 PROVE IT

Introduction:

Republicans and Democrats, business people and environmentalists, scientists and scientists.....all of them have something in common. They all disagree about the Earth's changing climate. Who is telling the truth? Where is the proof that will tell us what is really happening to the Earth's climate? In the assignment that follows you will read an article that describes scientists' efforts to discover what is happening to our climate?

Assignment:

Find two or more articles with opposing views regarding the Earth's changing climate. Include the title, the author and the publication when referencing your responses to the following:

1. Do scientists agree that the Earth is currently experiencing a human caused increase in the greenhouse effect?
2. Name two pieces of evidence that do NOT support global warming.
3. Why don't scientists know what is causing climate change?
4. Why is Greenland a better indicator of global climate change than Antarctica?
5. Identify five possible explanations for Greenland's thinning ice sheet.
6. Why is it risky to make inferences about global climate change from a five year study?
7. Identify three things that scientists use to learn about Earth's past climate.
8. Identify two things that cause natural climate variations.
9. What does QED stand for and what does it mean?
10. How do scientists prove causation? (Causation is the cause of something.)
11. Why is disagreement among scientists inevitable when discussing global climate change?
12. Identify three ways that technology is used to monitor and learn about climate change.

13. Can two very smart; very good scientists have two very different opinions about global climate change? Explain your answer.

14. The article says that there is no single indicator that will prove or disprove theories about climate change. It says the scientists must reach a consensus about what they think is happening. What is a consensus?

15. If scientists cannot explain what is causing climate change, what good is science? Explain why science is useful even if it does not provide all the answers.

16. Can science prove what is causing global climate change? Why or why not?

3.11 MODELING THE GREENHOUSE EFFECT

Introduction:

The sun is the major source of Earth's energy. Some of the solar radiation that reaches Earth is reflected but most is absorbed. Gases in the atmosphere trap some of the heat energy that is absorbed and delay its radiation into space. This greenhouse effect retains energy longer in the Earth system.

Refer to the following web sites to understand what the greenhouse effect is, how it works, and why it is vital to life on Earth.

Greenhouse—Green Planet →

<http://www.pbs.org/wgbh/nova/ice/greenhouse.html>

EPA Kid's Site for Greenhouse Effect →

<http://www.epa.gov/climatechange/kids/greenhouse.html>

Your task is to design a model that demonstrates the reduction of heat loss (which is another way of saying that the heat is trapped) due to a greenhouse effect. Your model may be as creative or as boring as you wish. The important thing is that your model must demonstrate the reduction of heat loss due to a greenhouse effect. In other words, your model must show that a barrier of some sort traps the sun's energy and keeps the heat on Earth. For examples, a car is a classic example of the greenhouse effect in action. The sun's energy enters the car through the windows. The sun's radiant energy hits the car's seats and is converted to heat energy. The heat energy is trapped by the car's windows and roof and so the car's interior warms up. Heat loss is reduced by the greenhouse effect that takes place in the car.

You cannot use a car as your model---that would be too easy. Use your creativity to create a MODEL that shows how heat loss is reduced by a greenhouse effect. Remember that a model is not a diagram. You will not be drawing a picture. You will make something and take temperature measurements. See the assignment that follows for more details.

Assignment:

Materials:

- * thermometer
- * whatever else you need

1. Decide what type of model you will make. When you design your model you must have a way to measure the temperature inside the model BEFORE placing it in the sun and AFTER it has been in the sun for several hours. Ideally you will be able to take the temperature inside the model at regular intervals during the day however, at the least, you must be able to take an initial and final temperature.
2. Write a brief description of what you intend to do. Your description should include:
 - A description of what your model will look like and how you will make it
 - A plan for how you will measure the temperature inside and outside your model.
3. STOP!!! Email your description to me. I promise to respond quickly to your email.. If the design is scientifically sound, you may go ahead. If it has flaws, we will work together until you have designed a valid, reliable model---then you may go ahead.
4. AFTER you have received my go-ahead, make your model.
5. Be to measure the temperature before you put the model in the sun and after the model has set in the sun for several hours. Also measure the temperature of the air outside the model. At the very least you should have a starting and ending temperature measurement for the temperature inside and outside the model.
6. Make a graph and/or table of the data that you collect.
7. Answer the following questions: [Use complete sentences to answer the questions.]
8. Follow the directions below to submit your assignment.

ANALYSIS

- A. Re-send me a description of the model that you built.
- B. Send me a graph of your data (temperatures inside and outside the model, before and after the investigation. I want to the observations that you recorded. Do not simply send me a summary of your results. I want to see a record of your observations.
- C. Based on your observations, write a conclusion. What does your data tell you? What did you learn from your experimental results?

- D. Did your model demonstrate a reduction of heat loss due to a greenhouse effect? If so, how did it demonstrate a reduction of heat loss? Give evidence to support your answer. If not, explain why it did not demonstrate a reduction of heat loss.
- E. How is your model like the Earth's greenhouse effect?
- F. How is your model unlike the Earth's greenhouse effect? (Hint: Consider air currents when answering this question.)
- G. In your own words, explain what a greenhouse effect is.
- H. What causes the Earth's greenhouse effect?
- I. What is a greenhouse gas?
- J. Name three greenhouse gases.
- K. Why is the greenhouse effect vital for life on Earth?

3.12 MORE INTERACTIONS!

Introduction:

Interactions, interactions, and more interactions! Are you sensing a theme here? Earth systems interact with each other. In this almost final assignment of third quarter, you will again describe interactions. This time you will describe interactions between the atmosphere and each of the other spheres. By now you should be an expert on interactions. This will be a quick and easy assignment for you.

Assignment:

Each description should be written in COMPLETE SENTENCES. Do NOT write one or two word answers. In each description, tell me how the two spheres interact and write one or two sentences telling about how the interaction changes the atmosphere.

For example, for my description of an interaction between the atmosphere and the biosphere, I could write the following: Animals need oxygen to live. Oxygen is found in the atmosphere. Animals change the atmosphere when they breathe. They breathe in oxygen, which removes some oxygen from the atmosphere, and they exhale carbon dioxide, which puts some carbon dioxide back into the atmosphere.

Here is the assignment:

1. Describe a way the atmosphere interacts with the hydrosphere.
2. Describe a way the atmosphere interacts with the biosphere. (Do NOT use my animal example.)
3. Describe a way the atmosphere interacts with the Geosphere.

NOTE: There are no specific correct answers for this assignment. There is not a place where you can go to find the answers. This assignment requires you to think. Use what you know about the various spheres to answer the questions.

3.13 THE END

You have done it!! Congratulations! You are done. You have earned your .25 third quarter credit.

In order to quickly and efficiently process your certificate of credit, you must send me the following information:

1. Full name
2. The last four digits of your Social Security number.
3. The name and address and fax number of the school to which you want the credit sent.
4. The name of the counselor to whom you want the credit sent.
5. List the three assignments, which were the most educational for you. Explain why you liked them.
6. List the three assignments, which were the biggest waste of time for you. Explain why they were a waste of time.
7. What things (if any) did you like about the course?
8. What things (if any) need to be changed?

