ScienceWorks

Science is all around you.
Explore, make a prediction and investigate.

A K–2 Unit of Study

The Children's Museum
of Indianapolis

A K–2 Unit of Study

ENDURING IDEA

Science is all around you.

Explore, make a prediction and investigate.

The whole of science is nothing more than a refinement of everyday thinking.
—Albert Einstein

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The Children's Museum
of Indianapolis

The Children's Museum of Indianapolis is a nonprofit institution dedicated to providing extraordinary learning experiences for children and families. It is one of the largest children's museums in the world and serves people across Indiana as well as visitors from other states and countries. In addition to special exhibits and programs, the museum provides the **infoZone,** a partnership between **The Children's Museum of Indianapolis** and The Indianapolis-Marion County Public Library. The **infoZone** combines the resources of a museum with the services of a library where students can read, search for information and find the answers to their questions. Field trips to the museum can be arranged by calling **(317) 334-4001** or **(800) 820-6214**. Visit **Just for Teachers** at **The Children's Museum** Web site: www.childrensmuseum.org.

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A K–2 Unit of Study

Enduring Idea

ScienceWorks: Science is all around you. Explore, make a prediction and investigate.

Young children come to school with open minds to investigate, discover and explore. This is the age when they know innately how to “explore like a scientist.” But something happens somewhere around Grade 3, when many children turn away from scientific observation. Studying science becomes boring to them or seems to be irrelevant or too difficult. Many teachers respond to this lack of interest by focusing on reading and vocabulary instead of observation and experimentation, which unfortunately can reinforce disinterest. It does not have to be this way.

Science is a process where new ideas are generated and tested. After testing, ideas are often modified and tested again. Science asks questions and looks to nature for empirical evidence — data — to support ideas and increase understanding. Science really does have the power to hold students’ interest. Science is all about the things in this world that grab their attention and make them want to know more. Science activities can motivate students to count the days until they can do science again.

A K–2 Unit of Study

This **ScienceWorks** unit of study provides teachers in Grades K–2 with tools and activities that nurture the natural scientific inquisitiveness that we all possess. Lessons and experiences included here will help demystify science. The unit is designed around the popular **ScienceWorks** gallery at **The Children’s Museum**. **ScienceWorks** has been the center of hands-on science learning at the museum since the exhibit opened in 1996. This unit of study provides teachers of Kindergarten and Grades 1 and 2 with standards-based science inquiry experiences in an easy-to-use format. The unit focuses on three of the most popular areas of **ScienceWorks**: The Dock Shop, the Indiana Pond and the Construction Zone. Lessons are designed to build upon each other. Teachers have the option to focus on one or more of the **ScienceWorks** areas. Each lesson offers a classroom experience prior to the visit and a **ScienceWorks** experience at the museum. Students use skills and strategies to explore, predict and investigate like a scientist. The culminating experience is an assessment that asks students to complete a science report after their visit and investigation in **ScienceWorks**. The lessons and experience in this unit can be completed with classroom resources and library books and by visiting **The Children’s Museum ScienceWorks**.

What Will Students Learn?

Indiana's Academic Standards and National Science Standards

This unit of study helps students achieve academic standards in Language Arts, Math and Science. Specific academic standards are listed with each experience. A complete list of the Indiana Academic Standards is located at http://ideanet.doe.state.in.us/standards/welcome.html. In addition, Indiana Academic and National Science Standards used are listed in the resources section at the back of this unit of study.

What's Ahead

Lesson 1

Explore Like a Scientist

This lesson introduces students to science as a way to ask questions about their world. Students make observations and learn science terms. Students record observations and notes in a **Science Journal**.

- **Experience 1:** Science Questions and Words
- **Experience 2:** Science Observations
- **Assessment:** Fruity Observations

ScienceWorks Options: Focus on one or more **ScienceWorks** areas as you use Lessons 2, 3 and 4.

Lesson 2

Investigate Like a Scientist — ScienceWorks: Indiana Pond

In this lesson students complete an experience in their classroom about plants and animals found in a pond. Then they visit **ScienceWorks** to investigate and collect data on inhabitants of a real Indiana pond.

- **Experience 1:** Prepare for an Indiana Pond Field Trip
- **Experience 2:** Indiana Pond at **ScienceWorks**
- **Assessment:** Student-led Science Conference

Lesson 3

Investigate Like a Scientist — ScienceWorks: Dock Shop and Creek Area

This lesson provides students the experience of building, testing and modifying a model boat. Students complete an experience in their classroom about objects that float and sink. Then they apply what they have learned to build and test a boat in the **ScienceWorks** Creek Area.

- **Experience 1:** Prepare for a Dock Shop Field Trip
- **Experience 2:** Dock Shop and Creek Area at **ScienceWorks**
- **Assessment:** Student-led Science Conference

Lesson 4

Investigate Like a Scientist — ScienceWorks: Construction Zone

In this lesson students experience simple machines and structures. Then they visit **ScienceWorks** to investigate the structures and simple machines on display.

- **Experience 1:** Prepare for a Construction Zone Field Trip
- **Experience 2:** Construction Zone at **ScienceWorks**
- **Assessment:** Student-led Science Conference

Culminating Lesson

Communicate Like a Scientist

This culminating experience provides an opportunity for students to use another science skill: communication. Students give class reports about the science they have learned. Student reports are assessed with a "scientist" rubric in which five famous scientists represent the science strategies used.

- **Step 1:** My Science Report
- **Step 2:** Venn Diagram
- **Assessment:** Student Science Presentations and Rubric

What Will Students Know and Be Able to Do?

Unit Goals

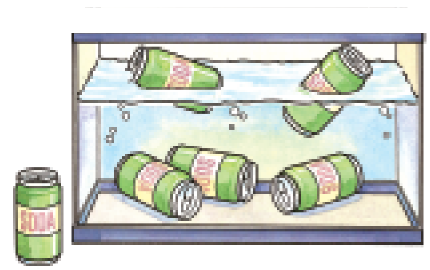
Students will

- ask and answer questions about the natural world and record data in a journal.
- use their senses to make observations, and recognize that scientists use this skill.
- draw pictures, make observations and write words to describe new science ideas.
- make observations and describe, draw, and classify data as they investigate a variety of objects.
- write a brief description of real objects based on observations.
- explore movement and determine how different animals move in different ways.
- give examples of plants and animals found in a pond.
- observe and describe differences, such as size or markings, among the individuals within one kind of plant or animal group in a pond.
- give short oral reports using student-created handouts that include drawings and pictures.
- observe that models are like the real things in some ways but different in others.
- construct, describe and take apart a model boat using materials provided.
- test various objects to determine if they sink or float.
- design and construct an object to test a science idea.
- construct a model structure using classroom materials.
- identify simple machines.
- work in teams to solve a problem.

Getting Started

Scientific Method

"Scientific method" is a term used to describe one way scientists solve problems — making observations, asking questions, making hypotheses, testing and evaluating ideas and drawing conclusions. Students and scientists may follow different paths in an investigation to generate evidence to support ideas.



Sink or Float:

An Easy Way to Understand Scientific Processes

The following activity is an easy way to understand how the scientific method is used in science. All you need is two unopened soft drink cans (regular and diet versions of the same brand) and a container of water large enough to hold them. Start your investigation with **questions.** Are regular and diet soft drinks the same density? Is the amount of sugar the only difference in the two drinks? Through **prior knowledge** we know soft drinks have different tastes, ingredients and calories. We call these **variables** — things that can be different or that can change. In this activity, some variables are the same: the size and type of can, the amount of liquid and the brand. The soft drinks are packaged in aluminum cans that are the same size and shape — congruent containers. Popular soft drink cans contain 355 ml (milliliters) of liquid volume. Start by examining and making **observations** of the two cans. When you compare the label of a regular (sugar) drink to the label of the diet version, you notice a big difference in the amount of calories. This will lead you to **formulate a hypothesis**, an idea that can be tested. Your hypothesis might be: *regular soft drinks are denser than diet soft drinks.* Now you need to **test** your hypothesis. Take the regular soft drink can and place it carefully in the water. Make sure the water is deep enough to completely cover the can. Record the result. The can should sink. Repeat the test with the can of diet drink. It should float. **Collect the data** from each test. The more tests, the more data to support your hypothesis. After collecting data from repeated tests you can **interpret** the results and come to a **conclusion**. You should be able to conclude that for this brand of soft drinks, *regular cans sink and diet cans float*. This is the outcome of your investigation. You learned that regular soft drinks are more dense than diet soft drinks because they sink in water, and diet soft drinks are less dense than regular soft drinks because they float in water. Your conclusion becomes a science **theory** when many more tests are done by other people with the same results.

