2013

High School

Earth Day

The benefits are endless!

Office of Academics and Transformation
Department of Mathematics and Science

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Dear Teacher,

The Department of Mathematics and Science is providing you with a packet that contains activities to use with your students during the weeks of April preceding Earth Day, which is celebrated on Monday, April 22, 2013.

A list of Next Generation Sunshine State Standards addressed by the activities in this packet is provided on page 3, and a list of websites is included in the Appendix to provide additional resources to complement or supplement classroom activities.

Miami-Dade County Public Schools wants to ensure that our students, parents, and staff remember to appreciate nature and learn ways to help keep the planet clean and protect our environment!

Please visit the Science department website to download the lesson. http://science.dadeschools.net

History of Earth Day

It is believed by many that Santa Barbara, California, is the birthplace of the modern environmental movement. Following the disastrous oil spill in 1969 off the coast of Santa Barbara, worldwide attention was placed on the need to protect our fragile ecosystem. In fact, it was following a visit to the oil-drenched Santa Barbara Channel and shoreline that national leaders conceived the first Earth Day event.

In 1970, the first efforts were made for a nationwide demonstration of concern for the environment. As twenty million people joined in the first ever Earth Day, attention was achieved at the political level. Due to the apparent concern, the federal government established the Environmental Protection Agency (EPA) and passed the Clean Water and Clean Air Acts. Earth Day was born and has spread around the world to become an annual international celebration on April 22.

Every year, America and over 100 different countries join together in the celebration of Earth Day. Earth Day is the largest, most celebrated environmental event worldwide.

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Next Generation Sunshine State Standards:

Standard 1: The Practice of Science

SC.912.N.1.1 Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science, and do the following: 1) pose questions about the natural world, 2) conduct systematic observations, 3) examine books and other sources of information to see what is already known, 4) review what is known in light of empirical evidence, 5) plan investigations, 6) use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs), 7) pose answers, explanations, or descriptions of events, 8) generate explanations that explicate or describe natural phenomena (inferences), 9) use appropriate evidence and reasoning to justify these explanations to others, 10) communicate results of scientific investigations, and 11) evaluate the merits of the explanations produced by others.

SC.912.N.1.2 Describe and explain what characterizes science and its methods.

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

Standard 3: The Role of Theories, Laws, Hypotheses, and Models

SC.912.N.3.5 Describe the function of models in science, and identify the wide range of models used in science.

Standard 7: Earth Systems and Patterns

SC.912.E.7.3 Differentiate and describe the various interactions among Earth systems, including: atmosphere, hydrosphere, cryosphere, geosphere, and biosphere.

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.E.7.7 Identify, analyze, and relate the internal (Earth system) and external (astronomical) conditions that contribute to global climate change.

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Standard 8: Matter

SC.912.P.8.8 Characterize types of chemical reactions, for example: redox, acid-base, synthesis, and single and double replacement reactions.

Standard 10: Energy

SC.912.P.10.4 Describe heat as the energy transferred by convection, conduction, and radiation, and explain the connection of heat to change in temperature or states of matter.

SC.912.P.10.19 Explain that all objects emit and absorb electromagnetic radiation and distinguish between objects that are blackbody radiators and those that are not.

Standard 14: Organization and Development of Living Organisms

SC.912.L.14.2 Relate structure to function for the components of plant and animal cells. Explain the role of cell membranes as a highly selective barrier (passive and active transport).

SC.912.L.14.7 Relate the structure of each of the major plant organs and tissues to physiological processes.

Standard 17: Interdependence

SC.912.L.17.4 Describe changes in ecosystems resulting from seasonal variations, climate change and succession.

SC.912.L.17.8 Recognize the consequences of the losses of biodiversity due to catastrophic events, climate changes, human activity, and the introduction of invasive, non-native species.

SC.912.L.17.13 Discuss the need for adequate monitoring of environmental parameters when making policy decisions.

SC.912.L.17.15 Discuss the effects of technology on environmental quality.

SC.912.L.17.16 Discuss the large-scale environmental impacts resulting from human activity, including waste spills, oil spills, runoff, greenhouse gases, ozone depletion, and surface and groundwater pollution.

Greenhouse Effect

(Adapted from activities found at http://www.reachoutmichigan.org)

Overview of Lesson Plan:
In this lesson, students will learn about the Greenhouse Effect and how it is linked to the idea of global warming.