PROCTORED EXAM: QUARTER 3

1. Which of the following removes CO₂ from the atmosphere?
 - * a. rainforest trees
 - b. cars
 - c. burning coal
 - d. spraying aerosol cans

2. In the carbon cycle, how does carbon enter living organisms?
 - a. Decomposers release carbon dioxide.
 - * b. Photosynthesis by plants.
 - c. Humans burn coal.
 - d. Respiration by animals.

3. Tess designed an experiment to measure how color affects the absorption of solar energy. She covered one Styrofoam cup with a black, nylon sock and another Styrofoam cup with a white, cotton sock. She left a third cup uncovered. She filled all three cups with 100 ml of room temperature water and set them in the sun. After 60 minutes, she measured the temperature of each of the cups. Which of the following statements accurately describes Tess's experimental design?
 - a. The design was valid because Tess measured the absorption of solar energy.
 - b. The design is valid because she used two variables; different materials as well as different colors.
 - * c. The design is flawed because she used two variables; different materials as well as different colors.
 - d. The design is flawed because water temperature cannot be used as an indicator of the absorption of solar energy.
 - e. The design is flawed because 60 minutes is not long enough to measure the absorption of solar energy.

4. Burning fossil fuels adds carbon dioxide to the atmosphere. If we continue to add carbon dioxide to the atmosphere at the current rate, how will this affect the carbon cycle?

- a. The number of carbon atoms on Earth will increase.
- b. The number of carbon atoms on Earth will decrease.
- * c. The number of carbon atoms in the atmosphere will increase.
- d. The number of carbon atoms in the atmosphere will decrease.
- e. The carbon cycle will be unaffected.

6. What is the purpose of including a control in a scientific investigation? To provide:

- * a. a basis for comparison
- b. a correction for experimental errors
- c. a preliminary trial of the methods
- d. an opportunity for repetition of the experiment.

7. Which of the following statements is true about the ozone and human health?

- a. Ozone is harmful in both the lower and upper atmosphere.
- b. Ozone is helpful in both the lower and upper atmosphere.
- * c. Ozone is harmful in the lower atmosphere and helpful in the upper atmosphere.
- d. Ozone is a helpful in the lower atmosphere and harmful in the upper atmosphere.

8. What effect is most commonly associated with the "ozone hole"?

- * a. skin cancer
- b. heart attacks
- c. ocean saltiness
- d. loss of hair

9. Which substance is considered the main cause of the "ozone hole"?

- a. carbon dioxide
- * b. chlorofluorocarbons (CFC's)
- c. methane
- d. water vapor

10. Hans designed an experiment to measure the effect of color on the absorption of solar energy. He put a 3m x 3m black plastic tarp and a 3m x 3m clear plastic tarp over a snow bank that was 1m deep. At 4:00 pm each day for a

week he measured the amount of snow remaining under the tarps. Which of the following statements accurately describes Hans's experimental design?

- * a. The design was valid because Hans measured the effect of color on the absorption of solar energy.
- b. The design is flawed because the results cannot be quantified.
- c. The design is valid because it tests two variables.
- d. The design is flawed because it has two controls.
- e. The design is valid because it has no control.

11. Which of the following is NOT considered a "greenhouse" gas?

- a. Carbon dioxide
- b. Methane
- c. Water vapor
- * d. Nitrogen

12. The "greenhouse effect" could cause a number of problems. Which is NOT a problem associated with it?

- a. rising sea level
- b. changes in weather patterns
- c. changes in ocean currents
- * d. increased skin cancer.

13. Which of the following responses best describes why nitrogen is important to your body?

- a. You breathe in nitrogen.
- b. The atmosphere is 80% nitrogen
- * c. Nitrogen is vital component of the proteins and DNA.
- d. Nitrogen fixation must happen because atmospheric nitrogen cannot be used by most living things.

14. Which of the following best describes nitrogen fixation?

- * a. It is done by soil microbes and/or lightening.
- b. It releases nitrogen back into the atmosphere.
- c. It is caused by excess fertilizer in lakes and streams.
- d. It is part of the denitrification process.

15. In the Antarctic Ocean, there is a significant amount of phytoplankton (phytoplankton are microscopic organisms that do a lot of photosynthesis) that live near the surface. (A) Predict an effect of severe ozone depletion on the amount of carbon dioxide in the atmosphere. (B) Justify your prediction by describing one or more cause/effect relationship.

Correct Answer:

(A) Severe ozone depletion would increase the amount of carbon dioxide in the atmosphere.

(B) Severe ozone depletion allow more ultra violet radiation to enter the atmosphere, which will kill off many of the phytoplankton, which would reduce the amount of photosynthesis that occurs. Reduced photosynthesis means a reduction in the amount of CO₂ removed from the atmosphere which means the amount of CO₂ in the atmosphere would increase

Quarter 4

4.1 “GETTING TO KNOW YOU”

Hi! Your first assignment is to introduce yourself to me I want to know who you are and what you like. But wait!! I don't want you to tell me. I want to hear what your pet would say about you. Introduce yourself through the eyes of your pet. That's right! Give voice to your pet and let him/her introduce you to me. If your pet could talk, what would it say about you? Tell me! If you do not have a pet, let your room introduce you. You can include information about where you live, your school and schooling, and what your personal interests and hobbies are.

Let me introduce myself through the eyes of my ewe.

There you have it: The Teacher as seen through the eyes of her ewes. I don't eat alfalfa and I don't chew cud but I do love to eat—I especially love to eat nectarines off my own tree, smoked oysters out of a can, and marinated salmon cooked on a grill. I taught high school biology for five years. Now I teach this online Earth Systems course. I also love to jog, read, and camp in the mountains. Most of all I love my adorable husband and four charming children.

I look forward to working with you,
The Teacher

Assignment:

1. Write a paragraph introducing yourself through the eyes of your pet (or your room if you do not have a pet.)
2. Be sure to label your assignment (Assignment 4.1) and put your first and last name on it.
3. Submit your assignment.
4. Have a great day!!

4.2 STAYING ON COURSE!!

Assignment 4.2

Have you ever noticed that every teacher has different rules and expectations? It is so easy to get confused and “off course” when trying to navigate different classes in this “river” we call the Electronic. This assignment is designed to help you “stay on course” in Earth Systems.

Assignment:

1. What is the name of the textbook for the course?
 - a. Earth Systems Science
 - b. Getting to Know the Earth as a System
 - c. Eating Elephants for Energy
 - d. There is no official textbook.

2. During this Earth Systems science course, I will be:
 - a. Taking field trips
 - b. Doing experiments
 - c. Reading and writing
 - d. All of the above

3. In order to receive credit, I must:
 - a. Do all of the assignments. I will not receive credit unless I satisfactorily complete ALL of the assignments.
 - b. Earn at least 60% of the possible points.
 - c. Send The Teacher chocolate.
 - d. Complete as many assignments as I need to in order to earn the grade that I want.

4. All assignments are labeled. Assignment 1.4 means:
 - a. First quarter, fourth assignment
 - b. Fourth quarter, first assignment
 - c. Fourth inning of the first game in the play-offs
 - d. Part four of assignment one

5. To find out my grades I:
 - a. Click on Student Tools on the left side bar and then click on “My grades”.
 - b. Click on Information on the left side bar and then enter my name.
 - c. Email The Teacher and ask her to look up my grade.
 - d. Click on Groups, enter my name, and then record whatever grade I think that I earned on the assignment.