Scientific Method

- Question
- Make observations
- Consult prior knowledge
- Formulate a hypothesis
- Test hypothesis
- Collect data
- Interpret data
- Draw conclusions
- Share knowledge
- Make additional observations

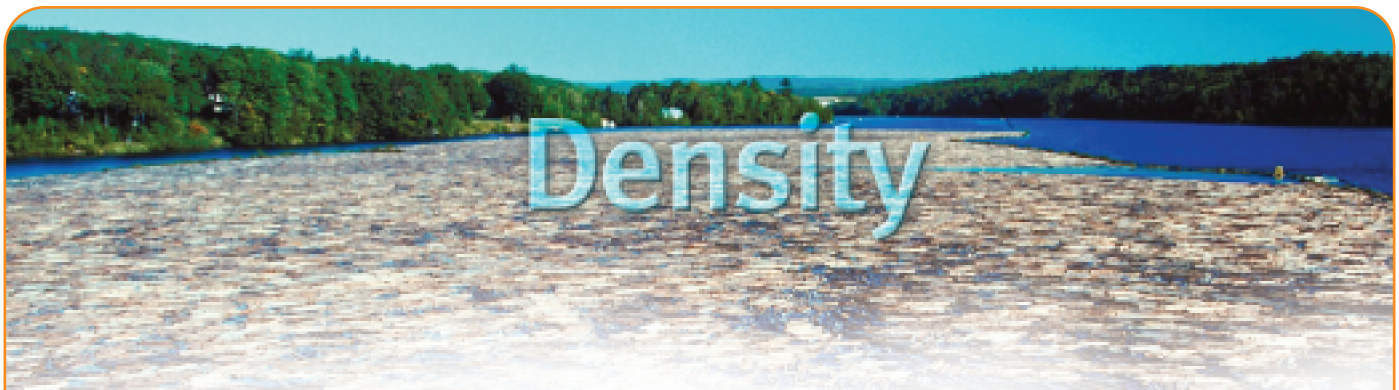
Science Problem Solving

Science is about solving problems. It is a process that helps us understand our world. The following diagram shows how questions lead to new information. This in turn can lead to more questions.

Question → **One Explanation** → **New Information**

Possible Outcomes

- What can occur from the new information?
- Explanation is still possible based on information.
- Explanation is changed or modified.
- Explanation discarded for lack of information.
- New possible explanation created with new information.



Density

Like length, mass and volume, density is a property of matter. Density is a measure of mass per unit volume. You can measure and compare the density of two objects. For example, if two students have identical school supply boxes, then the boxes have the same volume. However, if one box is filled with scissors, pencils and crayons but the other box contains only tissue, the boxes will not have the same mass. One box has greater mass because the materials inside it have a greater combined mass than the materials in the other box. The volume of the box containing only tissue is less dense than the other box, even though they take up the same volume. This example compares two solid objects that have the same volume.

Density = Mass / Volume
or
Density = the Mass of the supply box / the volume of the supply box

The density of a liquid also can be determined. A hydrometer is a tool to measure the density of a liquid. The average density of seawater is 1.025 kg/m^3 (kilograms/cubic meter). Pure water has an average density of 1.000 kg/m^3. The dissolved salt in seawater gives it more mass per volume than pure water.

A solid round object that floats in pure water is less dense than the water. A solid round object that sinks in water has greater density than the water. A dense material, such as steel or granite, will sink in water because it has a high ratio of mass to volume. You can change an object's overall density by modifying its shape, adding a float or chemically altering it. Most modern boats are made of items that are naturally dense, but a boat's shape allows it to float.

ScienceWorks

The first planning for **ScienceWorks** began in 1991 as **The Children's Museum** prepared to renovate and rededicate both the Natural Science Gallery on Level 1 and the Science Spectrum Gallery on Level 4. **ScienceWorks** opened to the public in 1996 as a hands-on gallery dedicated to enhancing science learning for children ages 6 through 10. The gallery was designed using the concepts of constructivism, a process in which learners increase their understanding by building on a foundation of prior knowledge and life experiences. The Enduring Idea for **ScienceWorks** is: Science is all around you. Explore, make a prediction and investigate.

Focus Questions

Science is driven by questions. Often one science question will lead to many more questions. The essence of science is to ask questions about the world around us. This unit of study asks questions and encourages students to ask many more. It also validates inquiry by having students write in their **Science Journal**. Students are asked to share questions with each other and to keep a list of questions and observations that they think are interesting and important. Each experience starts with focus questions to help direct student investigations:

- Do animals move the same way?
- What makes a boat float?
- What is the strongest shape for a bridge?
- What tools do scientists use?

These questions are the first step in using science to investigate a topic to find answers. Good questions help us explore, make predictions and investigate the world.

Science Class Environment

ScienceWorks is a great place to investigate and explore. However, your classroom should also be a place for science discovery. Students should be encouraged to bring in objects and artifacts to share with the class. Rocks, fossils, plants and aquariums should be common in the classroom. The goal is for students to understand that science is all around us — not just in the science lab down the hall or the **ScienceWorks** gallery at **The Children's Museum**. You should strive to have your own collection of science books, posters and objects for students to explore. Many of the tools that we use in science should be readily available for students to use during recess or free time. Putting out several magnifiers will guarantee student observation. A table with four magnets and a box of paper clips may be just the materials needed to start a student on the path to becoming an engineer. Students need time to explore and experiment with materials prior to using them in an investigation. If you provide this time before the science lesson, students will be better prepared. They need to have the tools in their hands and the time to explore tools and objects before investigation can begin. Your classroom is an excellent place to provide this "science play" practice.

The K–2 Science Student

Indiana's Academic Standards describe the educational development expectations for primary science students. The following is a general guide.

Kindergarten students are eager participants in exploring how their world works. They use numbers, pictures and words about their world. Without knowing it, they are actually making observations, communicating ideas and beginning to answer questions about the world. Through their investigations and observation, Kindergarten students begin to understand that there are things in the world that are similar and different. These are the same activities that help to define the essence of science. These activities provide lifelong science skills that will help them find answers and develop future questions about the world.

Grade 1 students continue to ask many questions about living things and events in their natural surroundings. They build science knowledge from past science experiences. Their curiosity leads to questions about plant and animal interactions and basic needs. They learn that observations can help answer their questions and create new science mysteries. Students begin to find answers to questions about the world by using observation, measurements and estimation. Science allows them to work with materials and communicate their findings through numbers, words and drawings. They retain these skills and strategies to use in future science investigations.

Grade 2 students actively engage in exploring how the world works by observing, counting, collecting, measuring, comparing and asking questions. They begin to identify parts of an object and recognize how these parts interact with the whole. They use numbers for computing, estimating, naming, measuring and communicating specific information. They use evidence to explain how or why something happens. Students begin to understand plant and animal interaction and process. They begin to use the same skills, strategies and problem-solving techniques shared by scientists around the world. They learn that people of all ages everywhere can use science to explore the world.

Modifications

Younger students may need help with words and observations. You may want to provide help using word lists and word walls. Students can draw pictures and write words to describe objects and experiences. Some students may search for and cut out pictures from magazines. Older students can be invited to help write observations that younger students make for their **Science Journal**. Encourage students to have family members help them at home. Modify science tools and units of measure to match students' abilities. In some of the activities students can team up in small groups or the whole class can work together to complete the tasks. An assessment activity is included at the end of each lesson and in the culminating activity. The assessments include criteria for success and a rubric that measures three levels of performance: partial, essential or excellent. In addition, a checklist for nonreaders is provided for teachers to use with younger students who have difficulty reading and writing.

Literature Connection

There are many excellent science books for reference and inquiry that teachers can use along with textbooks and trade books. Many of these books can be used to support a field trip to **The Children's Museum**. While this unit of study promotes a hands-on investigative approach for students, several useful books for teachers are annotated in each lesson and also listed in the resources section at the back of this unit. Many titles listed are available through **infoZone**, a branch of the Indianapolis-Marion County Public Library located at **The Children's Museum**.

Science Journal

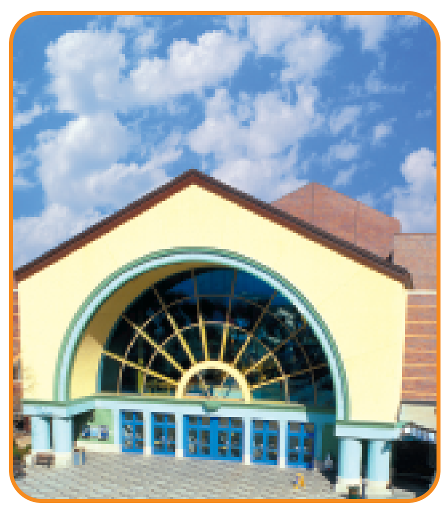
Students use a **Science Journal** to make observations, write questions and terms, and make drawings and diagrams. An example **Science Journal** is included in the resources section of this unit of study. Teachers are encouraged to use this or create their own teacher **Science Journal** to complete experiences in this unit of study. The **Science Journal** should be a personal collection of science thoughts, ideas and drawings. You might suggest to students that this journal is something they can continue using at home, on vacation, during the summer and in other grades. Stress to the students that they are writing **Science Journal** notes that they will read in the future. Some students may respond to the idea of using dictation partners. Older students, teachers or assistants can be used to pair with students to write down science words and observations. This may be useful for younger students not yet able to write proficiently. At the end of each activity students are asked to respond to the following **Science Journal** science writing prompt, "Today I discovered . . ."

