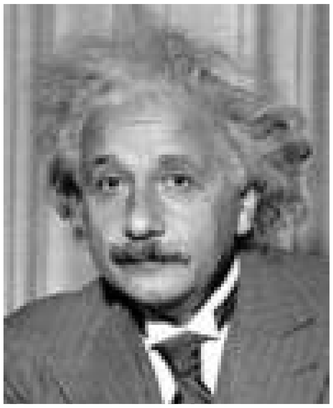
Sir Isaac Newton

Louis Pasteur



Albert Einstein

A SCIENCE Winter Inquiry Land

Earth and Space Sciences

Winter 2011-2012

Miami-Dade County Public Schools
Curriculum & Instruction

TABLE OF CONTENTS

Appendix

WELCOME TO *A SCIENCE WINTER INQUIRY LAND*

Preparing for Science

Science is not something mysterious. Being "scientific" involves being curious, observing, asking how things happen, and learning how to find the answers. Curiosity is natural to children, but they need help understanding how to make sense of what they see.

Bruno V. Manno
Acting Assistant Secretary
Office of Educational Research and Improvement

Many people are frightened by science and see it as something that can only be understood by the mind of a genius. Increasing the number of people going into the fields of science and mathematics is the national goal. However, even if a student is not planning to pursue a career in one of those fields, they have to be prepared to live and work in a world that is becoming increasingly complex and technical.

What Is Science?

Science is not just a collection of facts. Facts are a part of science. However, science is much more. It includes:

- Observing what is happening,
- Predicting what might happen,
- Testing predictions under controlled conditions to see if they are correct,
- Trying to make sense of our observations, and
- Involving trial and error--trying, failing, and trying again.

Science does not provide all the answers. The world around us is always changing and we learn something new every day, so we have to be willing to make changes and adjustments to our knowledge when we discover something new.

The Winter Break Packet

The activities and reading passages in this packet were selected to allow students to experience the relevancy of science in a fun and engaging way. As they navigate through these activities, students should realize that science is not limited to the classroom but that it is all around in everyday lives and that it explains most of the phenomena encountered in life.

Included as part of this packet, is a link to the Miami-Dade County Public Schools Student Portal *Links to Learning* technology activities. Individualized student learning paths have been designed based on FCAT scores and are aligned to the District's Pacing Guides. These online activities are supplemental and, as such, are not to be assigned or graded. All online activities are provided as a resource to both parents and students to engage learning using technology. Please log on just as you do at your school.

Links to Learning

<u>Resources:</u>
Technology-based resources can be accessed through the Student Portal on the district website, http://www.dadeschools.net, under the *Links to Learning* initiative. Here you will find additional activities designed for each student's individual needs, like virtual laboratory investigations with Explorelearning Gizmos.

The Appendix provides information designed to give the student a framework for the expectation of the scientific writing process.

Who Were They?

Sir Isaac Newton was a physicist, mathematician, astronomer, alchemist, and natural philosopher. He is best known for his explanation of Universal Gravitation and the three laws of motion. He was also able to prove that the reason of both the motion of objects on Earth and of celestial bodies is controlled by the same Neutral laws. These findings would make a revolutionary change in the development of science. His invention of the reflecting telescope was his great contribution in optics.

Louis Pasteur was a French chemist and microbiologists and one of the most famous and influential contributors in medical science. He is remembered for his remarkable breakthroughs in the causes and preventions of diseases supported by his experiments on the germ theory of disease. He also created the first vaccine for rabies and anthrax. Pasteur also invented the method of "pasteurization", where harmful microbes are stopped from causing sickness in food.

Albert Einstein is the greatest scientist of the twentieth century and the most notable physicist of all time. He was born in Germany but eventually migrated to America to take a teaching position at Princeton University. It is told that he had a learning disability in his childhood. He could not talk till he was three and could not read till he was eight. Despite such problems, in 1921 he became the noble prize winner for his contributions to Physics. His *Theory of Relativity* is considered a revolutionary development of Physics.

ACTIVITY 1: EXPLORING THE MOTION OF EARTH AND THE MOON

Benchmarks:
SC.912.E.5.6: Develop logical connections through physical principles, including Kepler's and Newton's Laws about the relationships and the effects of Earth, Moon, and Sun on each other.

SC.912.N.1.7: Recognize the role of creativity in constructing scientific questions, methods and explanations.

In the following activity you will make a model to explain the motion of the Earth and its relation to Kepler's Laws of Planetary Motion.

Kepler's Laws of Planetary Motion:

1. The Law of Orbits: All planets move in elliptical orbits, with the sun at one focus.
2. The Law of Areas: A line that connects a planet to the sun sweeps out equal areas in equal times.
3. The Law of Periods: The square of the period of any planet is proportional to the cube of the semimajor axis of its orbit.

Kepler's laws were derived for orbits around the sun, but they apply to satellite orbits as well.

Visit the following websites and investigate the motion of the Earth and Moon with respect to the Sun. Relate planetary motion to Kepler's Laws and begin to think how to design a model that will be used to explain planetary and satellite motion.

- http://kepler.nasa.gov/johannes/
- http://hyperphysics.phy-astr.gsu.edu/HBASE/Kepler.html
- http://galileoandeinstein.physics.virginia.edu/more_stuff/flashlets/kepler6.htm
- http://phet.colorado.edu/simulations/sims.php?sim=My_Solar_System

Design a model of the Earth

Using the following materials, design a model of the Earth orbiting the Sun.

- 1 sharp pencil
- 1 medium Styrofoam ball
- 1 black marker
- 1 lamp

I. Describe the materials and their use in the experiment/investigation setup:

1. What is the purpose of each item? ____

____

____

____

2. What variables described in (1) can you measure? ________________________________

____

____

3. What variables can you control? ____

____

II. Design and experiment/investigation

1. Identify the independent variable (IV) and the dependent variable (DV)

____

____

2. Describe other possible variables

____

____

3. Purpose of experiment/investigation (problem statement)

____

____

____

4. Hypothesis (If – Then – Because statement incorporating the IV and DV)

____

____

5. Experiment design (how to use the materials, lab set up, and procedures)

____

____

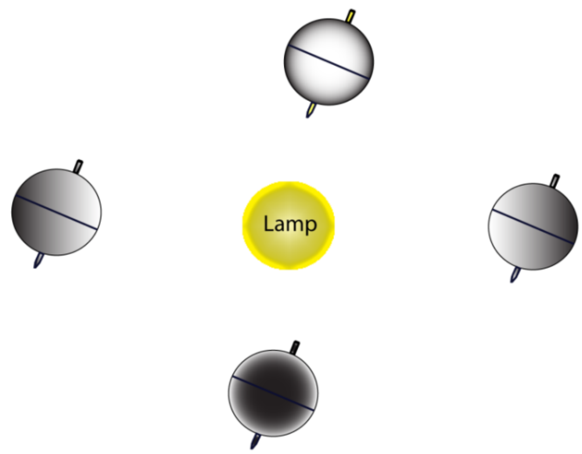
____

____

____

Helpful hints:

1. Make a model of the motion of the Earth around the Sun. Push the pencil straight through the center of the Styrofoam ball, representing the Earth's axis. Label the North and South poles, equator, and other markings deemed necessary for the demonstration.



2. Use a lamp to represent the Sun. Bring the ball a few feet from the lamp and tilt it slightly so the North Pole is about 23 degrees from straight up and down and pointing away from the lamp.
3. Slowly move the ball counterclockwise around the lamp. Try to maintain the tilt — always pointing the North Pole toward the same place in the room.

Questions:

1. Describe the pattern of light and shadow on the ball at the starting point. What season do you think this is in the Northern Hemisphere? In the Southern Hemisphere?

