Discovery Lesson

TEACHER ENRICHMENT RESOURCE PACKET

I Wonder...

June 6 - September 6, 2009

Why is the sky blue? How do plants eat? Explorit has collected visitors' questions about the world around us. Join us in the scientific process as we search for answers.

Learning Objectives:

- Scientific progress is made by asking meaningful questions and conducting careful investigations.
- Properties of materials can be observed, measured, and predicted.
- Scientists find answers through observed patterns, evidence that can be confirmed, and interpretation of their observations
- Scientists conduct multiple trials to test a prediction and draw conclusions about the relationship between predictions and results.

Think it.
Try it.
Explorit.

what's inside

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NORTHROP GRUMMAN

Discovery Lesson: I Wonder...

Welcome

Our Mission:

We engage people in science experiences that touch all our lives.

Thank you for choosing Explorit Science Center's *Discovery Lesson* program to supplement your ongoing science curriculum. You might use the program to kick off a new unit, wrap up a nearly completed unit, or purely to excite and interest your students in the wonderful world of science. Whichever way you incorporate it, advance preparation and follow-up with your students are critical to achieving the greatest educational benefit from this unique science experience.

Explorit provides two resources to help prepare you and your students for the *Discovery Lesson*. First, simple logistics of the program are detailed in the confirmation packet. Second, this Teacher Enrichment Resource Packet outlines appropriate science content and processes to help you:

- successfully prepare your students prior to visiting Explorit;
- participate fully in the *Discovery Lesson* yourself; and
- follow-up with your students back in the classroom.

Background Information

WHAT DO SCIENTISTS MEAN BY INQUIRY?

Science always starts with a question; looking at the world around us and wondering why something is the way it is. Inquiry is the art and science of asking and answering questions. It involves observation and measurement, hypothesizing and interpreting, model-building and model-testing. It requires experimentation, reflection, communication, and recognition of the strengths and weaknesses of its own methods. Inquiry is what scientists do.

An old adage states: "Tell me and I forget, show me and I remember, involve me and I understand." The last part of this statement is the essence of inquiry-based learning. Involving students in inquiry-based learning means that students are able to ask and answer their own questions.

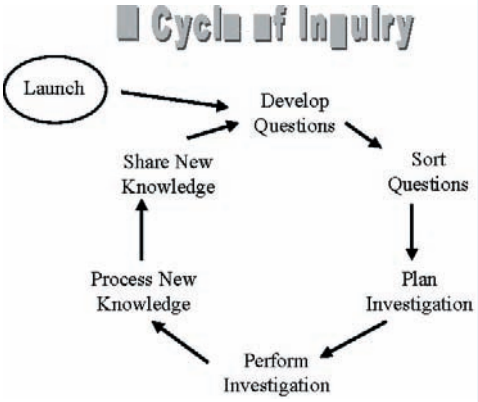
WHAT IS THE PROCESS OF INQUIRY?

The Scientific Method is the formal name for a process that scientists follow during the process of inquiry. It helps guide their question-asking and answer-seeking. Anyone can easily follow the Scientific Method; it is actually a process that most people use everyday without even knowing it. The steps of the Scientific Method provide a common-sense map for how to 'do' inquiry about the world around us.

There are seven main steps outlined in the Scientific Method:

1. **Make observations.** Notice something that makes you curious.
2. **Ask questions.** Ask "I wonder..." and "What if...," then choose one main question.
3. **Form a hypothesis.** State your best guess (what you predict to be true) about the answer to your question.

4. **Find a method of testing.** Plan out a procedure (course of action) to follow that will help you seek answers. Know how you will test your question, list what materials you will need, and plan how to record your data (information you gather)
5. **Perform experiments.** Investigate by repeating trials of tests, taking measurements, making observations, and recording data.
6. **Gather results.** Organize new knowledge, perhaps by talking about the data or mapping it out visually. Interpret (make sense of) results to figure out what they mean to you.
7. **Reach a conclusion.** Decide on an answer that is supported by the evidence (facts) in your results, and report this answer.



HOW CAN STUDENTS PRACTICE INQUIRY?

The Scientific Method is an inquiry process that can be easily done in the classroom or at home. Inquiry requires students to take responsibility for their own education. Below are some tips for leading inquiry-based learning:

- Encourage students to develop and answer their own questions
- Answer questions with questions
- Allow exploration, including trial & error
- Admit to not knowing all the answers yourself
- Don't give away answers at the beginning of the process
- Let students take their time when they need to think

Vocabulary

Here is a list of words that may be used during an "I Wonder..." *Discovery Lesson*:

Conclusion – answer decided on and reported, based on results
Control – the part of an experiment where no conditions are changed; a 'normal' set-up to compare with the other set-ups where changes are being tested
Data – a collection of facts, such as information from measurements and tests
Evidence – knowledge and information that are based on facts, including facts gathered from data
Experiment – a planned out and controlled test or investigation
Hypothesis – best guess; an informed guess
Investigate – examine; look into something further
Inquiry – asking and answering questions using the Scientific Method
Observation – act of noticing or detecting things with the senses, and then recording those things
Predict – tell in advance what will happen
Procedure – course of action, method
Results – data and knowledge that has been organized to help it make sense
Scientific Method – standard sequence of steps that guides the questioning and answering process in science
Trial-and-error – trying one possibility, then another, etc., and learning from errors until one way works

Classroom Activity 1

You will need:

- 7 containers (test tubes) + 1 extra for mixing
- tap water
- vinegar
- salt
- string
- marking pen
- 7 iron nails
- 7 soda can tabs
- 7 nickels
- 7 small rocks or pebbles

ACTIVITY 1: "WHAT CAUSES CHEMICAL REACTIONS?"

Objective: To investigate chemical reactions by observing the process of rusting, and finding out what materials and conditions make it happen.

Procedure:

1. Ask students why they think chemicals react. Make a list of different chemical reactions students have seen before. Ask if anyone knows what rust is. (The result of a common chemical reaction.) Show pictures of rusted objects, and ask what makes rust happen.
2. Find a place for the 7 containers to sit undisturbed. Label them each a number 1-7. Place objects (iron nail, soda can tab, nickel, pebble) into each of the 7 containers and label them as you set up the experiment.
3. "Air Only" → The control.
4. "Water Only" → Pour in enough water to fully submerge the objects.
5. "Air and Water" → Pour in just enough water to partially submerge the objects. Each object should be 1/2 in the water and 1/2 sticking out in the air.
6. For grades K-2, end set-up here, and skip to step 11. For grades 3-6, follow all steps of the procedure.
7. "Vinegar Only" → Make a vinegar solution in extra mixing container. Straight vinegar is more acidic (about pH 2.5) than acid rain (about pH 5.0). Use a ratio of about 1/3 vinegar to 2/3 water in your solution. Pour in enough vinegar solution to fully submerge the objects.
8. "Air and Vinegar" → Pour in just enough vinegar solution to partially submerge the objects. Each object should be 1/2 in vinegar solution, and 1/2 sticking out in the air.
9. "Salt Water Only" → Make salt water solution (1 tsp salt per 1 C water) in extra mixing container. Sea water is about 3.5% salt. Pour in enough salt water to fully submerge the objects.
10. "Air and Salt Water" → Pour in just enough salt water to partially submerge the objects. Each object should be 1/2 in salt water, and 1/2 sticking out in the air.
11. Leave all 7 containers in an undisturbed spot where students can observe them over a period of weeks. What objects in which conditions will rust?

Results & Explanation:

The iron nail should be the object that rusts the most. In the grades K-2 experiment, the iron nail will probably rust in "Air and Water." In the grades 3-6 experiment, students will further observe the iron nail rusts even faster in "Air and Salt Water," and in "Air and Vinegar."

Chemical reactions happen when one substance is turned into another. This change can be anything from a change in color to a huge explosion. There have to be certain conditions and certain materials present in order for chemicals to react. Rust is a chemical compound called iron oxide. It requires iron (a type of metal), oxygen, and water in order to be made. Iron and oxygen combine to make rust

when water is around to help, especially salt water or acidic water. Acid and salt make iron break down faster so that molecules of iron can join more quickly with molecules of oxygen, to form rust.

Discussion questions: When and where is rusting a problem? (Bikes left out in the rain, bridges spanning bodies of water, boats in seawater, etc.) What is acid rain? (Rain that has been made acidic due to pollution.)

Classroom Activity 2

You will need:

- potting mix
- fertilizer
- stakes, ties & labels
- Wisconsin Fast Plants Standard Seeds (limited supply available for purchase at Explorit Science Center)
- 'growing systems,' each consisting of a lid, watermat, watermat wick, small container, large reservoir, 4 pots, 4 small watermat wicks, good lighting

Note: Number of 'growing systems' depends on class size.

Classroom Activity 2
further exploration

ACTIVITY 2: "HOW DO PLANTS GROW?"

The Seed Challenge: How Many Seeds Can You Get from a Single Seed? Below is a short version of the "Seed Challenge" activity. Before doing this activity with your class, please see http://www.fastplants.org to download the complete pdf of the "Seed Challenge". It includes background info, directions, worksheets, illustrations, and many more details than listed here.

Objective: To follow a procedure to track plants as they grow, and investigate characteristics of plants. Discover how plants grow and reproduce, what plants need to grow, what stages are in the life cycle of a plant, and what are various parts of a plant.

Procedure:

1. Before beginning the activity, familiarize yourself with the Wisconsin Fast Plants Growing Instructions. Be sure your lighting system is adequate.
2. Plant seeds. Have students keep detailed records of the progress of their plants. Seeds are designed to develop into full plants in just 28 days.
3. At each stage of plant life, let students draw observations, record thoughts in journals (see p. 11 for topics), and complete related activities.
4. At the end of the experiment, try wrap-up activities for further challenges (see p. 29). Happy growing!