Concept:
Global warming is a natural process that keeps the planet warm and hospitable for living organisms. The greenhouse effect (understood to mean an *enhanced* greenhouse effect) is the warming of the earth beyond this natural process of global warming.

Principle:
Greenhouse gases are in the earth's atmosphere.

Some solar radiation is absorbed by these greenhouse gases; some reaches the earth and is absorbed by its surfaces. In both cases, light is absorbed as heat.

Earth's surfaces, warmed both by solar radiation and by warmth from deep within the earth, radiate heat into the atmosphere, where some is absorbed and some passes out into deep space. The enhanced greenhouse effect occurs when more heat is absorbed by the atmosphere, due to increased greenhouse gases, than can pass by convection into space in a normal manner.

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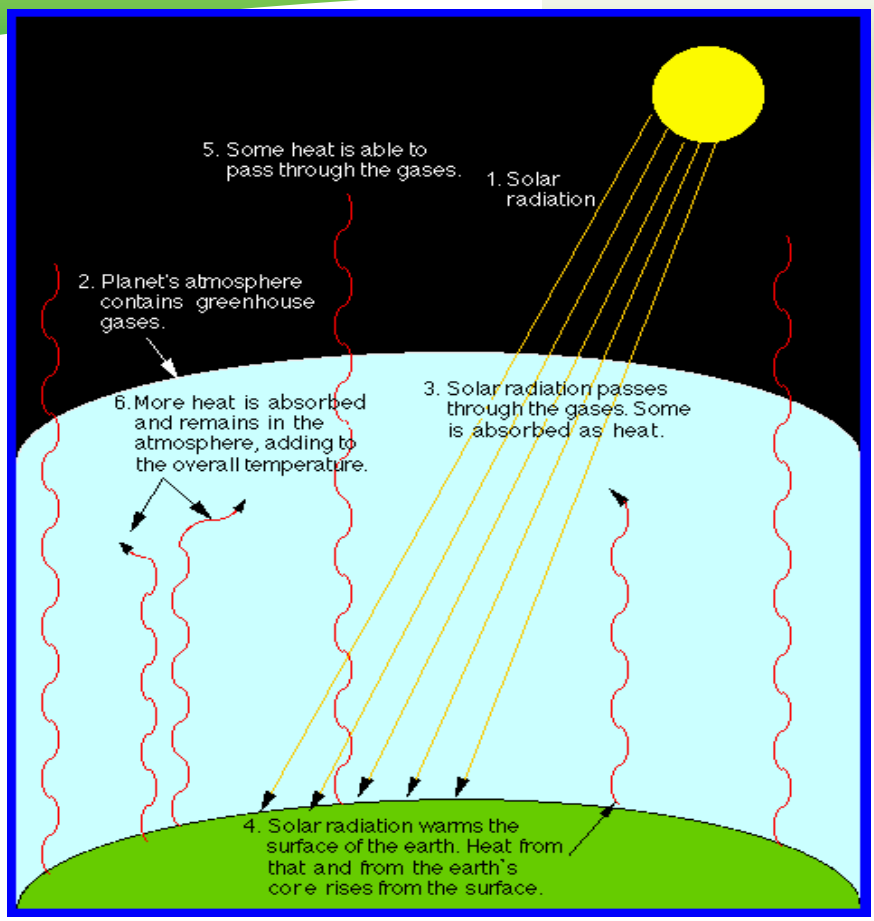

The diagram illustrates the process of the greenhouse effect.

Skills:

- Explain the Greenhouse Effect
- Explain how the Greenhouse Effect contributes to global warming.
- Identifying ways to conserve
- Understanding cause-and-effect relationships
- Making inferences.

Activities:

Have materials ready and glass pre-cut to desired size (small enough to fit into boxes). **Caution!** Danger of broken glass! Handle glass with care. Cover edges of each pane with electrical tape to prevent injury from cut edges.

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Vocabulary:
Atmosphere, Carbon Dioxide, Fossil Fuels, Global Warming, Greenhouse Effect, Greenhouse Gases, Solar Radiation, Sunlight

Materials:

1. Cardboard boxes
2. Black construction paper
3. 3 thermometers for every box
4. 1 classroom thermometer
5. 3 glass panes for every box (have them cut to fit in the box at the store)
6. 6 blocks of wood for every box
7. Glue
8. Scotch tape
9. Electrical tape

Guiding Questions:

1. What happens to a car that has been sitting in the sun on a hot day with all its windows rolled up?
2. Why does the car get so hot?
3. What happens to the sunlight that passes through the windows into the car?
4. What is keeping the heat inside of the car?