2. Stop when you have gone a quarter of the way around the Sun. Describe the pattern of light and shadow on the ball on this day. What season do you think this is in the Northern Hemisphere? In the Southern Hemisphere?

3. Continue moving the ball counterclockwise. Stop when you have gone another quarter revolution. Describe what you observe as before.

____

____

____

4. Continue counterclockwise stopping each quarter turn and describing the position and the season until you get back to the starting point.

____

____

____

5. Many people think that the seasons change because the Earth moves closer to and farther from the Sun during the year. Is this correct? Why do you think they believe this? Relate to Kepler's 1st Law and use examples from your model to support your answer.

____

____

____

____

____

____

____

____

ACTIVITY 2: CLIMATE AND THEIR EFFECTS

Benchmarks:
SC.912.E.7.4: Summarize the conditions that contribute to the climate of a geographic area, including the relationships to lakes and oceans

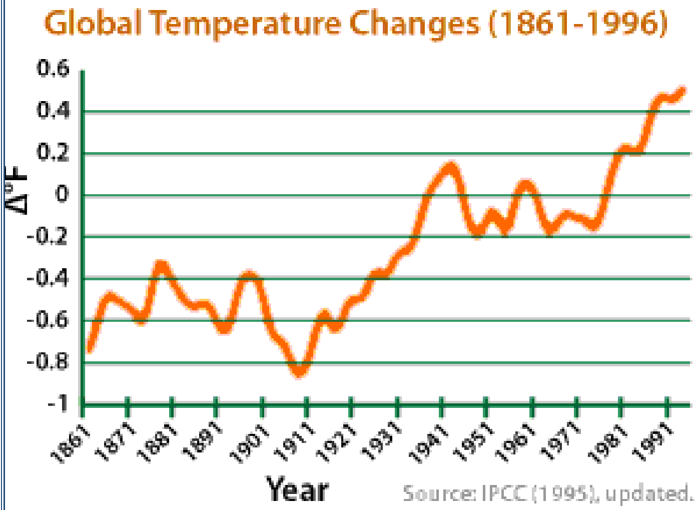
SC.912.E.7.5: Predict future weather conditions based on present observations and conceptual models and recognize limitations and uncertainties of such predictions.

SC.912.N.1.3: Recognize that the strength or usefulness of a scientific claim is evaluated through scientific argumentation, which depends on critical and logical thinking, and the active consideration of alternative scientific explanations to explain the data presented.

Climate Change:
(Adapted from http://www.cotf.edu/ete/modules/coralreef/CRclimate.html)

Human activities have caused much of the destruction of the world's coral reefs. For example, human-induced global climate change may be causing an increase in ocean temperatures. This is suspected to be a major culprit of coral loss. Global climate change is a change in the long-term weather patterns that characterize the regions of the world. Weather refers to the short-term (daily) changes in temperature, wind, and/or precipitation of a region (Merritts et al., 1998), and is influenced by the sun. The sun heats the Earth's atmosphere and its surface, causing air and water to move around the planet. The result can be as simple as a slight breeze or as complex as the formation of a tornado.

When weather patterns for an area change in one direction over long periods, they can result in a net climate change for that area. The key concept in climate change is time. Natural changes in climate usually occur over geologic time. That means they occur over such long periods of time that they are often not noticed within several human lifetimes. The gradual nature of these climate changes enables plants, animals, and microorganisms to evolve and adapt to the new temperatures, precipitation patterns, etc.

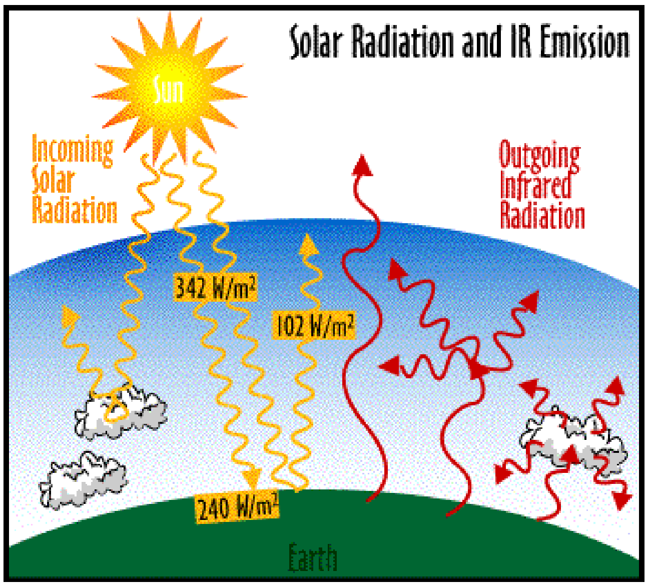


The real threat of climate change lies in how rapidly the change occurs. For example, over the past 130 years the mean global temperature appears to have risen 0.6 to 1.2 degrees Fahrenheit (0.3 to 0.7 degrees Celsius). Look at the temperature changes depicted in the graph from the Environmental Protection Agency's Global Warming web site. The increasing steepness of the curve suggests that changes in mean global temperature have occurred at greater rates over time. Further evidence suggests that future increases in mean global temperature may occur at a rate of 0.4 degrees Fahrenheit (0.2 degrees Celsius) each decade. The graph shows the changes in global temperature (degrees Fahrenheit) from 1861 to 1996 (Graph adapted from image courtesy of the U.S. Environmental Protection Agency).

So, what explains the rapid global climate change? One factor is an increasing greenhouse effect. The greenhouse effect, depicted in the graphic below, is a warming process that balances Earth's cooling processes. During this process, sunlight passes through Earth's atmosphere as shortwave radiation. Some of the radiation is absorbed by the planet's surface. As Earth's surface is heated, it emits long-wave radiation toward the atmosphere. In the atmosphere, certain gases called greenhouse gases absorb some of the long-wave radiation. These include carbon dioxide (CO_2), chlorofluorocarbons (CFCs), methane (CH_4), nitrous oxide (N_20), tropospheric ozone (O_3), and water vapor. Each molecule of greenhouse gas becomes energized by the long-wave radiation. The energized molecules of gas then emit heat energy in all directions. By emitting heat energy toward Earth, greenhouse gases increase Earth's temperature.

Note that how the greenhouse effect truly works differs from the traditional misconception, which is partially caused by the name itself. Many believe that Earth's atmosphere acts as greenhouse walls do, physically trapping heat in the same way as a greenhouse's walls trap heat inside the building and prevent it from escaping to the atmosphere. In fact, it's the presence of greenhouse gases and water vapor in the atmosphere that creates the greenhouse effect. These gases reflect the infrared radiation (long-wave radiation) from the Earth's surface back to the surface, thus increasing the heating of the surface.