6. To submit an assignment I:
 - a. Email the assignment to The Teacher at the address provided.
 - b. Send the assignment to the office.
 - c. Give the assignment to one of the science teachers at my school.
 - d. Decide not to do the assignment and tell The Teacher that I sent it to her but it must have got lost in cyber space.

7. If I submit an assignment that is incomplete or unacceptable, then The Teacher will:
 - a. Return the assignment to me with instructions on what needs to be done in order to earn credit for the assignment.

- b. Return the assignment with a big fat LOSER written on it and drop me from the course
 - c. Give me a failing grade on the assignment.
 - d. Contact my parents.
8. If I get a low score on an assignment and I want to improve my score, I should:
- a. Contact the Electronic principal.
 - b. Whine and complain to my friends.
 - c. Ask my parents to write The Teacher a note explaining why I should get a better score.
 - d. Make the suggested corrections on the assignment and re-submit it for a better score. I can always correct and re-submit assignments.
9. All assignments are worth:
- a. 10 points
 - b. 100 points
 - c. 5,000,000,000,000,000,000,000,000 points
 - d. The point value of each assignment varies depending on how hard the assignment is.
10. If I submit an assignment to The Teacher and it somehow gets lost in cyber space (i.e. for some reason she does not receive my assignment) then I do not have to worry about it because:
- a. The Teacher is very nice. She will understand and will give me credit for the assignment even though she has not seen it.

- b. Things like that happen all the time so it is okay if I do not turn in one or two assignments.
 - c. Superman will rescue my assignment from the vast voids of cyber space and will submit it for me.
 - d. I have followed the advice to ALWAYS keep a back up copy of my work. I can simply access my back up copy and re-send the lost assignment.
11. Which of the following assignments would earn a score of 10/10, A?
- a. I did MORE than was required by the assignment. For example, I wrote longer answers than necessary or I included graphics or I used some extra creativity.
 - b. I wrote a correct answer for every question.
 - c. I sent The Teacher pizza AND told her that her children are adorable.
 - d. I copied the essay from a friend who got a score of 10/10, A, on the assignment.
12. When doing assignments:
- a. I can do the assignments in any order that I wish.
 - b. I must do the assignments in numerical order.
 - c. I have to sit in a dark corner and chant "The Teacher is the greatest teacher in the world" ten times. It is better if I do the chant in Latin.
 - d. All of the above.
13. If I have a question I can:
- a. Email The Teacher at the address provided . She is very willing to help me.

- b. Ask my parents, friends, or a teacher at school for help. They can help me but I will do the actual work myself.
- c. Search online for information.
- d. All of the above.

4.3 SOLAR ENERGY.....LOST IN SPACE!!!

Energy is not created nor destroyed. I am sure you have heard that plenty of times. What does it mean? We talk about using energy.....if energy is used up, then how can we say that it is not destroyed?

The secret to understanding energy use is to understand that energy is used but not used up! Do you understand the difference? Energy does not change in amount but it changes form very easily. When we use energy, we do not use it up. Instead we change its form. For example, consider the energy coming from the sun. It is radiant energy. When the sun's energy hits the desert soil in the Southwest US it changes form to become heat energy. The amount of energy does not change but the type of energy changes.

The heat energy of the desert warms the surrounding air. The warm air rises which causes wind. Some of the energy dissipates out to space in the form of heat (it does NOT return to the sun) and some of the energy changes form to become energy of motion as the wind blows.

The electrical energy may be used in a light bulb, in which case it is changed to light energy.

Remember that energy flows from the sun, through the various Earth systems and eventually flows to space in the form of heat. When heat energy flows to space, it is lost to us. The energy is still there but it is not in a form that is useful to us. Because it is not useful to us, I call it lost. In reality, it is not lost. It is still there but it may as well be lost to us because we cannot use it again.

Radiation is the movement of energy in rays. The sun's energy comes to Earth in the form of radiation. . So, how much radiation energy do we get from the sun? Every day, more energy falls on the U.S. than we use in an entire year. The total amount of solar energy per year falling on the continental 48 states is 1.37×10^{16} kW-h/year - or 46,700 TWh/year - of solar energy. Compare this to 94.2 Quad/year, the rate of energy consumption in the U.S. in 1997 (Ref: Renewable Energy Annual 1998, DOE/IEA-0603(98), pg 1.) Every day more solar energy falls to the Earth than the total amount of energy the planet's 5.9 billion inhabitants would consume in 27 years (.). That is a lot of energy! What happens to that energy?

About 30% of the sun's energy is reflected or bounced back, immediately to outer space in the form of light. It never makes it to Earth. Clouds reflect back about 25% of the sun's energy and snow, ice, and other reflective ground surfaces send back an additional 5%.

So, how much of the sunlight that comes toward Earth actually makes it to Earth? Do the math. Take the 30% that is reflected back and subtract it from the original 100% and you get.....70%. Good job. The remaining 70% of the sunlight that

reaches Earth is absorbed, or taken in. This absorption occurs in many ways. The atmosphere absorbs twenty-five percent (25%). Forty-five percent (45 %) is absorbed by the Earth's surfaces. Of that 45%, about 16% is immediately re-radiated as heat, 24% evaporates water, and 5% powers our winds.

Most of the sunlight that reaches the Earth is absorbed by water and solid materials and immediately converted to heat. Think of asphalt in the late afternoon of a sunny day. It has definitely absorbed some of the sun's energy. HOT!! Or remember the warmth of the sun's rays on your back. The energy in the sunlight was changed to heat energy, which warmed you. Any material that is heated by the sun will then radiate that heat outwards. You do it, the asphalt does it, everything that is heated by the sun eventually loses that heat as it radiates back out. Eventually that heat radiates through the atmosphere and leaves the Earth to become "lost in space".

A large amount of the solar energy that arrives on Earth powers the water cycle.

Plants capture a tiny but very important amount of the sun's energy, about 0.08%.

There you have it. Energy is never created or destroyed. It does not increase or decrease in amount. It does, however, change from one form to another. Energy flows through the Earth's systems. It changes form but it does NOT recycle. The solar energy absorbed by Earth eventually changes to heat energy that is "lost in space".

Through the process called photosynthesis, plants convert the sun's energy to chemical energy. The energy is stored in the chemical bonds of the sugars formed in plants. Those of us who eat plants change the chemical energy in the food to body heat. We lose body heat all the time. Guess where that heat goes? Eventually it leaves the atmosphere and is "lost in space."

Water absorbs the sun's energy and evaporates to become a gas in the atmosphere. When the water vapor condenses back into a liquid (rain) or solid (snow, sleet), the same amount of energy that was absorbed to evaporate the water is released as it condenses. The energy is released as heat that escapes the atmosphere and is "lost in space".

Or it may be used in a toaster, in which case it may be changed to heat energy. In all cases, the energy is not destroyed. It simply changes form. Eventually, the energy we receive from the sun is changed to heat energy and is lost to space.

We could go even further and pretend that the wind energy moves the blades of a windmill where there is a generator. The generator changes the wind's energy of motion to electricity, another form of energy. Notice that in all of these steps,

energy is not destroyed. It changes from one form to another but it is not destroyed or used up.

Assignment:

There are TWO parts to this assignment. You must do BOTH parts to receive credit for the assignment.

1. Create a diagram that illustrates the distribution of energy coming from the sun that is reflected, changed to heat, or stored in plants. Use the data in the preceding paragraphs to create your diagram.