Family Connection

This unit is intended for use in the classroom as well as by families and individual science learners. Let families know that your class will be studying science. Encourage them to make discoveries at home and discuss discoveries that students have made at school. Share with them that science learning opportunities are all around. Families will enjoy making observations and posing questions while riding in the car, playing outdoors and eating meals. They can learn a lot by doing science together. It is important to make the connection between the science we learn at school and the science we use in our daily lives. Families are encouraged to learn science together in the **ScienceWorks** gallery. A family that uses this unit of study can make real science discoveries that lead to improved science literacy.

The Children's Museum

Plan a field trip or get more information about **ScienceWorks** via the Web site, **www.childrensmuseum.org.** A museum visit provides extraordinary learning opportunities for students to explore the world of science. Museums serve as field trip sites where science exhibits and activities help motivate visitors to learn more about the world. **ScienceWorks** at **The Children's Museum** provides a place where everyone can explore and investigate like a scientist. Visitors will see a real Indiana Pond, Construction Zone machines and tools and an active Dock Shop.



Additional Web sites are listed with each lesson and also in the resources section at the back of this unit of study.

Lesson 1
Explore Like a Scientist
Explore, Make a Prediction, Investigate!

Science and young children share one powerful trait: they both rely on asking more questions than we often have answers for. In this lesson students are encouraged to ask many questions and use science terms and tools to search for answers. This lesson introduces students to science as a way to ask questions about their world. The goal of this lesson is to provide experiences that allow students to explore and do science. Students collect observations and terms in a **Science Journal**.

Vocabulary

- journal
- magnifying lens
- observation
- science
- senses

You will need . . .

Classroom poster or bulletin board for "Science Questions" and "Science Words"; magnifying lenses; rock, leaf or twig — one for each student; paper lunch bags; Science Journal handout: What do I see? Feel? Hear?; **Science Journal**.

Time

Three class periods

Objectives

Students will

- ask and answer questions about the natural world and record in a journal (K.1.1)
- use their senses to make observations and recognize that scientists use this skill (K.1.2)
- draw pictures and write words to describe new science vocabulary terms (K.2.2)
- communicate their experience with science by creating a drawing (K.2.2)
- observe, draw and communicate the attributes of a object (K.2.2)
- give examples of plants and animals they see on a nature walk (K.4.1)
- describe an object by saying how it is similar to or different from another object (K.6.1)
- observe, describe, draw and classify as they investigate different objects (1.1.1)
- investigate a variety of objects, make observations and collect data (1.1.2)
- use a magnifier to investigate living and nonliving things around a school (1.1.2; 1.1.4)
- demonstrate that magnifying lenses help people see things they could not see without them (1.2.5)
- describe and compare objects in a collection in terms of shape, texture, size and color (1.2.6)
- write a brief description of real objects based on observations (1.2.7)
- manipulate and investigate an object using sight, smell and touch to gain additional information about it (2.1.1; 2.1.3)
- use tools, such as magnifying lens, to gain more information about objects in their physical world (2.1.2; 2.1.3)
- illustrate the key features of an object through drawings and short written descriptions (2.2.5)

(indicates Indiana Science Standards)

Focus Questions

- Can students do science like scientists?
- How can science help me find answers about the world?
- What does a scientist do?
- Can everyone do science?
- What science tools can I use?
- Will observations help me answer questions?
- How can my senses help me make observations?

Lesson 1: Experience 1
Science Journal: Questions and Words

In this activity students learn that asking questions is a key part of science. Students are encouraged to be *Question Collectors*.

Procedures

Part 1 — Pre-Visit

Science Journal

- Provide or create a **Science Journal** for each student. Use the handout "Science Journal: What do I see? Feel? Hear?" provided on page **52** or make binders or notebooks. Create a poster, bulletin board or area on your chalkboard for "Science Questions" and another one for "Science Words."

- Start the discussion by telling your students about something you saw on the way to school that made you wonder. Open your own **Science Journal** and read some of your questions and observations.
- Tell them that asking questions, making observations and recording what you learned are the same things scientists do.
- Make a **Science Journal** big book for the class to share. Make sections that include Science Observations, Science Words, Science Drawings and Science Questions.
- When students write in their **Science Journal**, make sure they always put a date on their observations. Write "Today I discovered . . ." at the end of each page as a way to end science observations. A **Science Journal** is a tool for personal lifelong learning.
- Help students pose questions about the natural world and write them in their **Science Journal**. They might include an observation — something they saw, felt, smelled or heard on their way to school. Help them write and use words such as how, why, what and where as question-starters.

Science Journal

Use the **Science Journal** handout or make your own **Science Journal**. It is important for students to see that the teacher can learn science in the same way they learn. Start your own journal entries by including questions that you have about things around your classroom or home. Think about some event or object that you thought was odd or had a question about. Write questions in your **Science Journal**. Asking questions and looking for answers is what science is about. Here are some questions that you might want to include:

- Why do leaves turn colors?
- How does the moon change shape?
- Where does the rain come from?

Indiana's Academic Standards

Language Arts: K.1.20, K.4.3, K.5.1, K.5.2, 1.5.2, 2.5.5

Math: K.1.9, 2.6.2

Science: K.1.1, K.1.2, K.4.1, 1.1.1, 1.1.2, 2.1.1, 2.1.2

Part 2 — Pre-Visit Questions

- Share with students the following section of **A Teacher's Science Journal,** found on this page. This teacher is a father and has recorded many science questions from his family and students. Ask your students if they have thought of any of the same questions that the teacher has written down in his **Science Journal**.

- Take your class on a science hike around your school. Provide students with magnifying lenses and pencils. Have them make observations in their **Science Journal**. Point out examples of where people are doing or using science, such as:
  - nurse (life science)
  - custodian (physical science)
  - groundskeeper (earth science)

- Select several student questions and words, such as "How does the nurse use science to keep us healthy?" or "How does the custodian keep our schools warm and cool?" Add them to the class Science Question or Science Word poster.

- Ask students to share their **Science Journal** with family at home. Students should ask family members to list questions, observations or science words for future investigation. Revisit this activity once a week. Ask students to share some of their new science questions and observations. Add the new observations to the class science posters.

A Teacher's Science Journal

Science Questions

- *Why does it seem like the moon is always following me when I am driving home at night?*
- *Why does the moon seem bigger when it first comes up at night?*
- *Will I get more drops on me if I walk or run when it rains?*
- *Do magnets work better in air or water?*

Observations and Questions

July 2, 2002

While we were driving south to Memaw's house Caroline looked out the window at the sky. The sun was setting and the sky was very red. She said,

"Dad, when can we drive to where the sky is always red?"

[Caroline was 5 when she asked this science question.]

March 22, 1995

It was raining when William asked me,

"How come the rain-drops always race to the back of the car when it is raining?"

[William was 6 when he asked this science question.]

Science Words

The following are several important words to start your "Science Words" poster. During the year add science words as you cover new areas. Add a special section to the "Science Word" poster for science words with –*ology* and –*ologist* endings. Write the suffix –*ology* and have students copy it in their **Science Journal**. Tell them that this means "the study of" and comes at the end of a word.

For example, geology means the study of *geo*, or earth. Geology is the science that studies the earth.

Geology:
Geo: earth + *ology:* study of = the study of the earth

Ask your students what each of the following –*ology* words might mean.

- Biology
- Archeology
- Ecology
- Paleontology

Introduce the suffix –*ologist*. Explain to students that this special word ending describes a person who studies a type of science. For example, a person who studies geology is called a *geologist*. Geologist: *Geo* earth + *ologist* a person who studies = a person who studies the earth.

Help your class decipher the following science terms.

- Biologist
- Archeologist
- Ecologist
- Paleontologist

Lesson 1: Experience 2
Science Observations

Science is for everyone. All of us can explore and do science. In this activity students learn how to make science observations. They will use their senses and tools to collect information about an object. Students model strategies and use skills that scientists use to answer questions about the world. Students collect observations and words in a **Science Journal.** Tell the students that in this activity they will explore and use tools like a scientist.