Facts:

- Many of the greenhouse gases are naturally occurring, which is the cause of natural global warming. Without naturally occurring greenhouse gases, the earth's surface temperature would average 33 degrees Celsius cooler.
- The first person to predict the greenhouse effect was a Swedish chemist named Svante Arrhenius. Over a hundred years ago, in 1896, he observed that when the industrial revolution began, more carbon dioxide was being released into the atmosphere, and he believed that carbon dioxide levels would rise as industry grew. He was the first to understand that this increase meant a rise in the temperature of the earth. He was ignored at the time, because the results of his predictions were seen as too far into the future for the people of his time to believe.
- When we burn fossil fuels and manufacture other products, we release gases into the atmosphere, which are greenhouse gases.

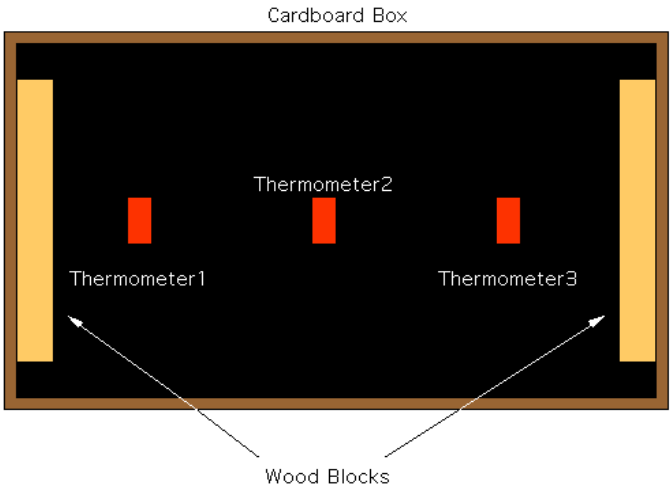
- Over the past 250 years, carbon dioxide levels have increased by 25%. Mass deforestation, as is occurring with our tropical rain forests, is decreasing the amount of plant life on the planet. Trees and plants are vital to us because they convert carbon dioxide into oxygen. Industry will continue to pump carbon dioxide into the air and, with the decrease of vegetation, more carbon dioxide will remain in the atmosphere to cause problems like the enhanced greenhouse effect. In the past 15 to 20 years, there has been an overall rise in temperatures.

For this lesson; however, keep in mind that *the mechanism is not the same:* heat is trapped in a car or a real greenhouse by the glass interfering with natural convection. In the atmosphere, the heat is not literally trapped; rather, enhanced global warming stems from the increased ability of the atmosphere to absorb heat due to greenhouse gases.

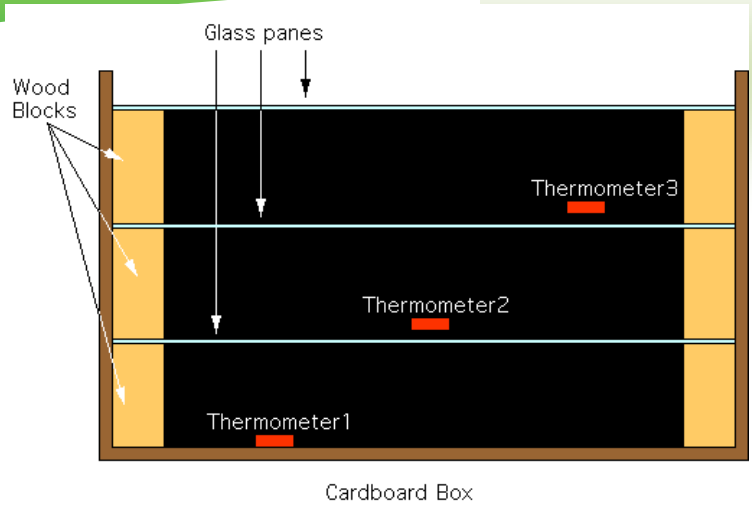
Construction:

Using glue, completely line the inside of a cardboard box with black construction paper.