- You may use whatever medium is best for you to create your diagram.
- You can create a diagram on your computer and email it to me.
- You can draw a diagram, scan it, and email it to me.
- You can create a poster or drawing and send it to me via regular mail. (My address is on the INFORMATION page for Earth Systems.)

2. Describe the pathway for converting radiant energy from the sun to the chemical energy that is stored in gasoline and used to transport you to school (or on a date or to a concert or wherever you want to go).

- Remember that gasoline comes from plant material that has been subjected to heat and pressure when it was buried deep in the Earth.
- Be sure to include the word photosynthesis in your description.
- All the information necessary to complete this assignment is available to you as you think about what is written in the paragraphs above and apply what you have learned to what you already know about energy pathways. You may submit your description in writing. Use proper punctuation, grammar, and spelling.
- Or you may submit your description as a diagram. If you create a diagram, you must label each energy conversion. (light to heat or light to chemical, etc...). Also, if you create a diagram, you may submit it to me in any of the forms mentioned in #1.
- The following website will help you understand the sun to gasoline process.
?

4.4 TO ABSORB OR REFLE.....THAT IS THE QUESTION

Introduction:

Obviously, solar energy does not stay in the same form as it flows through the Earth system. Energy from the sun enters the Earth system as sunbeams and exits the Earth system as heat. What happens to it in between? (A very good question, my clever student!!) Energy is transferred from one form to another as it flows through the Earth system. For example, energy enters the atmosphere as sunlight. When the sunlight strikes an apple tree leaf the energy is absorbed and some of it is transferred, through photosynthesis, to chemical energy that is stored in the form of sugar. When you eat that apple, some of the energy stored in the sugar is transferred, through cellular respiration, to the kinetic energy that you use to dance all night at the Prom. Dancing, in turn, causes some of your energy to be transferred to heat energy, which warms up the gym and eventually flows out of the Earth's systems into space.

As you know, energy undergoes many changes as it flows through the Earth's system. In this assignment you will examine how light energy from the sun is converted into heat energy by various materials. Some materials tend to absorb solar energy and convert the solar energy to heat. Other materials are more effective at reflecting solar energy.

Materials:

- * four thermometers if possible.
- * white construction paper
- * four plastic cups
- * colored pencils.

Assignment:

- Cover each cup with a different material-white paper, black construction paper, aluminum foil, and one with no covering.
- Fill each plastic cup two-thirds full of water that is about room temperature.
- Place a thermometer in each cup. (Or margarine, if you don't have thermometers.)
- Place all four containers in sunlight for sixty minutes.
- Take temperature readings initially and every five minutes. (Or estimate the percentage of margarine that is melted in each cup.)

· Write down your data on a table.

Send me the following. Use complete sentences to answer the questions.

1. Your data table.
2. Make a graph of your data. Plot each container's data on the same graph (temperature vs. time) in a different color.
3. What were the temperature readings for each of the containers when you started?
4. What were the temperature readings for each container at the end of the time?
5. How do the initial readings compare with the final readings?
6. What happened to the energy that arrived in the form of sunlight?
7. What evidence do you have that sunlight was reflected or absorbed?
8. If all of the cups received the same amount of sunlight then how can you explain why they have different temperatures?
9. Predict what will happen to the heat energy that was absorbed by the water in the cups.

Use your knowledge about how energy is absorbed or reflected to answer the following questions.

10. Apply your knowledge about how the various materials reflect and absorb sunlight to common situations. For example, most people living in Africa wear white or light colored clothing because it reflects sunlight and is therefore cooler. Give three examples of HOW various materials are used to absorb or reflect sunlight.
11. Why is it usually cooler in the country than it is in the city?
12. If plants absorb sunlight why don't they produce a large amount of heat? What energy conversion is taking place in plants?
13. Explain how the transfer of solar energy affects the atmospheric system.
14. Explain how the transfer of solar energy affects the hydrologic system.
15. Explain how the transfer of solar energy affects the geologic system.

16. Explain how the transfer of solar energy affects the biologic system.

4.5 SOLAR POWER TO THE RESCUE!

Introduction:

As far as Earthlings are concerned, solar power is where it is. Superman, Spiderman, Wonder Woman, X Men.....All of the super heroes have super powers but none of their powers hold a candle to the sun's power. Yes, ladies and gentlemen, our sun is THE super power. With it, we live. Without it, we die.

The sun is the major source of Earth's energy. Some of the solar radiation that reaches the Earth is reflected but most is absorbed. Gases in the atmosphere trap some of the heat energy and delay radiation into space. The greenhouse effect retains energy longer in the Earth system. Currents in the atmosphere and hydrosphere distribute solar heat energy. These currents help determine global and local weather and climate patterns. Photosynthesis uses a small but vital part of the total solar energy for the biosphere. This energy is stored in the chemical bonds of sugars formed in plants.

Assignment:

You have just completed an activity that investigated the energy absorption properties of various materials. Now your task is to design and conduct an experiment that investigates the interaction between energy and an aspect of any of the four spheres. WOW! How exciting is that! You get to choose. And the world is your laboratory.

The options are limitless. All you have to do is choose something from a sphere (biosphere, atmosphere, hydrosphere or Geosphere) and design an experiment that explores how energy interacts with something from that sphere.

I will give you an example of an experiment that explores the relationship between energy and plants (a part of the biosphere). THIS IS ONLY AN EXAMPLE. You may NOT use this experiment for this assignment. [Most of you did this experiment in elementary school!]

Plants, through photosynthesis, capture the sun's radiant energy and convert it to chemical energy. The chemical energy in plants is stored in food. When you eat food, you are eating converted solar energy. Some foods have more stored energy than others.

The question might be "Which type of food, peanuts or bread, contains the most stored solar energy?"

The hypothesis might be "If burned then the peanut will release more energy than the bread."

The experimental plan could be:

1. Get two different glass quart canning jars and put 0.5 liter of water in each jar.
2. Label one jar "Bread". Label the other jar "Peanut".
3. Get a large peanut.
4. Get a piece of bread that is the same size as the peanut.
5. Put the "Bread" jar on the top rack of the outdoor grill.
6. Take the temperature of the water in the "Bread" jar.
7. Record the temperature.
8. Put on safety glasses or protective eyewear of some kind.
9. Hold the piece of bread in a pair of tweezers and VERY CAREFULLY light it on fire.
10. QUICKLY put the burning bread under the "Bread" jar and leave it there until it is completely burned.
11. Measure the temperature of the water in the "Bread" jar.
12. Record the temperature.
13. Repeat steps 5-12 with the "Peanut" jar and the peanut.
14. Subtract the initial water temperature from the water temperature after the bread and peanut were burned to find out how much heat was released.

See how easy it is! Remember, you cannot**do an experiment with energy, peanuts, and bread for two reasons. One, you already know what the result will be. You probably did this already in elementary school. Two, I have already outlined the experiment. Part of what you need to learn in this class is how to design your own experiment. You cannot learn that by doing an experiment that I have already designed! So, off you go. Be creative. Design your own experiment. But wait! Be sure to read the directions below before you do anything!!!!

Materials:

- Whatever you decide

Assignment:

1. Determine what you want to find out when you do your experiment. Write down the QUESTION that you are trying to answer.