Results & Explanation:

Plants need certain conditions to grow. What happens if you try to grow a plant with no sunlight? No water? No soil? Plants produce their own food by using energy from sunlight, carbon dioxide from the air, and water from the soil. This process is called photosynthesis. A mature plant grows seeds that can be used to create a new plant. As a seed sprouts, grows into a plant, then makes new seeds which can be planted, we see a pattern called a life cycle. Activity from the University of Wisconsin's Fast Plants website: http://www.fastplants.org/activities.php

Further Exploration: How Do Plants Eat?

Try this simple experiment to show that plants bring water upwards towards their leaves. They do this the same way we drink from a straw: there is less pressure in our mouths than there is in our cup's liquid when we drink from a straw. Liquid moves to the place that has less pressure, which means up the straw, into our mouths. When a plant draws liquid up from its roots to its leaves, this is called capillary action.

You will need a leafy celery stalk, sharp knife, a clear glass, water, blue food coloring. Fill cup a few inches with water, and add blue food coloring. Use sharp knife to cut off a small amount of the bottom of the celery stalk so that it has a fresh cut end. Place celery stalk upright in cup. Watch over the next 24 hours as the blue rises slowly up the celery stalk until finally the leaves turn blue! Activity from Janice VanCleave's Chemistry for Every Kid.

Classroom Activity 3

You will need:

- overhead projector
- prism
- diffraction glasses (optional)
- multiples of the following: deep tray, water, mirror, stiff white paper.

ACTIVITY 3: "WHY ARE THERE COLORS?"

Objective: Expose students to the concept that white light is made of up and can be divided into the colors of the rainbow

Procedure:

1. Turn on the projector and place the prism on the glass. The spectrum should be visible on the ceiling.
2. Make your own prisms. On a sunny day, fill a deep tray with water and rest a flat mirror against the inside. Place the tray so that sunlight falls onto the mirror. Hold a sheet of stiff white paper in front of the mirror and move it around until the spectrum appears on the paper.
3. Put on diffraction glasses and observe different light sources

Results & Explanation:

Sunlight and light from a light bulb are called white light. White light is made of a mixture of different colors, we can only see those colors when light passes through a transparent substance that is able to bend the light and separate it into a rainbow pattern called a spectrum. You can see this spectrum in bubbles or in a rainbow.

In this experiment, the wedge of water between the mirror and the surface of the water acts as a prism. Because each of the colors in white light travels at a different speed (has a different wavelength), they are bent (refracted) at slightly different angles inside the prism. Violet light bends the most, and red light bends the least. Diffraction paper (used to make lenses in diffraction glasses) is also used to interfere with waves of light to make certain wavelengths visible.

Colors exist because of different wavelengths in light. We see colors on objects when certain wavelengths reflect back into our eyes. A red flower reflects mostly the wavelength of red. Activity from Harlem Children's Zone "Light and Color: Concepts and Activities for Elementary School."

Supplemental Resources

Books

VanCleave, Janice. **Chemistry for Ever Kid: 101 Easy Experiments That Really Work. John Wiley & Sons, Inc., 1989.**
Fun, clearly-written experiments that relate to everyday science.

Walpole, Brenda. **I Wonder Why the Sun Rises and Other Questions about Time and Seasons. Roaring Brook Press, 2006.**
Part of the "I Wonder Why" series which answers many common questions children

have about the world around them.

Web Sites

PBS Kids ZOOM Science Activities
http://pbskids.org/zoom/activities/sci/
Wide array of science experiments and activities for kids to test, improve, and explore. Kids post their own feedback and suggestions on the site.

New York Hall of Science TryScience
http://www.tryscience.org/
Interactive experiments for kids to try at home, with online components. Also features a Science Center locator, and 'LiveCam' views into science and technology centers worldwide.

Science Standards

CA STANDARDS

Physical Science (**K:** 1a)
Earth Science (**K**:3a; **2nd**:3b; **4th**:5a; **6th**:1e & 2a)
Investigation and Experimentation (**K**:4abcde; **1st**:4abe; **2nd**:4abc; **3rd**:5ade; **4th**:6cdf; **5th**:6abfh; **6th**:7abe)

NATIONAL STANDARDS

K-4: A, B, C, D, E, F, G

Explorit Programs for Schools and Groups

At Explorit's Site

Discovery Lessons & Labs Visit one or more of the Changing Exhibitions throughout the year
Nature Safaris & Labs Visit Explorit's outdoor spaces at Mace Park Branch

Explorit in Your Classroom

Classroom Adventures Explorit educators visit your classroom for hour-long presentations
Young Scientist Series Science investigations through multiple visits

For the Whole School

Health in Your World Learn about keeping your body and the world healthy and safe
Science in Your World The ultimate family science night
Science Assembly A multimedia presentation for the whole school

Reservations required.
For information please call
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Think it.
Try it.
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