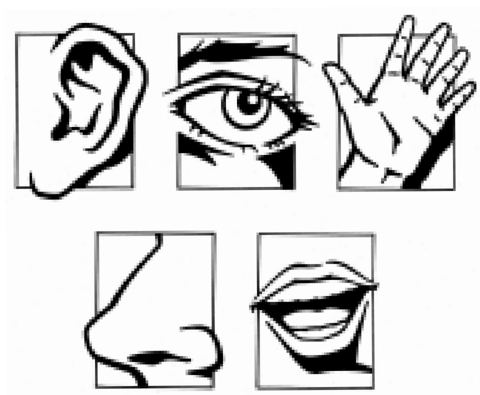
Procedures

Part 1 — Pre-Visit Observations

- Read aloud and write the word **observation** on the board. Discuss with your students the meaning of the word **observation**.

- Explain that scientists make observations about the world by using their senses. When students collect information by using their sight, hearing or other senses, they are making science observations.

- Tell students that tools are often used to help our senses make more observations. Reinforce the idea that this is the same process scientists use to make their observations.



- Hold up an everyday object from the classroom such as a book. Ask your students to tell you different senses used to make a science observation. The list should include examples of using sight, sound, smell and touch. Responses might include: *I use my eyes to observe that the book is red; I use my fingers to feel that the book is smooth; I use my nose to observe if the book has a new or old odor.* These are examples of science observations.

- Ask students to select one object in their desk or classroom. They should use their **Science Journal** to draw the object and list three science observations about it.

- Ask students to share their observations. Emphasize that observation describes the object; it should not name of the object. When an object is named it is often an inference, not an observation. They should share their observations by saying, "My object is red. It is smooth. It has straight lines." They should not say, "It is a book." The difference between an observation and an inference is important distinction for students to understand.

Part 2 — Pre-Visit Outdoor Observations

- Take your class outside to make science observations. Provide magnifying lenses for students to use to help make observations about objects they see. Ask them to search for things that are living and things that are nonliving. Remind them that scientists use symbols to help them make observations. Your students can use "L" for an observation about a living thing and "NL" for an observation about a nonliving object in their Science Journal.

Indiana's Academic Standards

Language Arts: K.1.20, K.4.3, K.5.1, K.5.2, 1.5.2, 2.5.5

Math: K.1.9, 2.6.2

Science: K.1.1, K.1.2, K.2.2, K.4.1, K.6.1, 1.1.1, 1.1.2, 1.1.4, 1.2.5, 1.2.6, 1.2.7, 2.1.1, 2.1.2, 2.1.3, 2.2.5

- Ask students to make observations that help them investigate the school grounds. Challenge your students to list as many observations as they can. They can use observations to list the living and nonliving things. At the end of the session ask students to share their observations.

- Help students understand how observations might answer a specific question. For example, ask students to find outdoor observations that might lead to answers for the following questions: Do plants move? How do plants move? What are things made from? What living things are found in our school? How are trees alike? How are they different?

- Discuss with your students how many of their observations can be used to answer questions. Point out that some science questions cannot be answered until new observations are made. Often two people will make different or conflicting observations about the same object. When this happens, new observations need to be made. Look for examples in your class that demonstrate this aspect of science. Observations are essential to science investigations. Lead your students outside to collect a set of natural objects from the school playground. Students should select one object. For example, have each student collect a rock, a twig or a leaf. The object should be of a size that is easy for small hands to manipulate.

Part 3 — Pre-Visit Observation Circles

- Back in the classroom, give students time to make observations, drawings and measurements of their objects in their **Science Journal**. Provide magnifying lenses for students to use to make observations. Students should complete and record their observations and draw the objects in their **Science Journal**. Place your students in pairs to share observations. Repeat the sharing in small groups. Younger students may work with older students or assistants to record their observations.

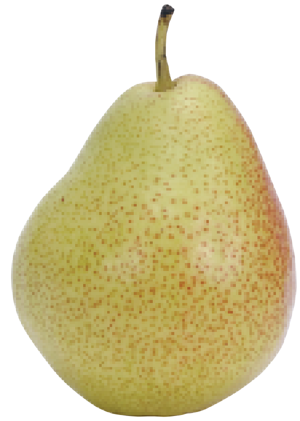
- Bring the entire class together in a circle on the floor. Each student should take a few minutes to study his or her object. Remind students to use their senses. Ask questions such as *How does it feel? Is it heavy? What color is it? Does it have a special bump or mark it? Does it have an odor? How many centimeters long is it? How many inches?*

- Direct students to pass the objects around the circle, observing each one for a few moments and passing it on until each gets his or her original object returned. Repeat the activity, passing the object in the opposite direction. Remind the students that they are practicing the science skill of making observations.

- Tell students that on the next pass they will not be able to use all of their senses. Ask students to hold their object and close their eyes. Ask them to use their hands to feel the shape and texture of the object. Give them enough time so they feel confident that they know their object. Ask them to keep their eyes closed as they carefully pass the objects around the circle.

- With a little practice each student should be able to identify his or her own object based upon observations they have made. Younger students will have more success if varied objects are used. For example, the circle could include rocks, twigs and leaves. If younger students have difficulty keeping their eyes closed when they pass the objects, use small paper lunch bags to hold each object. Students can put their hands inside the bags to feel the objects.

Lesson 1: Assessment
Explore Like a Scientist: Fruity Observations

You will need ...

A combination of apples, oranges, grapes, pears, strawberries and other fruits — enough for each student to have one fruit.

Provide one fruit to each student and read aloud this scenario:

You are a member of the _________ (name of your school) Science Team. Your class has just returned from a science field trip. On the trip you saw and touched many interesting things. Some of the things had beautiful colors and some had strange odors. You have been asked to work as a scientist to describe the fruits you brought back from the field trip. Once you have made your observations in your ***Science Journal****, the fruits will be mixed together. Your final job is to be able to find the fruit you investigated. Good luck!*

Your job as a scientist is to:

1. *Select one fruit to investigate.*
2. *Use words to describe the fruit. Do not use the real name of the fruit.*
3. *Ask or write questions about the fruit.*
4. *Make observations about the fruit.*
5. *Make drawings and take measurements of the fruit.*
6. *Find your own fruit in a pile of other fruits.*

Criteria for Success

The assignment will be scored based on the student's ability to:

- Write or speak words that describe a piece of fruit without using its actual name;
- Write or speak a question about the piece of fruit;
- Make an observation that describes a characteristic of the piece of fruit;
- Make a drawing showing a characteristic of the piece of fruit; and
- Use observations to identify the piece of fruit once it is placed in a pile of similar objects.

Scoring Rubric

This rubric provides a framework for assessing a student's ability to make careful observations and use words, measurements and drawings about an object. Examine the student's **Science Journal** to assess his or her science ability. Younger students who cannot yet write or read may benefit from an interview or conference.

Partial: The student uses only one or two words to describe the object. The student uses the actual name of the fruit in the observation. No question is written about the object. The drawing does not represent the object. Only one sense is used to describe the fruit: sight, feel or smell. No measurements or comparisons are made.

Essential: The student uses several words to describe the shape, texture, smell or color of the fruit. The student generates several questions and makes careful observations recorded in the **Science Journal**. The student uses units of measurement correctly. He or she makes personal discoveries and relates them to the experience. The student can identify his or her fruit in a collection of fruits. Students in Grades 1 or 2 can demonstrate the ability to use a centimeter ruler or a magnifying lens to help describe the fruit.

Exceptional: The student asks numerous questions and uses many words to make observations that include information from all the senses: texture, odor, color, shape, texture, etc. The student makes unique observations. The drawings are specific and show unique characteristics. The student shows excellent command of tools, measurements and other sensory input, and can relate the activity to the way scientists work to make observations.

Inference vs. Observation

Help students distinguish between inferences and observations. An observation represents information taken directly through the eyes, ears, or other sense organs and through instruments that extend the senses. Inferences are observations combined with the observer's prior knowledge or biases. Inferences are more subjective. For example, in the Observation Circles experience a student may say, "I have a tree branch." This is an example of an inference. The stick may or may not be from a tree. "I have a brown, bumpy, crooked object with a length of 10 centimeters" is an observation. The goal is to teach students to observe in ways that are as free from bias as possible.

Teacher Resources

Books

- Colburn, Alan. *The Lingo of Learning: 88 Education Terms Every Science Teacher Should Know.* Arlington, VA: NSTA Press, 2003.
- *NSTA Pathways to the Science Standards: Guidelines for Moving the Vision Into Practice, Elementary School Edition*, 2nd ed., eds. Lawrence F. Lowery et al. 3 vols. Arlington, VA: NSTA Press, 2000.
- *Scientific American Science Desk Reference.* New York: John Wiley & Sons, 1999.