· If you are having trouble coming up with a question, think of the many things associated with energy

Air currents

Water currents

Reflection of radiation

Absorption of radiation

Conversion of radiation to other forms of energy such as food, heat, etc

Once you have decided on which aspect of the energy that you would like to investigate, then start brainstorming about things that would influence that aspect. For example, you could investigate melting rates of different things—Which melts more quickly, milk or dark chocolate? Or insulation properties—Does wet wool really insulate better than wet cotton? Or the dynamics of air currents—Would perfume sprayed over a heat source dissipate more rapidly than perfume sprayed over a cold source. Try to think of your own question. The possibilities are limitless.

2. Predict what you think the outcome of your experiment will be. (Hypothesis)

3. Design an experiment to test your prediction. Remember to include a control. Be very specific. Tell me exactly what you plan to do. Tell me how much of everything you plan on using. Tell me how long you plan on running the experiment and how often you will check it. Tell me how you will record your data. I want details!!!

4. **Submit your experimental design to me via email before going any further. I will give you feedback on your design within three days. If the design is scientifically sound, you may go ahead and conduct your experiment. If it has flaws, we will work together until you have designed a valid, reliable experiment--then you may go ahead and conduct your experiment.

5. AFTER you have received my go-ahead, conduct your experiment. Be sure to keep detailed lab notes. Your lab notes should contain a record of everything you did as well as all the data you collected. Each entry should have a date on it (month/day/year).

6. Follow the directions below to submit your assignment.

ANALYSIS

- A. Re-send me your original question, your hypothesis, and your experimental plan.
- B. Send me your lab notes. I want to the observations that you recorded. Do not simply send me a summary of your results. I want to see a record of your observations. Be sure to include dates and measurements.
- C. Based on your observations, write a conclusion. What does your data tell you? What did you learn from your experimental results?
- D. What kind of relationships did you find between energy and the aspect of the sphere you studied?
- E. Do your findings support your hypothesis? Why or why not?
- F. If you were to do this again, what would you change? Why?
- G. What additional experiments could be performed?

4.6 CLIMATE, WEATHER, and CURRENTS

Introduction:

What is a current? Think of a fast flowing river. We say it has a fast current. A current is a “moving stream of water, air, electricity, etc...”. Rivers have moving streams of water. Our global atmosphere has moving streams of air. The world’s oceans have moving streams of water. These currents help determine global and local weather and climate patterns. In this assignment we will study the causes and effects of air and ocean currents.

Assignment:

Read the information on the web sites and answer the questions. Use complete sentences to answer all the questions.

1. What is weather?
2. What is the weather right now where you live?
3. What is climate?
4. Describe the climate where you live.

The sun’s rays hit the equator directly. The sun’s rays hit the polar regions at an angle. Therefore, the equator receives a much larger amount and intensity of solar radiation than the Polar Regions do. As a result, the equator is much hotter than the North and South Pole. That makes sense, doesn’t it?

Well, if the equator is hotter than the poles, then the air over the equator will be warmed more than the air over the poles, right? Right. So, we know that warm air rises. When the warm air at the equator rises, then something must take its place. Cooler air from the poles moves in. The cooler air is then warmed and the convection cycle continues. This movement of air is called an air current. These air currents move heat energy around Earth.

Air currents generally move from the poles toward the equator at the Earth’s surface. Of course this is a very simplistic model of what happens. In reality, air currents are affected by the rotation of the Earth, the Earth’s topography, and ocean currents.

5. What causes global air currents?
6. How do global air currents move heat energy around the Earth?

7. Identify three things that affect the global air currents.

Heat energy is also moved around the Earth by ocean currents. Ocean currents affect the climate even in the most remote areas of the Earth.

8. Name five (5) things that affect how ocean currents flow.

9. Why does water rise on the western edge of continents?

10. Ocean currents can be described as global conveyor belts of water. Describe the global conveyor belt of water. What causes it?

11. In which direction does the deep, cold water move?

12. In which direction do the warm surface currents move?

13. What drives cold surface currents?

14. What is coastal upwelling?

15. Why is upwelling important to the world's fisheries?

16. How do ocean currents move heat energy around Earth?

The Coriolis effect also has a role in global wind and ocean current patterns. Go to the sites below to learn what the Coriolis effect is and how it affects wind and ocean currents.

Coriolis Effect on Wikipedia → http://en.wikipedia.org/wiki/Coriolis_effect

The OzoneHole → <http://www.theozonhole.com/coriolis.htm>

Coriolis Force → [http://ww2010.atmos.uiuc.edu/\(Gh\)/guides/mtr/fw/crls.xml](http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/fw/crls.xml)

17. In your own words, briefly describe the Coriolis Effect.

18. How does the Coriolis Effect influence global wind patterns?

19. Thanks to the Coriolis Effect, wind moving from the equator towards the North pole deflects in which direction: east, west, north, or south?

Meteorology is the study of the atmosphere and weather. To study meteorology, one must study air currents and ocean currents. To understand weather one must also understand the topography of an area.

Topography refers to the surface features of a landmass. The topography of the Wasatch Front is mountainous. Like ocean currents and air currents, topography influences weather patterns.

1. How does flat, dry topography affect weather?

Whew! You are done with this assignment. Congratulations! Now, send me the answers to the above questions. Make sure you have written your answers in complete sentences.

4.7 WHO DUNNIT?

Introduction:

Who dunnit? Who killed off the dinosaurs? Or, more accurately, "What dunnit"? What caused the major extinctions of the past? Did you know there have been five major extinctions in the Earth's history? How many species were eliminated in those extinctions? What do scientists believe caused the major extinctions? Your task is to find out!

Put on your detective hat and go to work! The Earth is a crime scene. Five times something has caused a huge amount of species on Earth to become extinct. Most alarming of all, there are indications that the sixth and biggest extinction of all is occurring now. What happened before? What is happening now?

Your job is to find out!

Assignment:

Okay, Investigator---here is your assignment. Find answers to the following mysteries:

HINT: A good investigator does NOT make up facts. A good investigator INVESTIGATES. Do not simply answer the questions below out of your head. Research the information. The following websites will be a great help.

[5 extinctions](http://www.dimaggio.org/Evolution/5major.htm) → <http://www.dimaggio.org/Evolution/5major.htm>

[Reasons for extinction---Scroll about half way down the page.](http://www.dbc.uci.edu/~sustain/bio65/lec01/b65lec01.htm) → <http://www.dbc.uci.edu/~sustain/bio65/lec01/b65lec01.htm>

[Who Dunnit to the Dinosaurs?](http://unmuseum.mus.pa.us/deaddino.htm) → <http://unmuseum.mus.pa.us/deaddino.htm>

Use complete sentences to answer the following questions.

1. What were the dates of the last five major extinctions? (Write your answer in millions of years ago.)
2. Describe, as best you can, what types of species were lost in each extinction AND what percentage of total species was lost.
3. What do scientists think was the overall, major reason the extinctions occurred?

4. What do scientists think may have caused the major climate changes that caused most of the extinctions? (List several possible reasons.)
5. What causes species to go extinct today?
6. How is the current extinction different from extinctions of the past?
7. Many people believe that the current extinction is **entirely human caused**. Do you agree or disagree? Why? There is no right or wrong answer to this question. Use your brain. Think. Decide whether you agree or disagree with the author. Then write down at least two sentences telling why you agree or disagree. This is the most important question of the assignment. Do NOT neglect to answer it.