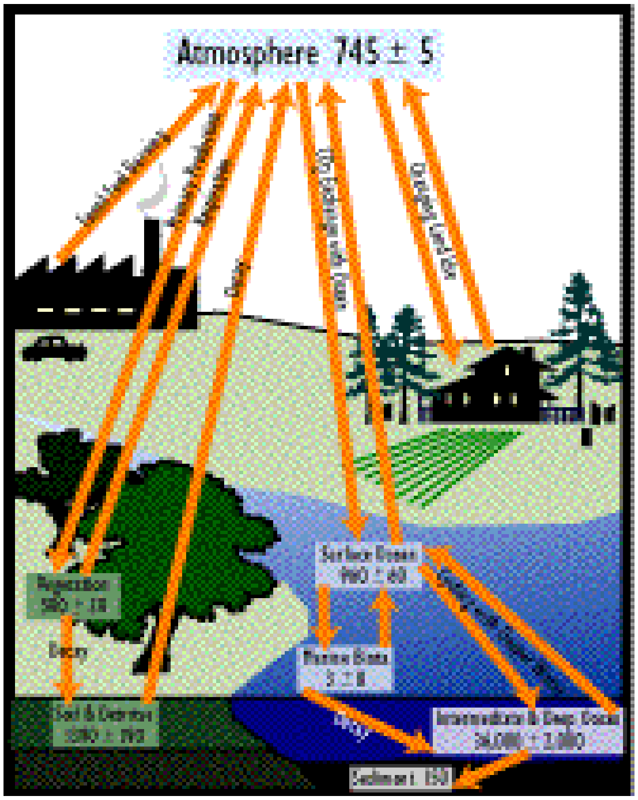
The greenhouse effect is a natural occurrence, which maintains Earth's average temperature at approximately 60 degrees Fahrenheit. The greenhouse effect is a necessary phenomenon that prevents all of Earth's heat from escaping to the outer atmosphere. Without the greenhouse effect, temperatures on Earth would be much lower than they are now, and the existence of life in its current form on this planet would not be possible. However, too many greenhouse gases in Earth's atmosphere could increase the greenhouse effect. As human activities such as farming, driving cars, and cutting forests increase, so does the concentration of greenhouse gases in Earth's atmosphere. This could result in changes in precipitation patterns as well as an increase in mean global temperatures.



The changes in temperature affect the ocean as well; and changes in ocean temperature can have detrimental effects on the coral. When ocean water temperature reaches 32 degrees Celsius or greater, and remains stable for extended periods of time the algae covering the coral begin to die. This causes the coral to die because they lose the energy-providing benefits of the algae. These symptoms can be observed when the corals' white calcium carbonate skeleton becomes exposed appearing bleached.

<u>Carbon Dioxide: Overview</u>

Compounds that contain the element carbon are referred to as "organic." These compounds are very important. They are present in all living things. The carbon element is continually moving among the earth's lithosphere, hydrosphere, biosphere, and atmosphere in various forms--as carbon dioxide (CO_2), sugars or carbohydrates ($C_nH_{2n}O_n$), and and calcium carbonate ($CaCO_3$), to name just a few. The movement of carbon among the earth's spheres, as diagrammed below, is known as the carbon cycle.



The boxes in the diagram indicate **carbon sources** (places of origin) and **carbon sinks** (places of storage). The arrows indicate the movement of the element among the earth's spheres. (Click on image at left for a larger view.) Green plants play a very important role in the carbon cycle. They absorb carbon dioxide (CO_2) from the atmosphere and produce carbon-containing sugars. This process is called **photosynthesis**.

There are two main steps in photosynthesis. First, plants trap the sun's light energy in a compound called chlorophyll. This energy is converted to a chemical form called adenosine triphosphate (ATP). In the second step, plants use the energy from ATP to produce sugar ($C_6H_{12}0_6$). The process of photosynthesis requires water (H_2O). It also produces water, as well as oxygen (O_2). The net chemical reaction for the process of photosynthesis is:

$6\ CO_2 + 6\ H_2O$ + sunlight ------> $C_6H_{12}O_6 + 6\ O_2$.

Animals eat plants to obtain the energy trapped during photosynthesis. As the animals' bodies break down the carbohydrates in the plant tissue, CO_2 is released to the atmosphere. This process is called **respiration**. The net chemical reaction for the process of respiration is the exact opposite of photosynthesis: $6\ O_2 + C_6H_{12}O_6$ ------> $6\ H_2O + 6\ CO_2$. Plants, too, respire as they break down the organic molecules in themselves in order to release the stored energy. Plants and animals also release CO_2 to the atmosphere when they **decompose** or decay. The chemical reaction for this process is the same as that for respiration.

When dead plants and animals slowly decay under high pressure and high temperatures, they may form pools of energy known as **fossil fuels**. Fossil fuels include coal, oil, and natural gas. People burn fossil fuels, as well as fresh vegetation, to release the energy stored in them. The energy is used for heat, operating automobiles, etc. The chemical process of burning fuel, known as combustion, is the same as respiration and decomposition:

$6\ O_2 + C_6H_{12}O_6$ ------> $6\ H_2O + 6\ CO_2$.

Since the Industrial Revolution, humans have burned increasingly greater amounts of fossil fuels in order to produce more energy. As the practice of burning fossil fuels grows, so does the amount of carbon dioxide emitted to the atmosphere. Historical data from ice cores and modern data collected from the Mauna Loa observatory in Hawaii support this. The graph below depicts a 30% increase in **atmospheric** concentrations of carbon dioxide (CO_2) since 1860.

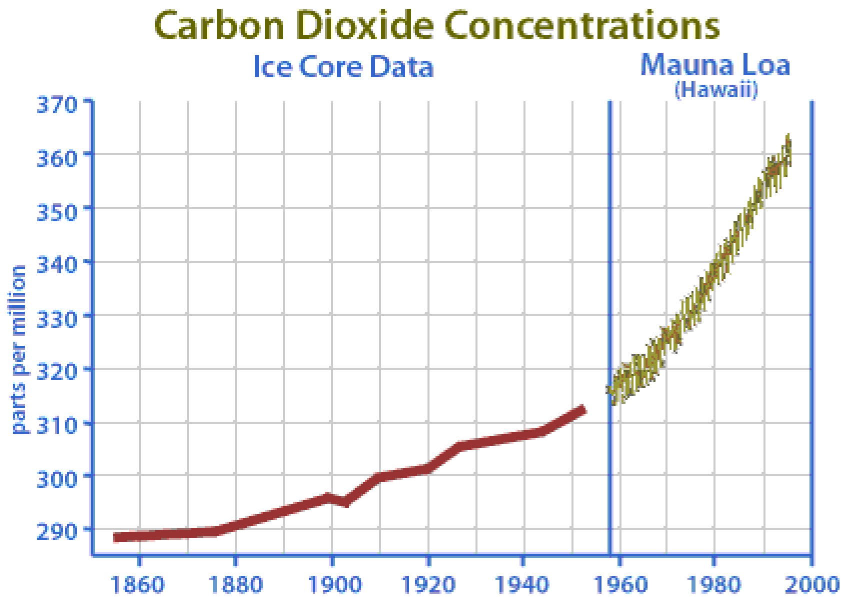


Image: Atmospheric concentrations of carbon dioxide from 1855 to 1996. Figure adapted from an image courtesy of the Whitehouse Initiative on Global Climate Change.

There is growing evidence that increases in atmospheric concentrations of CO_2 may increase the rate of global climate change due to the greenhouse effect. This is because CO_2 contributes to 55% of the greenhouse effect. Increases in atmospheric concentrations of CO_2 may also have great impacts on plant growth by affecting rates of photosynthesis.

Situation 1:
Jim Anderson, a young computer programmer, has won the lottery. After taxes, he will be getting enough money to realize his life's dream: to buy and operate a wheat farm in Kansas. Ever since he was a boy visiting his grandparent's farm, Jim has dreamed of enjoying the outdoors and the satisfaction of planting and harvesting wheat. Now that he can realize this dream, his wife has readily agreed that they should begin to plan their life on a farm.

Oddly enough, at just about the same time that Jim won the lottery, he happened to pick up a magazine that suggested some American farms may be in jeopardy from Mother Nature. The article discussed the **greenhouse effect** and global **climate** change. It stated that levels of atmospheric carbon dioxide--a greenhouse gas--have increased significantly over the past several decades. Elevated levels of atmospheric carbon dioxide may have dramatic effects on the Earth's climate, such as changes in precipitation and temperature patterns. If predicted changes come about, in 50 years farmers may see significant declines in the yields of wheat crops in the areas Jim had considered for his farm. This news was disturbing because Jim had hoped to find a farm that would provide not only for him and his wife, but also for his children's future benefit as well.