Web Sites

National Science Teachers Association, NSTA
http://www.nsta.org

Hoosier Association of Science Teachers, HASTI
http://www.hasti.org

National Science Resource Center, The National Academies and Smithsonian Institution, NSRC
http://www.nsrconline.org/

HowStuffWorks — Learn How Everything Works!
http://www.howstuffworks.com/

Science Project Ideas, Information and Support
http://www.scienceproject.com/

American Museum of Natural History Presents OLogy
http://ology.amnh.org/

The Art and Science of Investigation: Observation and Inference
http://www.units.muohio.edu/dragonfly/teach/barman.htmlx

Lesson 2
Investigate Like a Scientist — ScienceWorks: Indiana Pond Explore, Make a Prediction, Investigate!

This lesson provides experiences in the **ScienceWorks** Indiana Pond. Two experiences are provided to prepare students to investigate like a scientist. Students work in their classroom to explore the plants and animals that may be found in an Indiana pond. Students select pond inhabitants to research and study. In the second experience they visit **ScienceWorks** to test, observe and investigate their subject. Students use skills and strategies to investigate like a scientist.

Vocabulary

- fish
- frog
- living
- mud
- nonliving
- plants
- pond
- turtle

You will need ...

Magnifying lenses; clock; pencils and colored markers; pond books, such as *Life in a Pond* by Allan Fowler; handouts: ScienceWorks Indiana Pond Map, What's in an Indiana Pond? Indiana Pond Observation Sheet and Pond, Plant or Animal Observation Sheet; and **Science Journal**.

Time

Two class periods and one day for a museum visit.

Objectives

Students will

- explore movement and determine how different animals move in different ways (K.3.2)
- give examples of plants and animals found in a pond (K.4.1)
- identify different structures that animals and plants use to obtain nutrients (K.4.2)
- observe and describe differences, such as size or markings, among the individuals within one kind of plant or animal group in a pond (1.4.2)
- identify the basic needs of plants and animals in a pond (1.4.4)
- observe and identify animals within a pond habitat and explain how different external features allow the animals to survive in their environment (2.4.1)
- give short oral reports using student-created handouts that include drawings and pictures

(indicates Indiana Science Standards)

Focus Questions

- What living things can you find in a pond?
- What nonliving things can you find in a pond?
- How do animals move in a pond?
- How does a scientist study a pond?

Lesson 2: Experience 1
Prepare for an Indiana Pond Field Trip

In this experience students are introduced to the plants and animals found in a pond. Students learn to classify living and nonliving things. Students select pond inhabitants to research and study.

Procedures
Part 1 — Pre-Visit
What's in an Indiana Pond?

- Introduce the word *pond* to the class and explain that they will soon be visiting a pond at **The Children's Museum**. Explain that a pond is an ecosystem or community of living things. All plants and animals work together within the pond community to make it a complete living environment. The pond provides everything that animals and plants need to survive.
- Start by reading aloud *Life in a Pond* by Allan Fowler. The book introduces through text and photos the animal and plant life in and around ponds. Students use their **Science Journal** to make observations, drawings and notes about a pond.
- Have the students write the word *pond* in their **Science Journal**. Ask them to list the types of things that can be found in and around a pond. List all responses on your poster or chalkboard.
- Talk with students and provide examples of how plants and animals meet their basic needs of food, water, air and shelter in a pond. Share pond books, videos and Web sites to search for information about what might be found in a pond. Encourage students to write words and draw pictures of things they might expect to find in an Indiana pond.
- After six or more pond inhabitant names have been written on the board, ask students to suggest a way to sort or divide them into groups. Direct the discussion or suggest that one way to sort the examples given could be living and nonliving things in a pond. For example, living things in a pond might include plants, fish, birds, mammals, reptiles, amphibians, insects and people swimming or fishing.
- Pass out **ScienceWorks** Indiana Pond Map on page 53. Tell students to label "L" for living things they see and "NL" for nonliving things. Nonliving things in a pond might include water, air, rocks, trash and chemicals. Take this handout to **The Children's Museum** to complete.

Indiana's Academic Standards

Science: K.4.1, K.4.2, 1.4.2, 1.4.4, 2.4.1

Math: K.1.9, K.5.1, K.6.2, 1.1.10, 1.5.4, 1.6.2, 2.5.1, 2.6.2

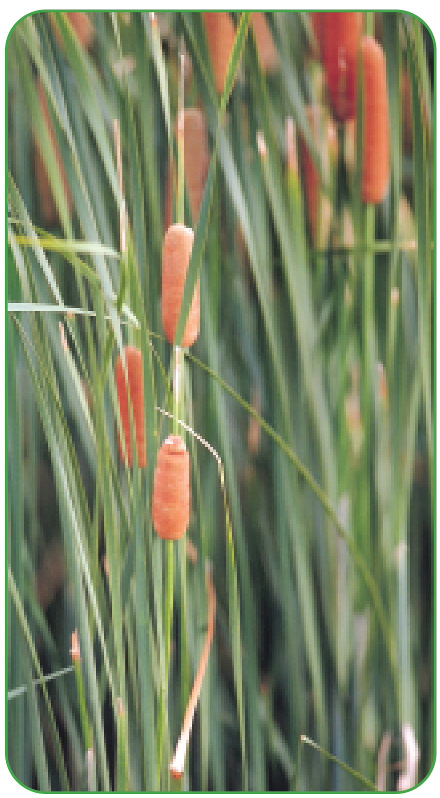
Language Arts: K.4.3, K.5.1, K.5.2, K.7.2, 1.5.2, 1.7.10, 2.5.5, 2.7.9

- Sort the examples and add new ones. Ask students to use the "What's in an Indiana Pond?" observation handout, found on page 54, or make a similar chart in their **Science Journal**.

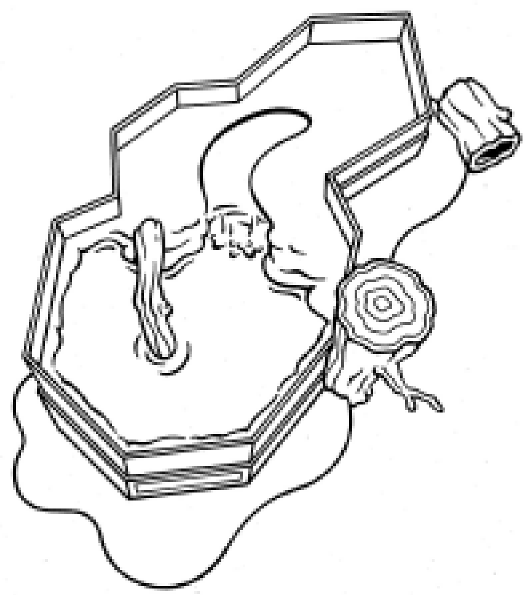
- Ask students to talk with friends and family about their experiences visiting ponds. Students should write this new information in their **Science Journal**. Encourage students to write the names and locations of the ponds they learn about. Discuss with students other ways to sort examples of what might be in a pond, such as things that live in the pond water; things that live on the pond's edge; things that fly in and out of a pond; and things that can live in or out of a pond. Ask students to use symbols or colors to sort the items listed. For example, all words or drawings of pond objects that live in water can be colored blue or have a symbol for water next to the item. Encourage students to add pond observations, photos or other new information to their journal. Ask them to share their **Science Journal** observations with each other and the class.

Part 2 — Pre-Visit Indiana Pond Research

- Ask students to research a plant or animal they might find in the Indiana Pond at the **ScienceWorks** gallery at **The Children's Museum**. A list of the frog, fish, crayfish and plant species found in an Indiana Pond is available in the ScienceWorks gallery.



- Students should use books, pictures, reference guides and the Internet to research their plant or animal. Information should be copied into their **Science Journal**. Model this technique for your students. It may help younger students to work with a buddy, a family member or an older student.



Part 3 – Pre-Visit Communicate Like a Scientist

- Ask students to share short science reports with the class. Encourage them to share drawings and observations they have made in their **Science Journal**. This will prepare students for their visit to the Indiana Pond in the **ScienceWorks** gallery.

Lesson 2: Experience 2
Indiana Pond at ScienceWorks

In this experience students study the plants and animals living in the Indiana Pond at **ScienceWorks**. They make observations and draw and label pictures of what they see in the pond. Careful observation may reveal fish, plants, frogs, crayfish and aquatic insects.

Procedures

Part 1 — Pre-Visit Pond Observations

- Review with the students what they learned about the Indiana Pond prior to arriving at **ScienceWorks**. Refer to the "ScienceWorks Indiana Pond Map." Ask them what type of science they would do at the Indiana Pond. Students should respond that they will observe living things.

- Tell them that this type of science is called *biology*, the study of living plants and animals. Ask the students to guess the word that describes a person who studies biology. Explain that the suffix *–ologist* creates a word that describes a person who studies. Write *biology* and *–ologist* for the class. Ask them to name the tools a *biologist* might use to investigate the pond.