When you have answered all the questions, submit your answers to me. I look forward to hearing from you. Use complete sentences to answer your questions.

4.8 FOUND IN SPACE!!!

Introduction:

You started out fourth quarter describing energy that is “Lost in Space”. (Remember assignment 4.3?) Now, at the end of fourth quarter you’ll describe information that is “Found in Space”. Lost and found.....Sounds like someplace you’d look for your missing yo-yo!

Well, I know where my favorite yo-yo is and hopefully you do too. But, do you know how scientists learned about the universe? Or how scientists believe the universe began? What about how stars are born and die? Or how Earth compares to other planets? You will find this, and other information, in the assignment that follows. Hang on and enjoy your intellectual journey to see you what you can find in (or about) space.

To this point we have studied Earth’s various sub-systems (I’m sure that by now you can recite them in your sleep; water system, geologic system, atmospheric system, biologic system). Now we will examine the Earth as a part of a larger system.

Earth is a part of the solar system. The solar system is a component of the system we call the Milky Way Galaxy.

Our galaxy is part of the universe as we know it and who knows what part the universe plays in an even greater whole. As a member of these systems the Earth is both affects and is affected by its celestial neighbors. In fact, the Earth itself exists thanks to interactions that occurred millions of years ago in our “corner” of the universe. It is your job to document these interactions.

Assignment:

This is a BIG project. You are to write a textbook that documents many of the components of the space systems of which Earth is a part. Your textbook will contain four chapters, as outlined below.

Your text must:

- Be written in your own words (that means it should be easily understood by the typical high school freshman)
- Cover ALL of the information required
- Include illustrations and diagrams.
- Be scientifically accurate

- Be referenced. You MUST cite all information sources you use, including the addresses of all Internet sites.
- Include THREE multiple-choice questions for each chapter. The multiple-choice questions must have answers with them.

Each chapter is worth 10 points. The entire project is worth 50 points. **(10 points for the information included in each of the four chapters and an additional 10 points for having illustrations and multiple choice questions.)

Suggested Internet sites will be given for each chapter. You may use these sites but you do not have to. You may use any sources of information available to you, provided that you reference them.

Each chapter will probably be about three pages long. You should include enough information to adequately cover the subject but I certainly do not expect a major research paper on each topic. I STRONGLY suggest that you complete the first chapter and send it to me before working on the remaining three chapters. I will review your work and will tell you whether what you have done is satisfactory or if you need to invest more time and effort into your work.

You may give your FOUR chapters any title of your choosing but the contents of your chapters must be as follows:

Chapter One: The History of Cosmology

Cosmology is the scientific study of the large-scale properties of the Universe as a whole. Over the centuries mankind's ideas about the nature of the universe have changed significantly. In this chapter you will describe how the accepted ideas regarding the nature of the universe have changed in science throughout history. In your chapter, include explanations of the ideas of the following individuals:

- The ancient Greeks
- Ptolemy
- Copernicus
- Galileo
- Kepler

- Newton
- Hubble
- Einstein
- ALSO, identify at least two examples of how technology has helped scientists investigate the universe. (HINT: The telescope is an example of technology.)

Refer to the following site for help:

[A Brief History of Cosmology](http://www-gap.dcs.st-and.ac.uk/~history/HistTopics/Cosmology.html) → <http://www-gap.dcs.st-and.ac.uk/~history/HistTopics/Cosmology.html>

Do NOT copy the text from this Internet site word for word. I have read the information on the site. I will recognize it if you cut and paste it into your text. You will FAIL the assignment if you cut and paste the information from this site into your textbook. You MUST write it in your own words.

REMEMBER to include your three multiple-choice questions with answers. Your chapter should also have illustrations.

Chapter Two: Origin of the Universe

- Describe the Big Bang Theory.
 1. What does the theory state?
 2. When did the Big Bang occur?
 3. What happened during the Bang?
 4. What happened in the microseconds, seconds, minutes, and years after the Big Bang?
- Describe at least three pieces of evidence that support the Big Bang Theory, including:
 1. Red shift evidence. What is a red shift? What does it tell us about the relative motion of a star or of the universe? Does the red shift indicate the universe is expanding or contracting?

2. Cosmic microwave background energy. Where does it come from? How does its presence support the Big Bang Theory?

3. The numbers and kinds of atoms found in the universe. There are many more hydrogen and helium atoms in the universe than any other kind of atoms. Where did they come from? How did they form? How does their relative abundance support the Big Bang Theory?

Refer to the following sites for help:

[Anchors of the Universe](http://map.gsfc.nasa.gov/universe/bb_tests_exp.html) → http://map.gsfc.nasa.gov/universe/bb_tests_exp.html

[NASA](http://map.gsfc.nasa.gov/universe/index.html) → <http://map.gsfc.nasa.gov/universe/index.html>

[Four Pillars of Cosmology](http://www.damtp.cam.ac.uk/user/gr/public/bb_pillars.html) → http://www.damtp.cam.ac.uk/user/gr/public/bb_pillars.html

[Big Bang Theory](http://www.umich.edu/~gs265/bigbang.htm) → <http://www.umich.edu/~gs265/bigbang.htm>

REMEMBER to include your three multiple-choice questions as well as your references. Also, write the text in your own words and include illustrations or diagrams.

Chapter Three: Star Life Cycles

- Describe the life cycle of a typical star.
- Compare life cycle to the sun to the life cycle of other stars.
- Hydrogen and helium (light elements) were formed during the Big Bang. Describe how the heavier elements were formed. (HINT: The answer has to do with the end of a star's life!)
- While you are at it, explain the origin of heavy elements on Earth. Where did most of the matter on Earth come from? (HINT: The answer is the same as the answer to the preceding question!)

The following sites may help:

[Life and Death of Stars](http://map.gsfc.nasa.gov/universe/rel_stars.html) → http://map.gsfc.nasa.gov/universe/rel_stars.html

[Star Life](http://zebu.uoregon.edu/~soper/StarLife/starlife.html) → <http://zebu.uoregon.edu/~soper/StarLife/starlife.html>

[Stars Birth](http://zebu.uoregon.edu/~soper/StarBirth/starbirth.html) → <http://zebu.uoregon.edu/~soper/StarBirth/starbirth.html>

REMEMBER to include your three multiple-choice questions with answers. Also, document your sources and write the text in your own words. Have you included diagrams or illustrations?

Chapter Four: Life on Earth

· Describe the unique physical features of Earth's environment that make life on Earth possible. Consider things like the atmosphere (including ozone layer and greenhouse gases), solar energy, and water.

· Choose two planets in our solar system and compare them to Earth. Consider their:

1. average temperatures, low and high
2. location in the solar system
3. satellites
4. atmosphere
5. gravity
6. common elements
7. geology
8. other interesting facts

The following Internet sites may help:

[Planets](http://www.nineplanets.org/) → <http://www.nineplanets.org/>

[NASA Planets](http://pds.jpl.nasa.gov/planets/) → <http://pds.jpl.nasa.gov/planets/>

[The Planets](http://www.enchantedlearning.com/subjects/astronomy/planets/) → <http://www.enchantedlearning.com/subjects/astronomy/planets/>

REMEMBER to include your three multiple-choice questions with answers. Also, write the text in your own words and identify your sources of information. Don't forget your diagrams and/or illustrations.