Jim and his wife have come to your firm, Earth Systems Science Environmental Research (ESSER) for technical advice. They want to make sure they are making a good investment. Using historical and predicted data provided in the "Remote Sensing" puzzle piece of this module, perform an Earth systems science analysis in order to determine how the yield of hard red winter wheat in Kansas will be affected by increased concentrations of atmospheric carbon dioxide as a result of its impacts on the four spheres. Provide recommendations or solutions as to whether or not Kansas wheat farmers will be able to maintain the current yields of this variety of wheat 50 years from now.

<u>Situation 2:</u>
Your firm, Global Environmental Research (GER) has been approached by a group of Kansas wheat farmers who are concerned that predicted increases in atmospheric carbon dioxide may affect the **climate** in their region and may thereby have an adverse impact on their livelihood. They have been getting more and more information from agricultural research journals that suggests that **global warming** could lead to a decline in Kansas the yield of hard red winter wheat crops. They want you to evaluate the situation and determine whether or not there will be a significant change in carbon dioxide, precipitation, and/or temperature over the next 50 years. Based on your findings, they also would like you to make recommendations on the issue of whether they will be able to maintain the current yields of hard red winter wheat 50 years from now.

As part of your evaluation, perform an Earth systems science analysis to determine the impacts of increased atmospheric carbon dioxide on the Earth's spheres. What--if any--changes have occurred in the Earth's spheres that support the hypothesis that global climate change is occurring at an increasingly rapid rate? How can such changes affect hard red winter wheat yield in Kansas?

<u>ESS Protocol:</u>
First, you will do an Earth system science analysis. Then, you will make predictions, based on the results of the ESS analysis, concerning the future of the growth of hard-red wheat in Kansas 50 years in the future.

Following the steps below will help you to accomplish your task.

<u>Step 1: List What is Known</u>

The two columns below illustrate the parallel jobs to be completed in Step 1. You do not need to conduct any research to do this step. Use your current knowledge and the information from the scenario to fill in the lines provided.

In the space provided in the first column, list what you know about hard-red winter wheat.

Then look at the Earth System Diagram in the second column. Notice how the arrows go to and from the event and spheres. These arrows indicate that the cause and effect relationships go both from the event to the spheres and from the spheres to the event (↔). While thinking about these relationships, list your ideas about how the event--increased concentrations of atmospheric carbon dioxide -- could possibly impact the four spheres that make up the Kansas wheat farm ecosystem.

List your prior knowledge about hard-red winter wheat.

____

____

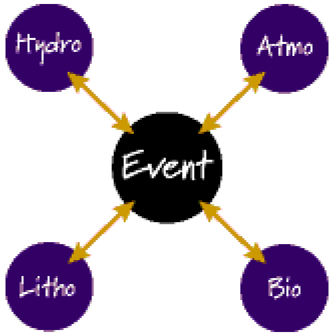
____

____

____

____

List prior Earth system science knowledge regarding increased concentrations of atmospheric carbon dioxide.



____

____

Increased Carbon Dioxide Event ⟷ Biosphere

____

____

Increased Carbon Dioxide Event ⟷ Lithosphere

____

____

Increased Carbon Dioxide Event ⟷ Atmosphere

____

____

Increased Carbon Dioxide Event ⟷ Hydrosphere

____

____

Step 2: List What Is Needed

Now that you have an idea of what you DO know about hard-red winter wheat and the impacts of the event on the spheres and the spheres on the event, you need to think about what you DO NOT know. Below, you will ask questions that will guide the research that may take place on the Internet, in the library, or with other resources.

In the first column, list your questions about hard-red winter wheat.

Ask questions in the second column to direct the research you will conduct in **Step 3**. These questions should help you focus your research on finding information to complete the ESS analysis of the impacts that increased concentrations of atmospheric carbon dioxide could have on the four spheres that make up the Kansas wheat farm ecosystem.

List your questions regarding hard-red winter wheat.

____

____

____

____

____

List your questions regarding the impacts that increased concentrations of atmospheric carbon dioxide could have on the four spheres that make up the Kansas wheat farm ecosystem**.**

____

____

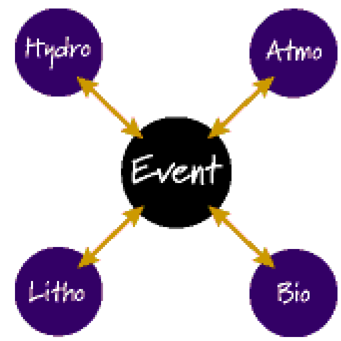
____

____

<u>Step 3: Gather Information needed to complete the ESS Analysis</u>

Part I

Using your answers from your research, list any additional cause and effect relationships you found for the event and the spheres. These relationships should build on or be different from the ones you listed in Step 1. The answers you find should explain the possible causes and effects increased concentrations of atmospheric carbon dioxide could have on the spheres that comprise the Kansas wheat farm ecosystem. Keep track of where you locate information. You may need to look it up again when you do Step 4.



Increased Carbon Dioxide Event ↔ Biosphere

____

____

Increased Carbon Dioxide Event ↔ Lithosphere

____

____

Increased Carbon Dioxide Event ↔ Atmosphere

____

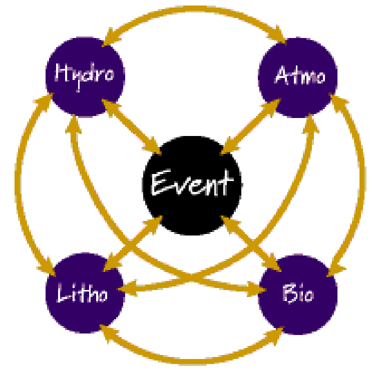
____

Increased Carbon Dioxide Event ↔ Hydrosphere

____

____

Part II
Using answers from your research, list the cause and effect relationships that occur between and among the spheres.



Note: Begin thinking about how these relationships may in turn affect future yields of hard-red winter wheat.

Atmosphere ↔ Biosphere

Atmosphere ↔ Lithosphere

Atmosphere ↔ Hydrosphere

Biosphere ↔ Hydrosphere

Biosphere ↔ Lithosphere

Hydrosphere ↔ Lithosphere

<u>Step 4: Present Your Findings</u>

Prepare a report or presentation of your predictions about the future yields of hard-red winter wheat based on your ESS analysis.

Predictions based on ESS Analysis:

ACTIVITY 3: SUNSPOT CYCLE

Benchmarks:
SC.912.E.5.4 - Explain the physical properties of the Sun and its dynamic nature and connect them to conditions and events on Earth.

SC.912.N.1.6 - Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied.

Student Goals:
Through this activity, students will

- Understand that the Sun has features called sunspots.
- Understand that the number and location of sunspots changes over time.
- Learn through graphing data that the number of sunspots varies over time with a regular pattern.
- Learn through graph interpretation that when the temporal pattern of sunspots has been disrupted in the past, there has been climate change on Earth.

Key Concepts:

- The Sun has features called sunspots that change in number and location over time.
- People have been keeping detailed records of the number of sunspots for hundreds of years.
- The number of sunspots waxes and wanes with a regular periodicity of 11 years; this is called the solar cycle.
- The solar cycle has been disrupted in the past, causing climate change on Earth (during the Little Ice Age, for example).

Science Background Information:
When viewed through a telescope, sunspots have a dark central region surrounded by a somewhat lighter region. The dark area is slightly cooler than the surrounding area. This cool area is likely related to a strong magnetic field around the sunspot. Sunspots typically last anywhere from a few days to a few months.