1. Tape down one thermometer towards the left side of the box, at the bottom. Be sure the thermometer can still be read.
2. Get two blocks of wood. Place one block to the far left and one to the far right so that they will support a pane of glass.
3. Carefully place one pane of glass on top of the wood blocks.
4. Position a second thermometer in the center, on top of the glass pane.
5. Repeat steps 3 and 4.
6. Position the third thermometer to the right on the topmost glass pane.
7. Repeat steps 3 and 4.



Top View



Side View

Testing Procedure:

Have students put their boxes in direct sunlight.

1. Have students read their thermometers and record their data once a day, at the same time. *Example:* At the beginning of each class period.
2. Also have students record the classroom temperature.
3. The collected data should be placed in a chart that looks like this:

	Temperature			
Time	**Thermometer 1**	**Thermometer 2**	**Thermometer 3**	**Thermometer in class**
Average				

4. Compute the average daily temperature for each thermometer.

Discussion:

Have students examine the relationship between increase in average daily temperature and an increase in the number of panes of glass. Think about why this is happening. Relate to greenhouse effect. A pane of transparent glass allows solar radiation to pass through, but interferes with the convection that would let heat out. This is the kind of role that greenhouse gases play in the greenhouse effect: they absorb more heat than normal atmospheric gases would.

Therefore, in this model, the effect of the increasing number of panes of glass is similar to the effect of increasing greenhouse gas levels.

Have students share reasons why we need global warming to an extent. Then have students share how we are changing the natural system of warming with greenhouse gases. Have students share what they think are the side effects of global warming.

Extension Ideas:

1. Discuss the impact of increasing temperatures on the polar regions, aquatic life, humans, and the planet in general. Some possibilities are: the effect on weather, rising sea levels, rise in ocean temperatures and how this affects sea life, effects on agriculture, etc. See other Web pages for more information on this topic: Global Change/Climate Change (a report from Hawaii on NASA's Mission to Planet Earth studies of the greenhouse effect); the Consortium for International Earth Science Information Network's Thematic Guide Potential Increases in Mortality Due to Global Warming; or the report Consequences: Trends in U.S. Climate from the National Climatic Data Center in North Carolina.

2. Relate Earth to Venus and its runaway global warming. For more information, see the page for Venus by Students for the Exploration and Development of Space in Arizona.

3. The theory that we are experiencing unusual global warming now is somewhat controversial. Some sites that try to help you make sense of the conflicting information available include WeatherEye's Global Warming lesson, a chemistry professor's article Debunking Rush Limbaugh on the Environment, and another professor's Bad Greenhouse page, debunking myths and common misperceptions about the greenhouse effect. NASA has a great Web page on this called Earth's Fidgeting Climate, and see the Environmental Protection Agency's Global Warming FAQ's.

Reaction Rates and Catalysts in Ethanol Production

By Emily Reith Arvada High School

http://www.earthday.net/100newplans/biomass_ethanolreactionrates.pdf

Overview:

Ethanol fuel is ethanol (ethyl alcohol), the same type of alcohol found in alcoholic beverages. It can be used as a transport fuel, mainly as a biofuel additive for gasoline. Ethanol is widely used in Brazil and in the United States, and together both countries were responsible for 89 percent of the world's ethanol fuel production in 2008. Most cars on the road today in the U.S. can run on blends of up to 10% ethanol, and the use of 10% ethanol gasoline is mandated in some U.S. states and cities. Since 1976 the Brazilian government has made it mandatory to blend ethanol with gasoline, and since 2007 the mandatory blend is 25% ethanol and 75% gasoline or E25 blend.

Bioethanol, unlike petroleum, is a form of renewable energy that can be produced from agricultural feedstocks. It can be made from very common crops such as sugar cane, potato, manioc and maize. However, there has been considerable debate about how useful bioethanol will be in replacing gasoline. Concerns about its production and use relate to the large amount of arable land required for crops, as well as the energy and pollution balance of the whole cycle of ethanol production. Recent developments with cellulosic ethanol production and commercialization may allay some of these concerns.

Ethanol is produced by fermenting sugar. The sugar can be simple sugars and starches found in the kernels of corn, or it can be found in the polymers of sugar molecules known more commonly as cellulose. In order to improve the efficiency and decrease the cost associated with ethanol production, cellulose can be used as a source of sugar for fermentation, if it can be broken down into its component sugar molecules. This process, called hydrolysis, is the subject of a major research effort today.