Part 2 — At ScienceWorks Pond Observations: Map Living and Nonliving Things

- Hand out the "Indiana Pond Observation Sheet" found on page 55. Take students on a short tour of **ScienceWorks**. Stop at the pond.

- Move the students to one side of the pond. Allow two minutes for student observations. Ask students to write or draw an observation about the pond. Share a few of the observations with the group. Move the students to another side of the pond and make a new observation. Ask students to record their observations. Share a few of their observations with the whole group.

- Instruct students to observe all the things found in the pond. They should identify two different groups in the pond: living things and nonliving things. Students should make observations, write words and draw pictures of the things they see on the "Indiana Pond Observation Sheet." Students can use pencils and colored markers to name and label the three pond areas: dry area, wet marsh and pond waterfall and pool. Point out the different areas and help each student with the pond map. Have students draw or list living and nonliving things they observe. Instruct students to observe all the animals found in the pond. Use the observation sheet to sort the animals found. Students should make observations, write words and draw pictures of the things they see.

Part 3 — At ScienceWorks Animal Observation

- Select one pond animal to observe, draw and study. Have students use the back of the "Pond, Plant or Animal Observation Sheet," found on page 56, to write words about how the animal moves and about its behavior, color, size and shape. Ask students to make observations about how the animal interacts with the other pond animals. Use your own **Science Journal** to write down any behaviors the students can identify, such as eating, hiding, fighting or swimming. Ask students to look for ways that the animals cause changes in the pond, such as using water, eating food or digging in the mud.

Indiana's Academic Standards

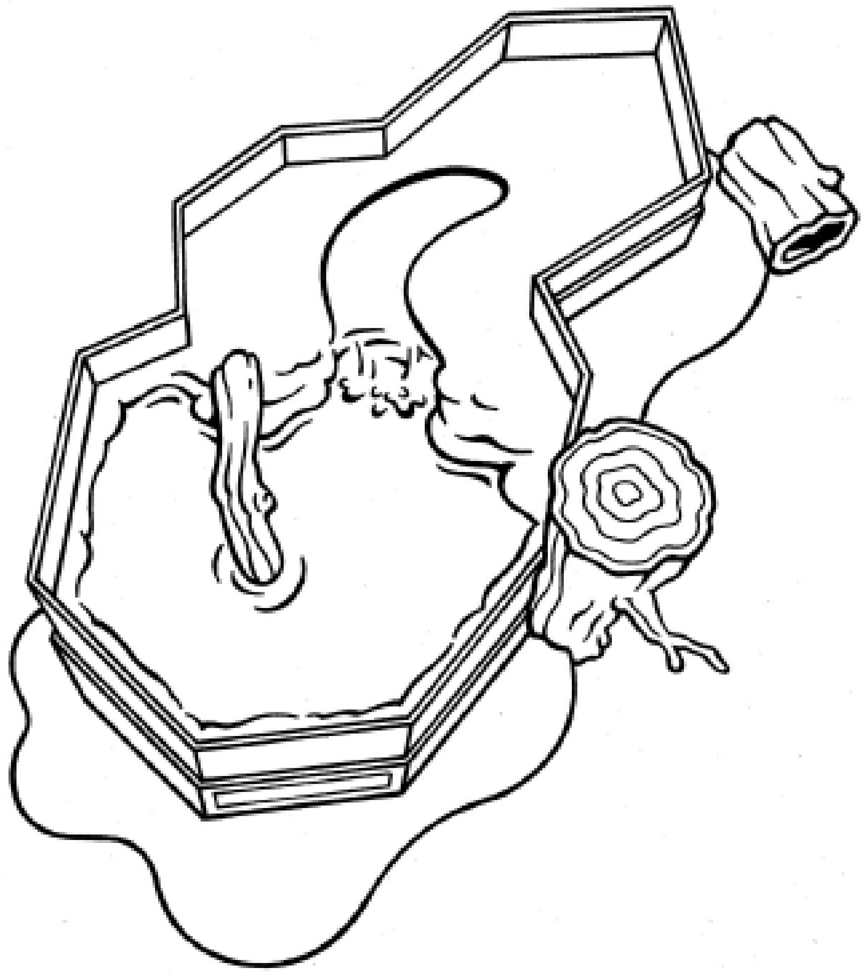
Language Arts: K.4.3, K.5.1, K.5.2, K.7.2, 1.5.2, 1.7.10, 2.5.5, 2.7.9

Math: K.1.9, K.5.1, K.6.2, 1.1.10, 1.5.4, 1.6.2, 2.5.1, 2.6.2

Science: K.3.2, K.4.1, 1.4.2, 2.4.1

Indiana Pond

The Indiana Pond in **ScienceWorks** has several purposes. The most important is to provide an active, living exhibit where visitors can make observations. The pond is divided into three areas: dry bank, marsh and a pool fed by a waterfall. The pond contains both living and nonliving things for students to identify. A pond is commonly described as a quiet body of water smaller than a lake and so shallow that rooted plants grow completely across it. The water temperature is nearly uniform from top to bottom and changes with the air temperature. There is little wave action and the bottom is mud-covered. There are many different kinds of ponds. Meadow stream ponds occur where the stream widens and the speed of the current slows dramatically. Farm ponds are built to allow fishing and boating as well as to provide water for animals. Cypress ponds, common to the central and lower Mississippi River Basin, have brownish water and are dry much of the year. Bogs have acidic water and may be covered with floating leaf plants. A wetland is any area of land regularly saturated with water. The water is usually shallow and may dry up for part of the year. Types of wetlands include marshes, swamps, everglades, bogs, ponds and land areas along lakes, streams and rivers. Ponds and wetlands provide food, shelter and water for animals and plants.



ScienceWorks Indiana Pond

Just like a real pond, the ScienceWorks pond has a variety of plants and animals. The following is a list of current inhabitants. This list changes.

Animals in the Pond

- Blacknose Dace: *Rhinichthys atratulus*
- Bluntnose Minnow: *Pimephales notatus*
- Central Stoneroller: *Campostoma anomalum*
- Creek Chub: *Semotilus atromaculatus*
- Fathead Minnow: *Pimephales promelas*
- Mosquitofish: *Gambusia affinis*
- Northern Studfish: *Fundulus catenatus*
- Orangethroat Darter: *Etheostoma spectabile*
- Silverjaw Minnow: *Notropis buccatus*
- Northern Leopard Frog: *Rana sp.*
- Freshwater Crayfish: *Orconectes sp.*

Plants in the Pond

- Blue Rush: *Juncus glaucus*
- Broadleaf Cattail: Typha latifolia (Narrowleaf is T. angustifolia)
- Hardy Water Lily: *Nymphaea 'Attraction'*
- Horsetail Rush: *Equisetum laevigatum*
- Obedient Plant: *Physostegia virginiana*
- Star sedge: *Dichromena colorata*
- Water Celery: *Oenanthe javanica*
- Yellow Iris: *Iris pseudacoris*

THE CHILDREN'S MUSEUM OF INDIANAPOLIS © 2007

Lesson 2: Assessment

Student Science Conference: Science Journal

Once students complete the lessons, you can assess their performance in a student conference. During the conference students share their **Science Journal** and **ScienceWorks** investigation. The purpose of the student conference is to show the students a way to self-evaluate their science work. In the Science Conference, students give examples of how they work like a scientist. A student-led science conference transfers the responsibility of thinking and working like a scientist from the teacher to the student.

Assessment for Nonreaders

Students in kindergarten may have difficulty writing science words and questions. Experienced teachers use strategies such as reading material aloud, assisting with writing and using older students or adult volunteers to mentor in the classroom. Another method is to provide visual keys or pictures that represent science words. See pages 48–50 for useful handouts, steps and information about conducting a good conference.The student forms can be modified or teachers can use the "Science Conference Checklist" during the conference, filling in the material as the student explains the science. In addition, a "My Science Conference Checklist" form for nonreaders is included in the resources materials on page 58.

Students use their **Science Journal** and the "Science Conference Teacher Evaluation Checklist" to present, explain and show their own work on the plants and animals of the Indiana Pond.

Teacher Resources

Books

- Fowler, Allan. *Life in a Pond*. Rookie Read-About Science. New York: Children's Press, 1996.

  Introduces the animal and plant life in and around ponds through text and photos.

- Ganeri, Anita. *Ponds and Pond Life*. Nature Detective. New York: Franklin Watts, 1993.

  Introduces pond life through the seasons by looking at the insects, mammals, birds and flowers that live in and around ponds.

- Morrison, Gordon. *Pond*. Boston: Houghton Mifflin, 2002.

  Examines how a glacial pond and the abundance of plants and animals that draw life from it change over the course of a year.

- Reid, George. *Pond Life: A Guide to Common Plants and Animals of North American Ponds and Lakes,* rev. ed. New York: St. Martin's Press, 2001.