People have been observing and keeping records of sunspots for hundreds of years. In 1612, Galileo proved there were spots on the Sun. He used a telescope to look at the Sun (not directly!). At the time, telescopes (and other optics) were very recent innovations and were allowing scientists such as Galileo to discover new aspects of our planet and space. Galileo's discovery was highly controversial at the time because the spots he found were viewed as imperfections. Many of his 17th century colleagues did not believe the Sun could be imperfect!

Over time, scientists have noticed a pattern in the number of sunspots. About every 11 years the number of sunspots reaches a high and then decreases again. This is known as the Solar Cycle. Other sorts of solar activity are related to this cycle as well, such as solar flares, which tend to occur on areas of the Sun near sunspots. The year 2011 will be a solar maximum, making 2006 and 2015 close to solar minimums.

When the Sun has fewer sunspots, it gives off less energy. This results in less energy making its way to Earth, and our planet cools. More than 300 years ago, when the climate was cooler for a time called the “Little Ice Age,” people noticed there were no sunspots for several decades. The period of time between 1645 and 1715) was called the Maunder Minimum. It was the coldest period of the Little Ice Age.

Introduction:

Never look directly at the Sun. (This can cause blindness.)

Observe images of the Sun provided in the next page. They are not photographs; the data is collected by a remote sensing instrument called MDI that is on the SOHO spacecraft and made into a representation or image that looks like a photograph.

Start with the upper left picture (A, courtesy of www.spaceweather.com). This shows a very large sunspot and quite a few smaller ones. To provide a sense of scale, there is a small dot to indicate the size of Earth as compared with the sunspots.
Look at the other images on the transparency (B-D) and see if you can find other sunspots.

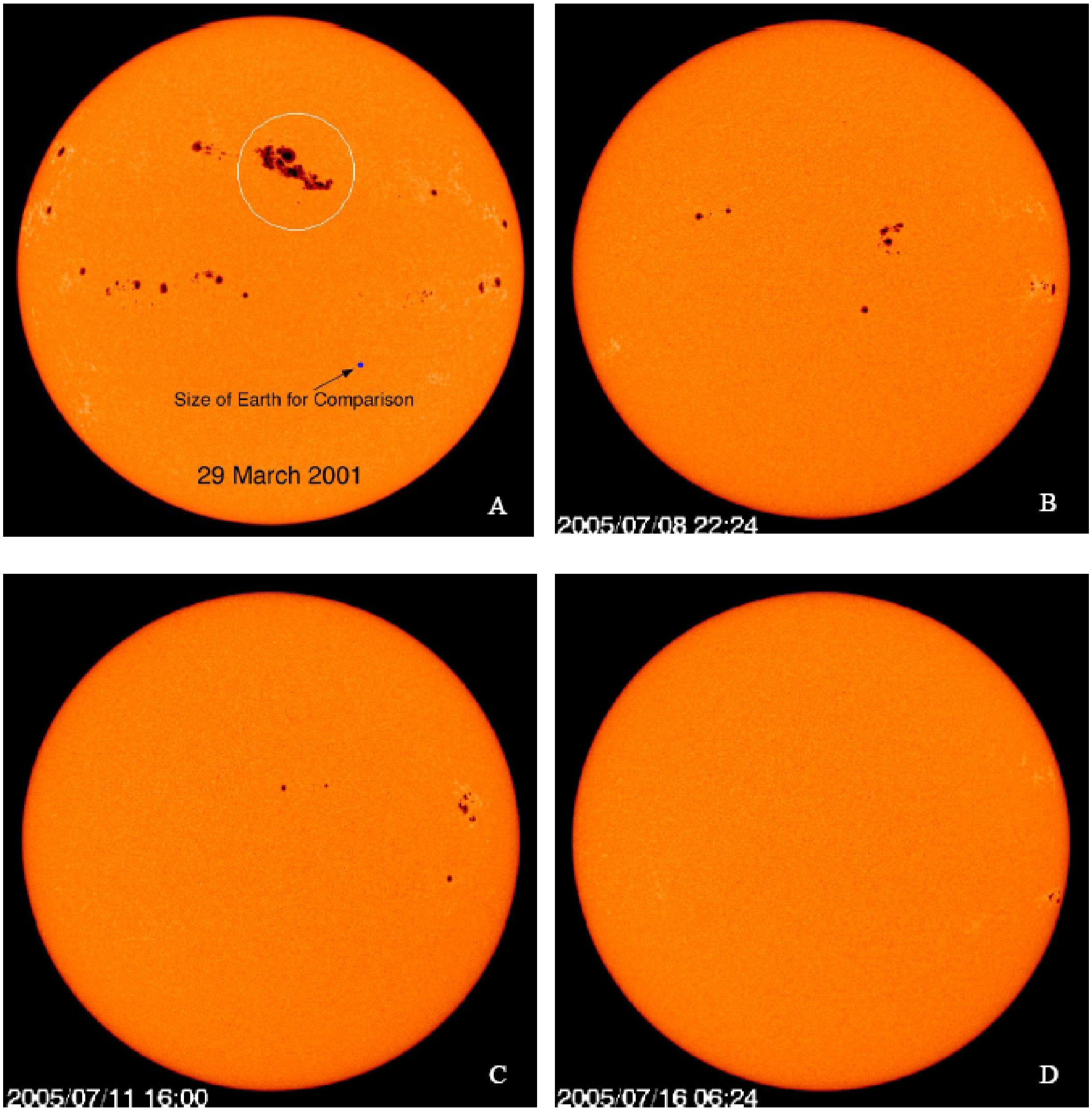
All three of these images show the Sun on different days of July 2005. The date and time are in the lower left of each image. (All three images courtesy of NASA SOHO.)

Engage Questions:

1. Do the number of spots stay the same? Brainstorm ideas about why the number of visible sunspots might change over time. There are two reasons why this might be: 1) we are not always looking at the same side of the Sun, because the Sun rotates and Earth orbits, thus the number of spots we can see can vary with the time of day over a few days or weeks (example: compare images B-D); 2) the number of sunspots can change over weeks, months, years (example: compare image A with the others) .

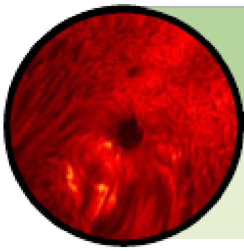
2. Are all the spots the same? Notice that some spots are large and others are small.

Scientists have been observing the number of spots on the sun for hundreds of years. In this lesson you will investigate this data to see if there is a pattern to the number of spots.



<u>Activity:</u>
Analyze the data in the following sections (Part A and Part B) and discover how the Sun changes over time. Relate this information to effects the Sun may have on the Earth.