During ethanol fermentation, glucose is decomposed into ethanol and carbon dioxide.

$$C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2 + \text{heat}$$

The current methods of hydrolysis involve using either sulfuric acid and high temperatures or complex biological enzymes. Both methods have their drawbacks, so the search is on for an alternative catalyst which will be easier to use and produces the fast reaction rates required for large scale production.

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Students will have the opportunity to investigate alternative catalysts for the degradation of hydrogen peroxide, which will be used as a model system for the breaking down of cellulose into sugar. After identifying other potential catalysts, students will develop their own research question relating to catalysts and conduct an additional experiment of their own design to investigate their question.

This lesson not only involves a system similar to one used in the production of ethanol, it also give students the opportunity to conduct research in a manner similar to that of research scientists. Use of the scientific method and presentation of research is emphasized.

Prerequisite Knowledge:

1. Students should know how to make and record observations in a lab notebook
2. Students should have some experience with designing their own experiments, or time should be added to the module to allow for this to be taught.
3. Students should be familiar with the different types of reactions, especially decomposition reactions.
4. Students should have had some exposure to thermodynamics and familiarity with endothermic and exothermic reactions.

Learning Objectives:

- Students will be introduced to the steps involved with the production of ethanol from cellulose.
- Students will be introduced to catalysts and gain an understanding of how they work.
- Students will understand the factors that affect reaction rate.
- Students will be able to make qualitative and quantitative observations.
- Students will be able to use the scientific method to design an experiment and properly control variables.
- Students will be able to use computer software to display data and communicate results.
- Students will be able to interpret and draw reaction progress diagrams for catalyzed and uncatalyzed reactions.

Vocabulary:

Catalyst, Decomposition, Cellulose, Biomass, Ethanol, Sugar, Polymer, Enthalpy, Endothermic, Exothermic, Renewable energy, Non-renewable energy, Anticatalyst

Time Allotted:

Five 45 minute periods are needed to complete the entire module. Any of the days can be combined to accommodate block scheduling. The break down is:

Day 1: Introduction
Day 2: Lab, part 1
Day 3: Lab, part 2
Day 4: Data analysis and time in computer lab
Day 5: Class presentations

The time required for this unit can be reduced if an alternate report format is used (other than the PowerPoint presentation) or if only one part of the lab is done. Also note that days 4 and 5 can be separated from the others by a few days.

Materials:

- 3% hydrogen peroxide (H_2O_2)
- Manganese dioxide (MnO_2)
- Test tubes
- Pipettes
- A variety of other possible catalysts (suggest zinc oxide, copper oxide, sugar, salts, sand, other manganese compounds, etc.)
- Hot plates, ice baths, and any other equipment needed for independent student experiments

Main Activities

Day 1:

The following material can be presented as a teacher-led discussion, as a PowerPoint presentation, or assigned to small groups to be researched using reference materials.

Part 1 -- Introduction to reaction rates and catalysts

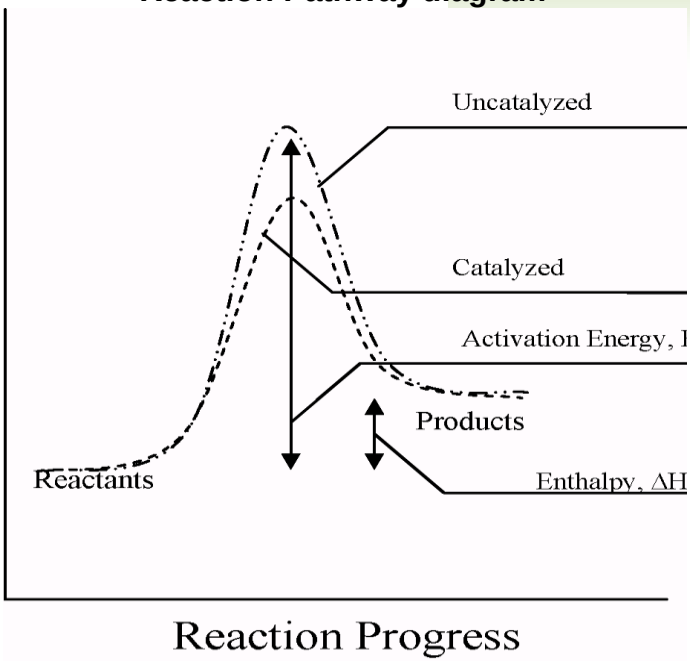
http://www.nclark.net/ChemicalReactions

Use the following resources to answer the questions below:

1. What is required for a reaction to take place?
   a The right molecules must collide with each other in the right orientation and with enough energy to overcome the activation energy barrier.
2. What factors can increase the likelihood of a reaction taking place?
   a increasing the speed and therefore the energy of the molecules by raising the temperature
   b increasing the concentration so odds of collision go up somehow lowering the activation energy barrier

3. How can the activation energy barrier be lowered?
   a Use a catalyst, which creates an alternate pathway. (See below)

Reaction Pathway diagram



Part 2 -- Connection to renewable energy and ethanol production

1. What are some sources of energy?
   - wind
   - biomass
   - wood
   - gasoline
   - coal
   - sun
   - geothermal
   - ethanol
   - hydrogen
   - nuclear
2. Which of those sources of energy are in limited supply?
   a coal
   b gasoline
3. What does it mean to be a renewable source of energy?
4. Ethanol is a liquid fuel which is considered renewable because it is made from corn, which is a fast growing crop.
   a Sugar from corn kernels is fermented to make ethanol
   b Most of the corn plant is made of cellulose, which consists of chains of sugar that cannot be directly fermented into ethanol. Cellulose is a polymer of sugar. (http://pslc.ws/macrog/kidsmac/wiap.htm)

c A catalyst must be used to break the bonds holding the sugar molecules together in cellulose, such that the sugar can then be fermented into alcohol.

d Using the cellulose to make ethanol will make the production of ethanol much less costly in terms of money and energy.

e The 2 current catalysts have drawbacks, so scientists are interested in finding different catalysts to break the cellulose down into sugar molecules.

$$\text{cellulose} \xrightarrow{\text{catalyst}} \text{glucose}$$

$$(\text{cellulose} + \text{catalyst} \rightarrow \text{glucose} + \text{catalyst})$$

Day 2: Alternative catalysts for a model decomposition reaction

Guided Inquiry Lab:

You are going to be doing research on alternative catalysts for a model system. Instead of breaking cellulose into sugar molecules, you are going to be breaking hydrogen peroxide (H_2O_2) down into oxygen (O_2) and water (H_2O).

Write a balanced equation for this process

$$\text{_____} \xrightarrow{\text{catalyst}} \text{_____} + \text{_____} \quad \text{or}$$

$$\text{_____} + \text{catalyst} \rightarrow \text{_____} + \text{_____} + \text{catalyst}$$

One known catalyst for our model system is manganese dioxide (MnO_2), which works well and relatively quickly. But what if we needed the reaction to happen a little less quickly for some reason (say, to waste less hydrogen peroxide in our micro-mole rockets experiment)? One way might be to simply use less of the catalyst (we'd need to test that to see if it would work), but another would be to find an alternative catalyst that doesn't work quite as well and therefore would take longer to complete the breakdown of the hydrogen peroxide.

The research question is given for this part: "What compounds can be used to decompose hydrogen peroxide and how does their effectiveness compare to manganese dioxide?"

Procedures:

1. Test a variety of compounds for their potential use as a catalyst. Use about 20 drops of H_2O_2 in a test tube and add a tiny sample of the test compound (about the size of a flea).
2. Start by testing the manganese dioxide in this manner to see what a positive result looks like.
3. Test as many or few substances as you like, but try and find at least 2 other compounds that have some ability to break down the hydrogen peroxide.
4. Be sure to keep careful records of which compounds you tested and the results.
5. Record your observations in an organized table. (These tests will be qualitative.)
6. Taking the compounds which showed potential as a catalyst, perform additional tests to rank them from most effective (rank=1) to least effective. Support your rankings with data and a graph! (These tests will be quantitative.)
   a What is the independent variable in these experiments? What factors will stay constant?
   b What is the dependent variable? (What measurement will you make?)
   c How does the measurement relate to effectiveness?
   d How many trials will you conduct for each condition?

Day 3: Further investigation of catalysts and reaction rates

Choose one additional research question and design and conduct an additional experiment to answer the question. Your question and experiment design must be approved before you begin experimental work. For this investigation, you must choose only one independent variable.