4.9 THE END

You have done it!! Congratulations! You are done. You have earned your .25 fourth quarter credit.

In order to quickly and efficiently process your certificate of credit, you must send me the following information:

1. Full name
2. The last four digits of your Social Security number.
3. The name and address and fax number of the school to which you want the credit sent.
4. The name of the counselor to whom you want the credit sent.
5. List the three assignments, which were the most educational for you. Explain why you liked them.
6. List the three assignments, which were the biggest waste of time for you. Explain why they were a waste of time.
7. What things (if any) did you like about the course?
8. What things (if any) need to be changed?

Once I have received the above information, I will forward it to the office.

PROCTORED EXAME – QUARTER 4

1. Coal, oil and natural gas are the results of the slow breakdown and decay of which organisms?

- a. cows
- b. insects
- * c. plants
- d. zooplankton

2. How does energy flow through an ecosystem?

- * a. The sun's energy is captured by plants, used by animals, and eventually returns to space as heat.
- b. Energy from the sun is recycled over and over again in the ecosystem.
- c. Energy from the sun is captured by animals to make sugars and fats.
- d. The sun's energy is captured by oxygen molecules, which causes photosynthesis.

3. Measurements of light from 7 nearby stars were made. Doppler analysis was performed and red shift was observed in all the measurements. What does this evidence suggest about the stars?

- * a. All the stars measured are moving away from the Earth.
- b. All the stars measured are moving toward the Earth.
- c. Four of the stars measured are moving away from the Earth.
- d. All of the stars are not moving relative to the Earth

4. In the 1600's Copernicus and Galileo believed that the earth and other planets orbited the sun. Why were their ideas not accepted at first?

- a. They had no good research to support their claims.
- b. People did not study the night sky in the 1600's.
- c. Their books were not published until after their deaths.
- d. Their claims could not be verified by the instruments of the time.
- * e. Their claims contradicted the beliefs of the prevailing churches.

5. Why is the Big Bang Theory the most accepted theory of how the universe was formed?

- * a. It is the simplest explanation of the current scientific data.
- b. It is based on a combination of scientific and religious facts.
- c. It has not been revised or changed by scientists for many years.
- d. It has been proven correct by using mathematical models.

6. Which of the following is an example of technology?

- a. the Moon's gravitational constant
- b. chemical composition of Moon rocks
- c. the moon's orbit
- * d. Hubble photographs of the Moon
- e. phases of the Moon

7. When do areas of upwelling in the ocean occur?

- a. When fish gather for feeding
- b. When the tides are at their lowest
- * c. When surface water is replaced by deep water
- d. When currents collide and form whirlpools

8. Which of the following most accurately explains the origin of heavy elements on Earth?

- * a. Formed by nuclear reactions in massive, ancient stars.
- b. Formed by radioactive decay deep within Earth's core.
- c. Formed by black holes scattered throughout the galaxy.
- d. Formed by comets and asteroids falling to the Earth.

9. The Earth, the moon, Venus and Mars are all made of similar elements. What factors contribute to the existence of life on Earth while the other neighbor planets and moons are lifeless?

- a. The tilt of the axis is different from that of the Earth on other planets and moons.
- * b. Liquid water and a protective atmosphere are found on Earth and not on the others.
- c. Earth has active tectonic plates that continue to create and destroy mountains and basins.

d. The laws governing the behavior of atoms and molecules is different here than elsewhere.

10. What is the purpose of including a control in a scientific investigation? To provide:

- * a. A basis for comparison
- b. A correction for experimental errors
- c. A preliminary trial of the methods
- d. An opportunity for repetition of the experiment.

11. Hans designed an experiment to measure the effect of color on the absorption of solar energy. He put a 3m x 3m black plastic tarp and a 3m x 3m clear plastic tarp over a snow bank that was 1m deep. At 4:00 pm each day for a week he measured the amount of snow remaining under the tarps. Which of the following statements accurately describes Hans's experimental design?

- * a. The design was valid because Hans measured the effect of color on the absorption of solar energy.
- b. The design is flawed because the results cannot be quantified.
- c. The design is flawed because it tests two variables.
- d. The design is valid because it has two controls.
- e. The design is flawed because it has no controls.

Ms. Magnificent, Lance's Earth Systems teacher, gave him an assignment to design and conduct an energy related experiment. Lance decided to compare the amount of energy required to melt ice with the amount of energy required to melt snow.

12. Which of the following hypothesis compares the energy required to melt ice with the energy required to melt snow?

- a. If salt is applied to snow and ice, then snow will melt faster.
- b. Ice is 50% more dense than snow.
- c. If the polar ice caps melted, then how many cities would be flooded?
- d. If energy is applied to snow and ice, then it will change water from a liquid to a solid state.
- * e. If energy is applied to snow and ice, then it will require 50% more energy to melt ice than snow.

Lance designed an experiment to compare the energy to melt snow with the energy required to melt ice. He put 100 ml of snow in a 250 ml beaker and 2 25 ml ice cubes in another 250 ml beaker. He put the beakers at equal distances over a Bunsen burner and measured the amount of time it took for the ice and snow to be completely melted.

13. Which of the following statements accurately describes Lance's experimental design?

- * a. The design was flawed because he did not use equal volumes of snow and ice.
- b. The design was flawed because he cannot determine how much energy was used to melt the snow and ice by measuring the amount of time each took to melt when placed over a burner.
- c. The design was flawed because he should have used two different burners.
- d. The design was valid because he compared the energy required to melt snow with the energy required to melt ice.
- e. The design was valid because he timed the ice and snow until they were completely melted.

14. What is the principle cause of the Coriolis Effect?

- a. isolation
- b. winds
- c. ocean currents
- * d. Earth's rotation

15. Extinctions have occurred since life began. Why are scientists concerned about plants and animals going extinct?

- a. Scientists care more about plants and animals now than they did in the past.
- * b. Current extinction rates are much higher than natural extinction rates.
- c. Extinctions cause meteorites to strike the Earth and scientist do not want that to happen.
- d. Extinctions are not a natural part of life; healthy ecosystems do not have extinctions.

16. Identify four things that happen to sun's light energy when it reaches the Earth's atmosphere. Be specific.

Correct Answer:
(ANY FOUR OF THESE)

- Absorbed by plants
- Reflected by clouds
- Powers the water cycle/evaporates water
- Causes wind
- Reflected by the atmosphere
- Absorbed by the atmosphere

Absorbed by the Earth's surface/heats the Earth

17. Explain how the energy you use to pedal a bicycle originally came from the sun. Use at least four steps.

Correct Answer:

The sun's energy is converted to chemical energy by a plant. An animal gets energy when it eats the plant. The student gets energy when it eats the animal. The boy's energy is used to pedal the bike.

18. Using the following terms, in a way that makes sense, write a paragraph that explains the big bang theory and the evidence that supports it.

red shift
cosmic microwave background energy
big bang theory
theory

Correct Answer:

The big bang theory is a theory that explains how the universe came into being. It says the universe started with a huge explosion and it is still expanding. Red shift and cosmic microwave background energy are evidence that support the big bang theory.