Part A



CLIMATE DISCOVERY STUDENT PAGES

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

Page 1:
Graphing Sunspots

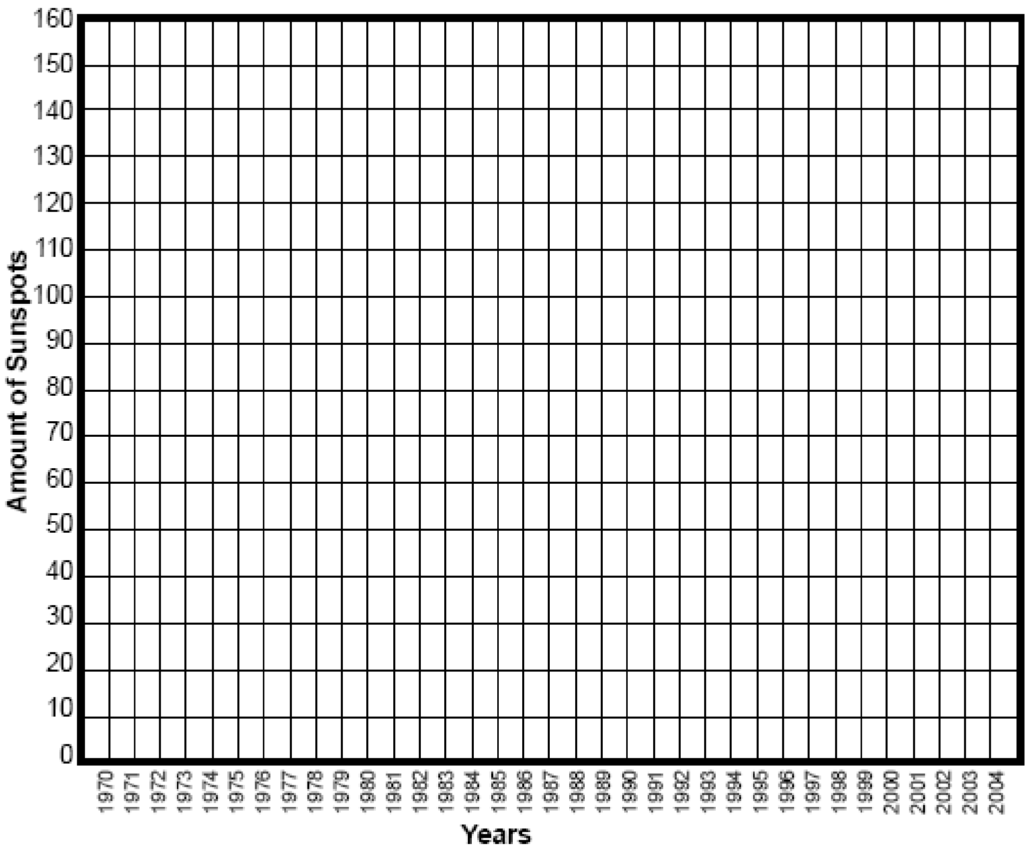
Name ______________________

Date __________ Class ____________

Make a graph of the number of sunspots over time:

- The data below indicate the average number of sunspots for each year. Use the data to make a graph of average number of sunspots as they change over time.
- Plot sunspot number against time by making a dot on your graph wherever the year and appropriate sunspot number intersect.
- Connect the points you've plotted with a line.

1970	109
1971	74
1972	72
1973	39
1974	34
1975	15
1976	14
1977	30
1978	103
1979	156
1980	141
1981	141
1982	116
1983	72
1984	44
1985	17
1986	12
1987	28
1988	89
1989	148
1990	149
1991	146
1992	96
1993	54
1994	36
1995	19
1996	9
1997	22
1998	65
1999	94
2000	120
2001	111
2002	104
2003	64
2004	41



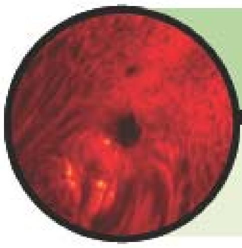
Answer these questions!

1. How many years are there between each time of abundant sunspots and each time of fewest sunspots? (In other words, how often does the pattern repeat?)

   ____

2. Make predictions! Will there be many or few sunspots during:
   - the year you graduate from high school? ______________
   - the year you were born? ______________
   - the year you turn 21 years old? ______________

Part B



CLIMATE DISCOVERY STUDENT PAGES
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

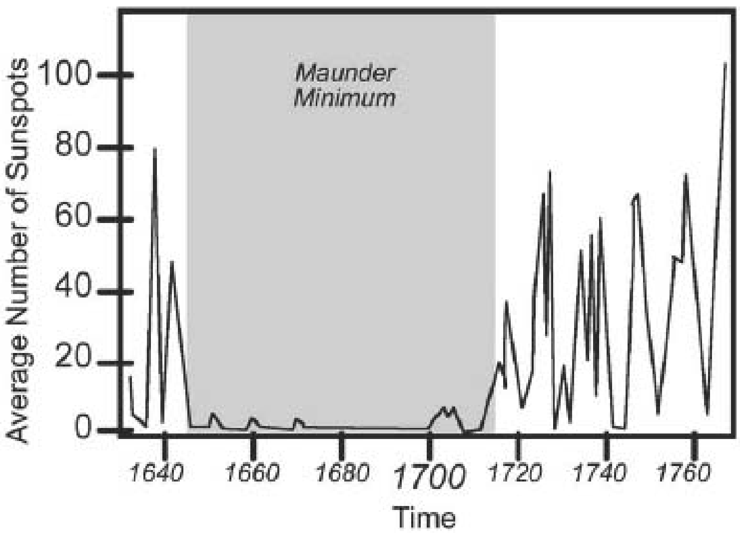
Page 2:
Sunspots and Climate

Name ______________________

Date ___________ Class ___________

Directions:

- Examine the graph and answer the questions below.
- To begin, identify the axes. What is the horizontal (x) axis? What is the vertical (y) axis? What does each axis represent?



Answer these questions!

1. How is this graph similar to the graph that you made of sunspot data from 1970-2004? ____________

____

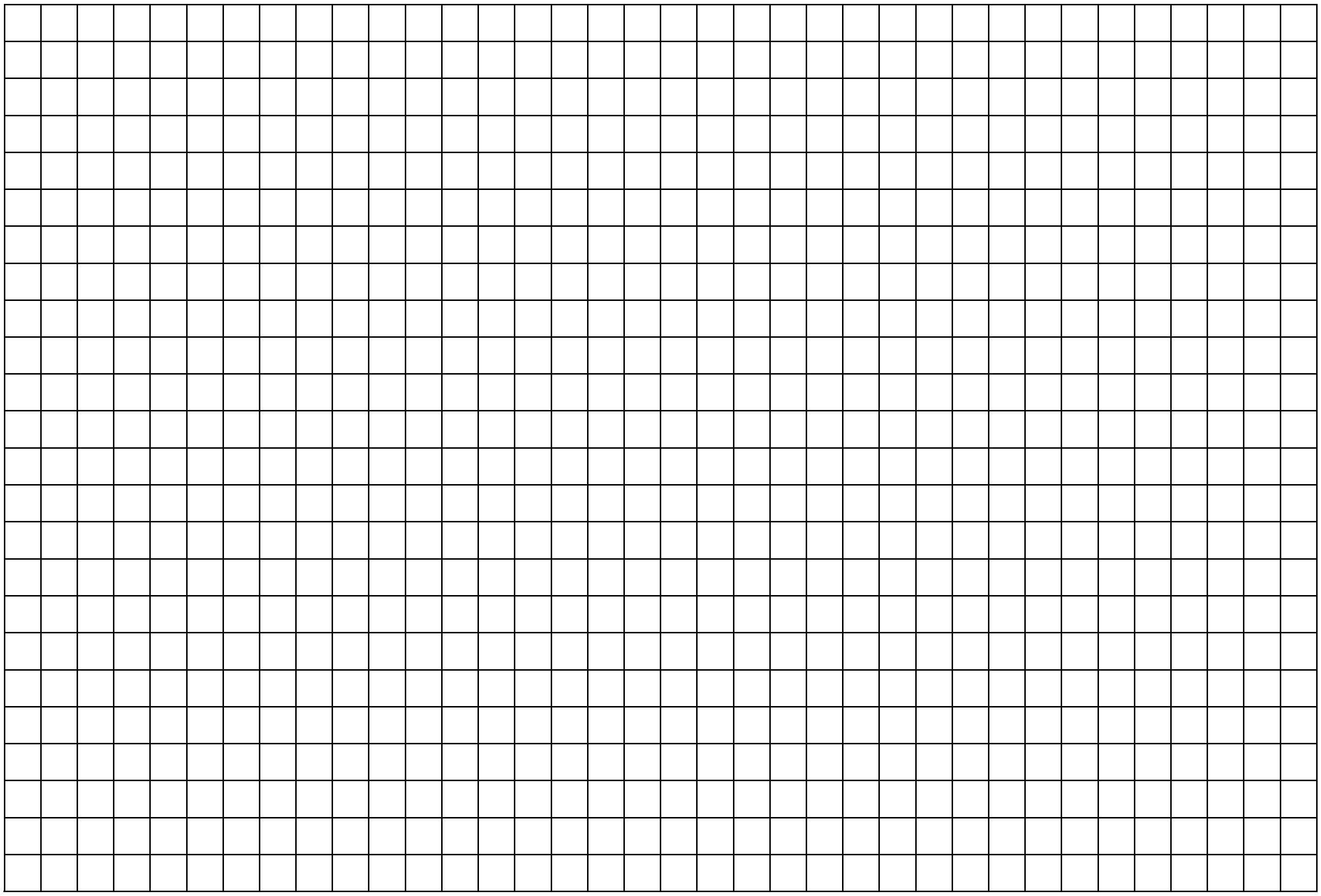
2. How is this graph different than sunspot data 1970-2004? ______________________________