Suggested Questions:

- How does temperature affect the decomposition of hydrogen peroxide?
- How does the amount of catalyst affect reaction rate?
- How does total volume affect reaction rate?
- How does agitation affect reaction rate?
- What effect does combining catalysts have on reaction rate?
- Write your own question.

Complete the following to discuss your experiment with your teacher and classmates.

Title: The Effect of _____ on the _____

Hypothesis:

If ___(use more space if needed)_____

then _(use more space if needed)_____

because __(use more space if needed)_____

Independent Variable (IV)				
Levels of IV				
Number of Trials				

Dependent Variable:

_____

Constants:

_____

Note: Students can present their experimental plans to the class prior to experimentation to help them refine their methods and plans.

Day 4: Data Analysis and Presentation Preparation

Students will need access to computers in order to graph their data and prepare their PowerPoint presentations.

Presentation Guidelines (see example)

1. Title Slide – Topic, presenter names, date
2. Presentation Outlline – What will you be telling us abbout?
3. Research question – Variables, controls.
4. Experimental design – What did you do to test the question?
5. Results – What did you find out? Include graphs.
6. Conclusions – What did you take away from this research? How is it useful? How does it relate to class? To life?

Day 5: Class Presentations

Students will present short (3-5 min) PowerPoint presentations to the class on their individual research questions. The audience should write 1-2 sentences summarizing the major findings of each research project.

Photosynthesis and Biomass Growth

(Revised from the Earth Day Network http://www.earthday.net/9through12)

Is natural sunlight, imitation sunlight, fluorescent light, or incandescent light best for plants?

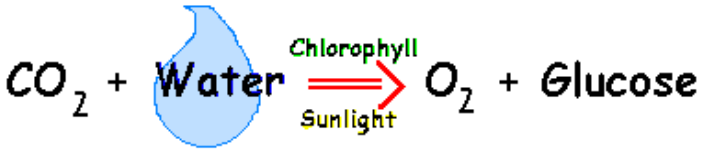
Today, corn plants are being used to create a renewable energy source called ethanol. Ethanol is used in gas tanks to power our cars and is one of the leading alternatives to natural gas. We all know that Earth's fossil fuel supply is finite, so fuels like ethanol provide an essential replacement for petroleum products. Plant research is the starting point for alternative fuel production. Throughout NREL's Biofuels Program, scientists are uncovering ways to transform plant biomass into innovative and beneficial materials, such as fuel, plastic, and fiber. In addition, biomass research is necessary for efficient food production and for understanding the numerous other products that plants provide.

Introduce your students to the power of plants! Photosynthesis is arguably the most important energy transformation and is a fundamental concept for students of all ages. Projects listed in this section should be used as an exciting starting point for both classroom and science fair projects. Most of the materials are easily obtainable at your local home or garden center. We encourage you to modify the experiments to fit your curriculum needs.

Background Information:

Why are plant leaves green? How do plants get the energy to live? Do plants "breathe"? All of these questions can be answered with one idea, **photosynthesis**. Photosynthesis is a process where plants take the sun's light energy and change it into **glucose**, a kind of sugar. A green chemical in the in plant leaves, called **chlorophyll,** makes it all happen and gives plants their green color.

When you breathe, your body uses oxygen (O_2) and gives off carbon dioxide (CO_2). Since all animals breathe in oxygen, why don't we ever run out? During photosynthesis, plants use carbon dioxide and release oxygen, so animals and plants have a **symbiotic** relationship; we rely on each other to survive!



Plants, trees and aquatic algae all create energy (in the form of glucose) through photosynthesis. Since people can't make their own energy from the sun, we eat food instead. We can use the energy stored in plants in other ways too! Scientists

are interested in **biomass** energy for things such as fuel for your car. Biomass can be found all over the world and there is an endless supply since it can keep growing! Things such as corn stalks that are leftover from harvesting, and forest brush that may cause a fire hazard, can be converted into fuels. These biomass fuels burn cleaner than gas or oil does, so it is also safer for the environment. The only problem is that right now biomass fuels are not as economical (or cheap) as we would like. Scientists are trying to find ways to grow biomass where they can get the most energy with the lowest cost. Can you discover some ways in which we should grow biomass? Use the ideas below or come up with your own!

Vocabulary:
Biomass, Chlorophyll, Chromatography, Control, Ecosystem, Glucose, Interdependence, Photosynthesis, Pigment, Pollutants, Symbiotic, Variable, Wetland.