  Text and drawings provide concise information about plants, animals and insects found in a pond.

- Silver, Donald. *Pond*. New York: Learning Triangle Press/McGraw-Hill, 1994.

  An up-close look at mammals, insects, plants, birds, fish, amphibians, bacteria and the ecosystems in a pond through drawings, diagrams and text.

Web Sites

Observations at the Pond
http://oregonstate.edu/precollege/GK12/Activities/ACT_EnvironStudies/ENVIRON_68_PondObservations/PondObservations.html

ExplorA-Pond
http://www.uen.org/utahlink/pond/

Pond Life Animal Printouts — Enchanted Learning
http://www.enchantedlearning.com/biomes/pond/pondlife.shtml

Pond Explorer (A Virtual Pond Dip)
http://www.naturegrid.org.uk/pondexplorer/pondexplorer.html

Create a Pond (A Virtual Pond Activity)
http://www.geocities.com/sseagraves/createapond.htm

Lesson 3
Investigate Like a Scientist — ScienceWorks: Dock Shop and Creek Area Explore, Make a Prediction, Investigate!

This lesson provides experiences in the Dock Shop and Creek area of **ScienceWorks**. Two experiences are provided to prepare students to investigate like a scientist. Students work in their classroom to explore what makes a boat float and sink. In the second experience they visit **ScienceWorks** to build their own boat to test, observe and investigate. Students use skills and strategies to investigate like a scientist.

Vocabulary
- boat
- current
- float
- prediction
- sink

Focus Questions
- What makes a boat float?
- What objects float?
- What objects sink?
- What makes a floating object sink?
- What makes a sinking object float?
- What happens when changes are made to a boat?

Objectives
Students will
- investigate how things move in different ways, such as fast or slow (K.3.2)
- describe an object by saying how it is similar to or different from another object (K.6.1)
- investigate by observing and then describe how things move in different ways (1.3.4)
- observe that models are like the real things in some ways but different in others (1.6.1)
- construct, describe and take apart a model boat using items such as straws and paper clips (2.2.4)
- draw pictures and write brief descriptions that portray key features of a boat (2.2.5)
- identify that a push or a pull is a force that makes objects move (K.3.2; 2.3.7)
- observe and describe how changing one thing can cause changes in something else (2.5.3)
- test various objects to determine if they sink or float
- design and construct an object to test a science idea

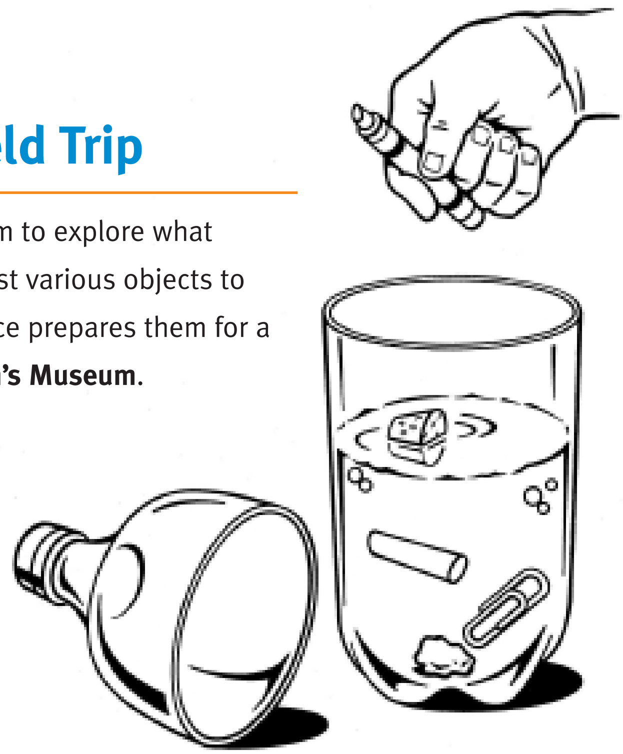
(indicates Indiana Science Standards)

You will need . . .
Science Journal, two-liter bottle with top cut off; various objects; water; pencils; boat books; paper towels, cups, aluminum foil squares (10 x 10 cm); small clay balls.

Time
Two class periods and one day for a museum visit.

Lesson 3: Experience 1
Prepare for a Dock Shop Field Trip

In this experience students work in their classroom to explore what makes a boat float and sink. They examine and test various objects to determine why objects float or sink. The experience prepares them for a science field trip to **ScienceWorks** at **The Children's Museum**.



Procedures
Part 1 — Pre-Visit
Sink or Float

- Read aloud a boat book, such as *Boat* by Christian Broutin. Introduce the phrase "Dock Shop" to the class. Ask students if they have heard either one of these words. Explain that the Dock Shop at **The Children's Museum** is a place where visitors can build boats and then test them in a creek. In this area visitors explore how things float and sink. They also discover that air and water can provide a *push* to move a boat. The Dock Shop and Creek areas provide everything that a young scientist needs to test ideas about things that sink and float.

- Students use their **Science Journal** to make observations, drawings and notes about boats and objects that float. Each student should write the word *float* in his or her **Science Journal**. Ask students to list the types of classroom items that float and those that sink. Make two separate lists on the board. Ask students to study the list to look for characteristics that are similar. The statements they make may or may not be true. Write several of these statements on the board. Tell students that a scientist would test one of these statements to see if it is correct.

- Divide the class into Science Teams of two students each. Give each Science Team a cup filled halfway with water. The teacher can use a two-liter bottle with the top cut off and filled halfway with water to model the tests. Ask each team to collect several classroom objects to test. Then ask students to predict if each object will sink or float. Have students copy in their **Science Journal** the chart above. They should list each object in the chart and label each with "sink" or "float" in the Prediction column.

Sink or Float Observations

Object	Prediction (float or sink)	Test (float or sink)
paper clip		
chalk		
rock		
cork		
pencil		

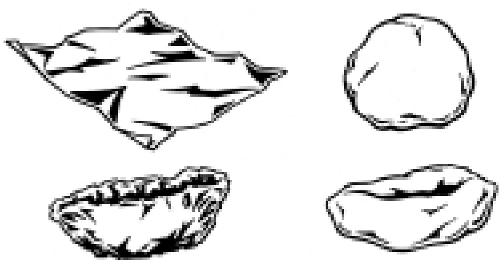
Indiana's Academic Standards

Language Arts: K.4.3, K.5.1, K.5.2, K.7.2, 1.5.2, 1.7.10, 2.5.5, 2.7.9

Math: K.6.2, 1.1.10, 1.6.2, 2.4.3, 2.6.2

Science: K.6.1, 1.6.1, 2.2.4, 2.2.5

- Test one object for the class using your two-liter bottle. Ask a student to volunteer to make a prediction about the object and then test it. Write the results on the board and in your teacher **Science Journal**. Allow students to complete predictions and tests for each of their objects. Have them record the results in their **Science Journal**. Ask students to explain how the objects are similar to and different from each other.



Part 2 — Pre-Visit
Aluminum Foil and Clay Boats

- Pass out a small piece of clay to each Science Team. Ask the class to predict if the clay will sink or float. Students should record the prediction in their **Science Journal**. Then ask the class to roll up the clay into a ball. Ask the class if they would like to change their prediction about whether the clay will float or sink. Allow time for students to think and possibly change their predictions. Then have them test the clay balls by dropping them into the water. They can draw pictures of the results and record them in the Sink or Float chart. Have them repeat the test, but this time show the students how to mold it into a small boat with the sides turned up. Ask the students to predict if the clay boat will float or sink. Test the clay boat by placing it gently on the water. Students can draw pictures of the results on the Sink or Float chart. Explain to the class that their clay boat is a model of a real boat. Scientists use models to study. A model can tell some but not all things about the real object. Discuss with the class what they have observed and discovered. The class should be able to give examples that match the following statements.

Sink or Float Science Statements

- Some objects almost always float.
- Some objects almost never float.
- Some objects that float can be made to sink.
- Some objects that sink can be made to float.

Reinforce the above statements with another test. Pass out aluminum foil squares to each student. Have students complete the test in the same manner as with the clay. They should predict, test and record the results. Then compare a foil ball to a foil boat. Students should make drawings and record what they discovered in their **Science Journal**.

Note: An aluminum foil ball will float! This seems to contradict the lesson. However, a foil ball is filled with trapped air. Squeeze the foil ball to push out all of the trapped air. Students may need to stomp on it with their feet. Better yet, have them discover ways to get the air out.

Part 3 — Pre-Visit
Communicate Like a Scientist

- Ask students to share what they learned about how things float and sink and how their observations might help them design a boat. Encourage them to share drawings and observations they have made in their **Science Journal**. This will prepare students for their visit to the Dock Shop and Creek area in **ScienceWorks**.