____

3. The area shaded grey indicates a time of cool climate called the *Maunder Minimum*. Knowing this clue, you will be able to mark the following **true** or **false**.

T F More sunspots mean more energy comes from the Sun.
T F Less sunspots means that Earth has a warmer climate.
T F Less sunspots means that Earth gets less energy from the Sun.
T F More sunspots means that Earth has a warmer climate.

Analyzing the sunspot data, how would the graph look like from 2004 until today?



Extensions:

Take a look at sunspots WITHOUT LOOKING AT THE SUN! To do this safely, you will need to project an image of the Sun through either a pair of binoculars, a telescope, or a device called a Sunspotter onto a piece of white paper or a white wall. For more information about how to safely look at sunspots with your class, see the websites listed in the *Additional Resources* section below. Additonally, consider taking a field trip to a local observatory, if possible.

Additional Resources:

- Windows to the Universe http://www.windows.ucar.edu

- Resources for safely looking at sunspots:
  - Tips about Safe Sunwatching
    http://www.spaceweather.com/sunspots/doityourself.html
  - Information about Sunspotters
    http://scientificonline.com/product.asp_Q_pn_E_3112800

PARTS OF A LAB REPORT: A STEP-BY-STEP CHECKLIST

Good scientists reflect on their work by writing a lab report. A lab report is a recap of what a scientist investigated. It is made up of the following parts.

<u>Title (underlined and on the top center of the page)</u>

Benchmarks Covered:

- Your teacher should provide this information for you. It is a summary of the main concepts that you will learn about by carrying out the experiment.

Problem Statement:

- Identify the research question/problem and state it clearly.

Hypothesis(es):

- State the hypothesis carefully. Do not just guess; instead try to arrive at the hypothesis logically and, if appropriate, with a calculation.
- Write down your prediction as to how the independent variable will affect the dependent variable using an "if" - "then" – "because" statement.
  - ❖ If <u>(state the independent variable)</u> is <u>(choose an action)</u>, then <u>(state the dependent variable)</u> will <u>(choose an action)</u>, because <u>(describe reason for event)</u>.

Materials and activity set up:

- Record precise details of all equipment used.
  - ❖ For example: a balance that measures with an accuracy of +/- 0.001 g.
- Record precise details of any chemicals used.
  - ❖ For example: (5 g of $CuSO_4 \cdot 5H_2O$ or 5 g of copper (II) sulfate pentahydrate).

Procedures:

- Do not copy the procedures from the lab manual or handout.
- Summarize the procedures that you implemented. Be sure to include critical steps.
- Give accurate and concise details about the apparatus and materials used.

Variables and Control Test:

- Identify the variables in the experiment. State those over which you have control. There are three types of variables:
  1. <u>Independent variable</u> (also known as the manipulated variable): The factor that can be changed by the investigator (the cause).
  2. <u>Dependent variable</u> (also known as the responding variable): The observable factor of an investigation that is the result or what happened when the independent variable was changed.
  3. <u>Constant variable:</u> The other identified independent variables in the investigation that are kept or remain the same during the investigation.

- Identify the control test. A control test is the separate experiment that serves as the standard for comparison to identify experimental effects and changes of the dependent variable resulting from changes made to the independent variable.

Data:

- Ensure that all data is recorded.
  - ❖ Pay particular attention to significant figures and make sure that all units are stated.
- Present your results clearly. Often it is better to use a table. Record all observations.
  - ❖ Include color changes, solubility changes, whether heat was evolved or taken in, etc.

Data Analysis:

- Analyze data and specify method used.
- If graphing data to look for common trend, be sure to properly format and label all aspects of the graph.

Results:

- Ensure that you have used your data correctly to produce the required result.
- Include any other errors or uncertainties that may affect the validity of your result.

Conclusion and Evaluation:

A conclusion statement answers the following seven questions in at least three paragraphs.

I. First Paragraph: Introduction

1. What was investigated?
   a) Describe the problem.
2. Was the hypothesis supported by the data?
   a) Compare your actual result to the expected result (either from the literature, textbook, or your hypothesis).
   b) Include a valid conclusion that relates to the initial problem or hypothesis.
3. What were your major findings?
   a) Did the findings support or not support the hypothesis as the solution to the restated problem?
   b) Calculate the percentage error from the expected value.

II. Middle Paragraphs: These paragraphs answer question 4 and discuss the major findings of the experiment, using data.

1. How did your findings compare with other researchers?
   a) Compare your result to other students' results in the class.
      - The body paragraphs support the introductory paragraph by elaborating on the different pieces of information that were collected as data that either supported or did not support the original hypothesis.

- Each finding needs its own sentence and relates back to supporting or not supporting the hypothesis.
- The number of body paragraphs you have will depend on how many different types of data were collected. They will always refer back to the findings in the first paragraph.

III. Last Paragraph: Conclusion

2. What possible explanations can you offer for your findings?
    a) Evaluate your method.
    b) State any assumptions that were made which may affect the result.
3. What recommendations do you have for further study and for improving the experiment?
    a) Comment on the limitations of the method chosen.
    b) Suggest how the method chosen could be improved to obtain more accurate and reliable results.
4. What are some possible applications of the experiment?
    a) How can this experiment or the findings of this experiment be used in the real world for the benefit of society?

POWER WRITING MODEL IN SCIENCE

1. Introductory Paragraph:

State the purpose of the experiment, what was set out to prove, and explain the reasoning behind the experiment. This is where the problem statement and the hypothesis are introduced. The problem statement introduces the problem you are trying to solve and the hypothesis describes the solution that you hope to obtain after the experimentation. (This section answers question 1: "What was investigated?"). Continue by providing relevant information supporting or not supporting the hypothesis (This section answers question 2: "Was the hypothesis supported or not supported by the data?"). This is how the rest of the sentences in the introductory paragraph are linked. They will describe the data that was collected and the major findings of the investigation (question 3) that supported or did not support the hypothesis as the solution to the restated problem.

2. Body Paragraphs:

The body paragraphs support the introductory paragraph by elaborating on the different pieces of information that were collected as data that either supported or did not support the original hypothesis. Using terms such as "as a matter of fact" or "for example" and "not only but also" for successive sentences is useful. Each finding needs its own sentence and relates back to supporting or not supporting the hypothesis. The body paragraphs may include Question 4, which describes how the findings compared with other researchers or groups investigating the same problem. The number of body paragraphs you have will depend on how many different types of data were collected. They will always refer back to the findings in the first paragraph. The concluding sentence can begin with a term such as "clearly" which would be followed by the statement that is true (support or non support) for the entire paragraph as it relates to the hypothesis. The commentary can include some inferences (opinions) although the major inferences should be reserved for the concluding paragraph.