APPENDIX: CA Science Content Standards

Earth Sciences - Grades Nine Through Twelve

Science Content Standards.

Standards that all students are expected to achieve in the course of their studies are unmarked.

Standards that all students should have the opportunity to learn are marked with an asterisk (*).

Earth's Place in the Universe

1. **Dynamic Earth** Astronomy and planetary exploration reveal the solar system's structure, scale, and change over time. As a basis for understanding this concept:
 - a. Students know how the differences and similarities among the sun, the terrestrial planets, and the gas planets may have been established during the formation of the solar system.
 - b. Students know the evidence from Earth and moon rocks indicates that the solar system was formed from a nebular cloud of dust and gas approximately 4.6 billion years ago.
 - c. Students know the evidence from geological studies of Earth and other planets suggest that the early Earth was very different from Earth today.
 - d. Students know the evidence indicating that the planets are much closer to Earth than the stars are.
 - e. Students know the Sun is a typical star and is powered by nuclear reactions, primarily the fusion of hydrogen to form helium.
 - f. Students know the evidence for the dramatic effects that asteroid impacts have had in shaping the surface of planets and their moons and in mass extinctions of life on Earth.
 - g. * Students know the evidence for the existence of planets orbiting other stars.

2. Earth-based and space-based astronomy reveal the structure, scale, and changes in stars, galaxies, and the universe over time. As a basis for understanding this concept:
 - a. Students know the solar system is located in an outer edge of the disc-shaped Milky Way galaxy, which spans 100,000 light years.
 - b. Students know galaxies are made of billions of stars and comprise most of the visible mass of the universe.

- c. Students know the evidence indicating that all elements with an atomic number greater than that of lithium have been formed by nuclear fusion in stars.
- d. Students know that stars differ in their life cycles and that visual, radio, and X-ray telescopes may be used to collect data that reveal those differences.
- e. * Students know accelerators boost subatomic particles to energy levels that simulate conditions in the stars and in the early history of the universe before stars formed.
- f. * Students know the evidence indicating that the color, brightness, and evolution of a star are determined by a balance between gravitational collapse and nuclear fusion.
- g. * Students know how the red-shift from distant galaxies and the cosmic background radiation provide evidence for the "big bang" model that suggests that the universe has been expanding for 10 to 20 billion years.

Processes

- 3. Plate tectonics operating over geologic time has changed the patterns of land, sea, and mountains on Earth's surface. As the basis for understanding this concept:
 - a. Students know features of the ocean floor (magnetic patterns, age, and sea-floor topography) provide evidence of plate tectonics.
 - b. Students know the principal structures that form at the three different kinds of plate boundaries.
 - c. Students know how to explain the properties of rocks based on the physical and chemical conditions in which they formed, including plate tectonic processes.
 - d. Students know why and how earthquakes occur and the scales used to measure their intensity and magnitude.
 - e. Students know there are two kinds of volcanoes: one kind with violent eruptions producing steep slopes and the other kind with voluminous lava flows producing gentle slopes.
 - f. * Students know the explanation for the location and properties of volcanoes that are due to hot spots and the explanation for those that are due to subduction.

Energy in the Earth System

- 4. Energy enters the Earth system primarily as solar radiation and eventually escapes as heat. As a basis for understanding this concept:

- a. Students know the relative amount of incoming solar energy compared with Earth's internal energy and the energy used by society.
 - b. Students know the fate of incoming solar radiation in terms of reflection, absorption, and photosynthesis.
 - c. Students know the different atmospheric gases that absorb the Earth's thermal radiation and the mechanism and significance of the greenhouse effect.
 - d. * Students know the differing greenhouse conditions on Earth, Mars, and Venus; the origins of those conditions; and the climatic consequences of each.
5. Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents. As a basis for understanding this concept:
- a. Students know how differential heating of Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat.
 - b. Students know the relationship between the rotation of Earth and the circular motions of ocean currents and air in pressure centers.
 - c. Students know the origin and effects of temperature inversions.
 - d. Students know properties of ocean water, such as temperature and salinity, can be used to explain the layered structure of the oceans, the generation of horizontal and vertical ocean currents, and the geographic distribution of marine organisms.
 - e. Students know rain forests and deserts on Earth are distributed in bands at specific latitudes.
 - f. * Students know the interaction of wind patterns, ocean currents, and mountain ranges results in the global pattern of latitudinal bands of rain forests and deserts.
 - g. * Students know features of the ENSO (El Niño southern oscillation) cycle in terms of sea-surface and air temperature variations across the Pacific and some climatic results of this cycle.
6. Climate is the long-term average of a region's weather and depends on many factors. As a basis for understanding this concept:
- a. Students know weather (in the short run) and climate (in the long run) involve the transfer of energy into and out of the atmosphere.
 - b. Students know the effects on climate of latitude, elevation, topography, and proximity to large bodies of water and cold or warm ocean currents.
 - c. Students know how Earth's climate has changed over time, corresponding to changes in Earth's geography, atmospheric

composition, and other factors, such as solar radiation and plate movement.

- d. * Students know how computer models are used to predict the effects of the increase in greenhouse gases on climate for the planet as a whole and for specific regions.

Biogeochemical Cycles

- 7. Each element on Earth moves among reservoirs, which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles. As a basis for understanding this concept
 - a. Students know the carbon cycle of photosynthesis and respiration and the nitrogen cycle.
 - b. Students know the global carbon cycle: the different physical and chemical forms of carbon in the atmosphere, oceans, biomass, fossil fuels, and the movement of carbon among these reservoirs.
 - c. Students know the movement of matter among reservoirs is driven by Earth's internal and external sources of energy.
 - d. * Students know the relative residence times and flow characteristics of carbon in and out of its different reservoirs.

Structure and Composition of the Atmosphere

- 8. Life has changed Earth's atmosphere, and changes in the atmosphere affect conditions for life. As a basis for understanding this concept:
 - a. Students know the thermal structure and chemical composition of the atmosphere.
 - b. Students know how the composition of Earth's atmosphere has evolved over geologic time and know the effect of outgassing, the variations of carbon dioxide concentration, and the origin of atmospheric oxygen.
 - c. Students know the location of the ozone layer in the upper atmosphere, its role in absorbing ultraviolet radiation, and the way in which this layer varies both naturally and in response to human activities.

California Geology

- 9. The geology of California underlies the state's wealth of natural resources as well as its natural hazards. As a basis for understanding this concept:
 - a. Students know the resources of major economic importance in California and their relation to California's geology.

- b. Students know the principal natural hazards in different California regions and the geologic basis of those hazards.
- c. Students know the importance of water to society, the origins of California 's fresh water, and the relationship between supply and need.
- d. * Students know how to analyze published geologic hazard maps of California and know how to use the map's information to identify evidence of geologic events of the past and predict geologic changes in the future.

Investigation & Experimentation - Grades 9 To 12

Science Content Standards.

1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:
 - a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
 - b. Identify and communicate sources of unavoidable experimental error.
 - c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
 - d. Formulate explanations by using logic and evidence.
 - e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.
 - f. Distinguish between hypothesis and theory as scientific terms.
 - g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.
 - h. Read and interpret topographic and geologic maps.
 - i. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).
 - j. Recognize the issues of statistical variability and the need for controlled tests.
 - k. Recognize the cumulative nature of scientific evidence.

- l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.
- m. Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.
- n. Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).