Activity:
In this activity, students will observe how sunlight separates into a variety of colors when passed through a prism, corresponding to the different wavelengths in the visible electromagnetic spectrum. Plant **pigments** reflect or absorb the light wavelengths resulting in the wide variety of plant colors. In this experiment, discover what happens when plants are grown under various types of light. Will different light sources generate a change in the size, color and rate of the growth responses?

Materials:
- Prism (http://www.sciencejoywagon.com/explrsci/media/prism.htm)
- Light fixtures
- Grow light bulb
- Fluorescent bulb
- Incandescent bulb
- Other types of bulbs (color)
- Green leafy plants
- Water

Optional Materials: (Only if plants will be grown to perform experiment)
- Rapid radish seeds
- 16 mini peat plant pots
- Potting Soil

Safety and Environmental Requirements:
Electrical shocks and serious injury can occur if the light fixtures are mishandled. Adult supervision is necessary!

Procedures:

- **Optional:** Grow four radish seedlings under each light source. Collect data after germination for 3-6 weeks.
- Perform experiment with a variety of plant types, such as coleus, geraniums, or sunflowers.
- Place plants under each different type of light source.
- Have students set up a rubric to be followed during the data collection process (i.e., leaf color, plant color to describe health/growth)
- Complete the following to discuss your experiment with your teacher and classmates.

Title: The Effect of _____ on the _____

Hypothesis:
If _____(use more space if needed)_____
then _____(use more space if needed)_____
because _____(use more space if needed)_____

Independent Variable (IV)				
Types of light				
Number of trials				

Dependent Variable:
_____

Constants:
_____

- Have students collect qualitative data, daily, by making observations following the selected rubric.

Data Analysis and Discussion of Results:
Facilitate a class discussion based on the observations collected by your students.

- Review the importance and the validity of the experiment by discussing scientific methodology and the appropriate steps taken to follow a systematic study of the effect of light on plant growth.
- Discuss the meaning of the data collected and how it relates to the hypothesis.
- Discuss possible implications of the experiment, and how other experiments can be developed/designed to answer new questions.

Additional Resources:
Fun site that shows videos of seed germinations:
http://sunflower.bio.indiana.edu/~rhangart/

Organic garden supplies
http://www.seedsofchange.com/

Earth Day Links

The History of Earth Day:
http://holidays.kaboose.com/earth-day/history/earthday-history.html

Activities to Celebrate Earth Day: (some adds before page)
http://www.education-world.com/a_lesson/lesson174.shtml

Earth Day Network:
http://www.earthday.org/

The Science Spot Earth Day Lesson Plan Links:
http://sciencespot.net/Pages/classearthday.html

Explore a Tropical Rainforest: An Earth Day Project, 2009:
http://www.teachersfirst.com/holiday/earthday.cfm

Envirolink: Idea List for Earth Day:
http://earthday.envirolink.org/guide6.html

Earth Day Lesson Activities Using the Smartboard:
Earth Day Lessons for the SMART board

Sustainable Footprint:
http://www.sustainablefootprint.org/en/cms/gebruikerscherm.asp?itemId=196

What On Earth Are You Doing?:
http://www.education-world.com/a_lesson/lesson059.shtml

Earth Day Teacher's Forum for Middle and High School:
http://www.theteacherscorner.net/forums/showthread.php?p=19177

The Environment:
http://www.atozteacherstuff.com/Themes/Environment/

Greening Schools:
http://www.greeningschools.org/resources/view_cat_teacher.cfm?id=45

Earth Day Tips
http://www.epa.gov/earthday/

Earth Day Tips on Podcast
http://www.epa.gov/earthday/podcasts/index.html

Earth Day Activities
http://www.seventhgeneration.com/search/node/Earth%20Day%20Activities

Global Water Sustainability
http://water.org/learn-about-the-water-crisis/lessonplan/

Teacher's Lounge Earth Day
http://earthday.wilderness.org/teachers/classroom.htm#3

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.

In Addition:

School Board Policies 1362, 3362, 4362, and 5517 - Prohibit harassment and/or discrimination against students, employees, or applicants on the basis of sex, race, color, ethnic or national origin, religion, marital status, disability, genetic information, age, political beliefs, sexual orientation, gender, gender identification, social and family background, linguistic preference, pregnancy, and any other legally prohibited basis. Retaliation for engaging in a protected activity is also prohibited.