3. Concluding Paragraph:

The concluding paragraph contains the major commentary about the problem statement and the hypothesis in the first paragraph of the conclusion. This is where question 5, what possible explanations can you offer for your findings? can be answered. The paragraph should also include answers to questions 6 and 7 that include what recommendations do you have for further study and for improving the experiment and some possible applications of the experiment? At the end of the paragraph the problem statement and hypothesis (introduction and thesis) is restated more specifically with an abbreviated version of the explanation of the findings to summarize the conclusion.

Questions and Examples:

Questions	Examples
1. What was investigated? (Describe the problem statement)	The relationship between the age of compost used in soil and the growth, health, and quality of the leaves of tomato plants were investigated.
2. Was the hypothesis supported by the data?	The data appears to support the hypothesis that the growth, health, and leaf quality of tomato plants would improve increasing the age of compost mixed with soil.
3. What were the major findings?	As the age of the compost increased the health, quality of the leaves, and the mean height of the tomato plants increased. The mean height of plants grown in soil with compost aged for six months was greater than the control group, with plants exhibiting similar health. More plants grown in soil with one month-old compost exhibited poor leaf quality than in the control.
4. How did your findings compare with other researchers?	No similar studies were found relating the age of compost to the growth of tomato plants.
5. What possible explanations can you offer for your findings?	As the compost decomposes, nutrients needed by the plant may be released thereby improving the growth of the plant.
6. What recommendations do you have for further study and for improving the experiment?	This experiment could be repeated with an increased number different ages of compost. Measurements of soil temperature may help to understand what is happening to the compost.
7. What are some possible applications of the experiment?	The use of compost aged for longer than six months will improve the growth of tomato plants.

II. Laboratory Report Writing Form (Template)

Title

FSSS (Strands, Standards, Benchmarks): ____

____

Science Concept (s): (Background information) ___________________________________

____

____

____

Problem Statement: (Can be written as a question) ______________________________

____

____

Hypothesis (es): (explanation to the Problem statement – should be written as an IF – THEN – BECAUSE statement) ____

____

____

Procedures: (as many as needed)

1. ____
2. ____
3. ____
4. ____
5. ____

Variables: ____

____

Independent (Manipulated) Variable: (if not comparative or observational investigation)

____

____

Dependent (Responding) Variable: ____

____

Variables Held Constant: ____

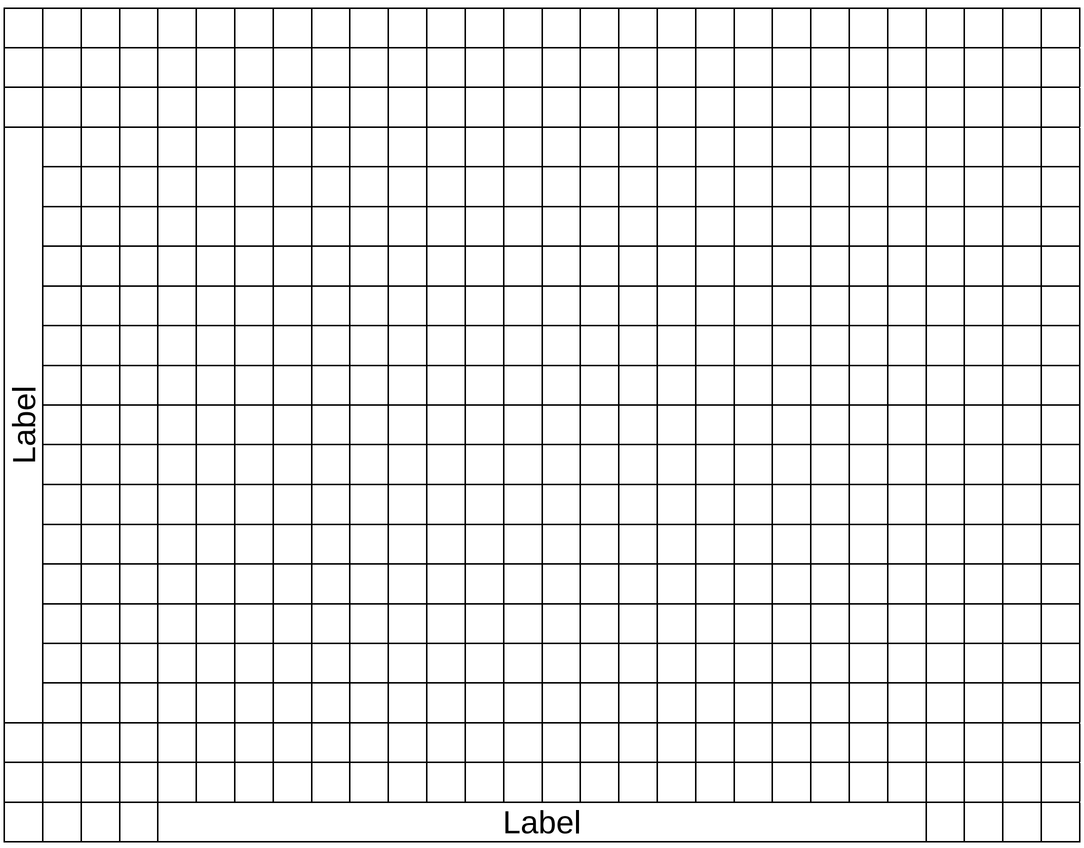
Number of Trials: ______________________________

Control Test: ______________________________

Data: (Tables, Charts, etc.) ______________________________

Data Analysis and Interpretation of data: (Graph and/or written description of results)

Title



Conclusions: (Use Seven Question Conclusion Form)

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

References: (Bibliography, Interviews, etc.)

____

____

____

____

____

Use additional pages if necessary

ANTI-DISCRIMINATION POLICY
Federal and State Laws

The School Board of Miami-Dade County, Florida adheres to a policy of nondiscrimination in employment and educational programs/activities and strives affirmatively to provide equal opportunity for all as required by law:

Title VI of the Civil Rights Act of 1964 - prohibits discrimination on the basis of race, color, religion, or national origin.

Title VII of the Civil Rights Act of 1964, as amended - prohibits discrimination in employment on the basis of race, color, religion, gender, or national origin.

Title IX of the Educational Amendments of 1972 - prohibits discrimination on the basis of gender.

Age Discrimination in Employment Act of 1967 (ADEA), as amended - prohibits discrimination on the basis of age with respect to individuals who are at least 40.

The Equal Pay Act of 1963, as amended - prohibits gender discrimination in payment of wages to women and men performing substantially equal work in the same establishment.

Section 504 of the Rehabilitation Act of 1973 - prohibits discrimination against the disabled.

Americans with Disabilities Act of 1990 (ADA) - prohibits discrimination against individuals with disabilities in employment, public service, public accommodations and telecommunications.

The Family and Medical Leave Act of 1993 (FMLA) - requires covered employers to provide up to 12 weeks of unpaid, job-protected leave to “eligible” employees for certain family and medical reasons.

The Pregnancy Discrimination Act of 1978 - prohibits discrimination in employment on the basis of pregnancy, childbirth, or related medical conditions.

Florida Educational Equity Act (FEEA) - prohibits discrimination on the basis of race, gender, national origin, marital status, or handicap against a student or employee.

Florida Civil Rights Act of 1992 - secures for all individuals within the state freedom from discrimination because of race, color, religion, sex, national origin, age, handicap, or marital status.

Veterans are provided re-employment rights in accordance with P.L. 93-508 (Federal Law) and Section 295.07 (Florida Statutes), which stipulates categorical preferences for employment.

Revised 9/2008