Lesson 3: Experience 2
Dock Shop and Creek Area at ScienceWorks

This lesson provides experiences in the Dock Shop and Creek areas of **ScienceWorks**. Students visit **ScienceWorks** to build their own boat to test, observe and investigate. Students use skills and strategies to investigate like a scientist.

Procedures
Part 1 — Pre-Visit Dock Shop and Creek Field Trip

- Review with the students what they observed and discovered in the first investigation.

Part 2 — At ScienceWorks Dock Shop and Creek Area Field Trip

- Take students on a short tour of **ScienceWorks**. Stop at the Dock Shop.
- Allow students time to explore at the Creek area. This is a busy science spot in the gallery. Encourage them to find places where they feel a *push* or a *pull* in the water or air. Ask students to put their hands in the water to feel the push. Tell them this is called a **current**.
- Have students work in the Dock Shop area to build their own boat. In this space are all the materials and tools needed to make a model boat. Point out to the students the many models of boats that are displayed in the Dock Shop. Encourage students to make their own design or to build boats like those on display. Once the boats are made, move to the Creek.

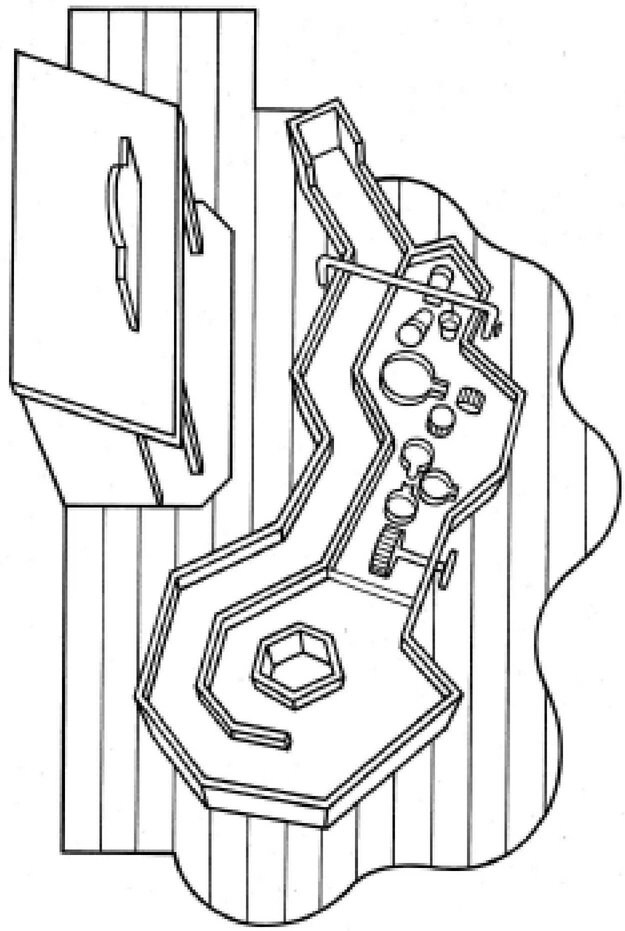
Part 3 — At ScienceWorks Boat Science Test: Float, Sink, Move

- Have each student carefully test his or her boat in the Creek area. Students should make observations that include such things as whether it floats or sinks, how fast or slow it moves and what direction it moves. Provide time for them to make drawings and complete the tests. Ask students to determine which direction the currents moved their boats.
- After the first test, ask students to change one or more things about their boat. They can add material, remove material, use a different shape or make other changes. Have students repeat the boat tests with their new boat design. They should make observations and compare the boat to the first tests. Students should look for similarities and differences in how the boat floated and moved. Ask students to think of one way their boat is like a real boat, and one way their boat is not like a real boat.
- Before leaving the museum, provide time for students to draw pictures and write notes in their **Science Journal**. Ask them to write any things they discovered and to describe the changes they made to their boat. Tell them that they will use their notes to give a science report when they are back in the classroom.

Indiana's Academic Standards

Language Arts: K.4.3, K.5.1, K.5.2, K.7.2, 1.5.2, 1.7.10, 2.5.5, 2.7.9
Math: K.6.2, 1.1.10, 1.6.2, 2.4.3, 2.6.2
Science: K.3.2, K.6.1, 1.3.4, 1.6.1, 2.2.4, 2.2.5, 2.3.7, 2.5.3

Dock Shop and Creek Area



The Dock Shop has workspace for visitors to design and build a boat. Along the walls are examples of boats and ships. Many different boats are displayed to reinforce the idea that boats are built for many purposes. Boats have been around since recorded history. They were once the primary means of transportation. From simple dugout boats to modern cruise ships, all boats rely on two basic principles: **Boats must float in water at some point (even submarines need to float), and all boats require some type of energy to make them move.**

The second important area is the Creek. This small stream is filled with features that wallow visitors to explore water currents. Students are encouraged to try floating the boats they make in the Dock Shop. Some visitors just like to explore and discover different ways to make the water move. The Creek has a fan, pumps, gates, funnels and other structures and simple machines to create and change water currents.

Boat Vocabulary

- A **mast** is the vertical pole that holds up a sail.
- A **mainsail** is the largest sail and the lowest one on the mainmast.
- The **mainmast** is the largest and often the tallest mast. It is usually the second mast from the bow.
- **Fore** is the term for the front of the boat. It can also be called the **bow**.
- **Aft** is the term for the back of the boat. It can also be called the **stern**.
- **Starboard** is the term for the right side of the boat when you are facing the bow.
- **Port** is the term for the left side of the boat when you are facing the bow.
- The **hull** is the main body of a boat or ship that keeps the water out.
- A **ship** is the term for a boat with three or more masts rigged with square sails.
- A **raft** is a boat without a hull that floats due to the natural buoyancy of its materials.
- **Oars** are tools used to propel a boat through water.
- An **outrigger** is a float or shaped log attached to the hull of a canoe or dugout boat that keeps it stable when sailing.
- A **yard** is the arm attached to a mast to hold the top of a sail.
- A **boom** is the arm attached to a mast to hold the bottom of a sail.
- **Rudder** is the term for a flat piece of wood or metal attached upright to the stern of a boat or ship for steering.
- A **keel** is the lowest and most important structural beam in the hull of a boat, extending longitudinally along the bottom center and often extending outward from the bottom.

Lesson 3: Assessment
Student Science Conference: Science Journal

Once students complete the lessons you can assess their performance in a student conference. During the conference students share their **Science Journal** and **ScienceWorks** investigation. The purpose of the student-led conference is to show the students a way to self-evaluate their science work. In the Science Conference students give examples of how they work like a scientist. A student-led science conference transfers the responsibility of thinking and working like a scientist from the teacher to the student.

Assessment for Nonreaders

Students in kindergarten may have difficulty writing science words and questions. Experienced teachers use strategies such as reading material aloud, assisting with writing and using older students and adult volunteers to mentor in the classroom. Another method is to provide visual keys or pictures that represent science words. See pages 48-50 for useful handouts and information about conducting a good conference. The student forms can be modified or teachers can use the "My Science Teacher Evaluation Conference Checklist" during the conference, filling in the material as the student explains the science. In addition, a "My Science Conference Student Checklist" form for nonreaders is included in the resources materials on page 58.

Teachers and students use their **Science Journal** and the "Science Conference Teacher Evaluation Checklist" to present and explain their own investigation into how things sink, float and move in the Dock Shop and Creek areas.

Teacher Resources

Books

- Broutin, Christian. *Boats.* A First Discovery Book. New York: Scholastic, 1993.

  Text and illustrations provide examples of boats big and small floating in water.

- Lincoln, Margarette. *Amazing Boats.* New York: A.A. Knopf, 1992.

  An introduction to the history of boats, from simple floating logs and dugout canoes to high-tech fishing boats, icebreakers and floating airports, in text and illustrations.

- *Visual Dictionary of Ships and Sailing.* Eyewitness. New York: Dorling Kindersley, 1991.

  Text, definitions and illustrations provide extensive information about all aspects of ships and sailing.

Web Sites

PBS Teacher Source: Boats
http://www.pbs.org/teachersource/prek2/theme/boats.shtm

Transportation Arts and Crafts Project Ideas
http://www.artistshelpingchildren.org/artscraftsideas.html

HowStuffWorks — Why Can Boats Made of Steel Float on Water ... ?
http://science.howstuffworks.com/question254.htm

Science NetLinks: Sink or Float?
http://www.sciencenetlinks.com/lessons.cfm?BenchmarkID=4&DocID=164

Density is the measure of mass per unit of volume. Pure water is used as the standard to determine the density of an object. An object that will float in water has low density — lower density than the water. A dense object, such as steel or granite, will sink because it has a high ratio of mass to volume. You can change an item's buoyancy (the ability to float) by changing its shape, adding material or chemically altering it. Most modern boats are made of items that are naturally dense, but the boat's shape is such that it floats.

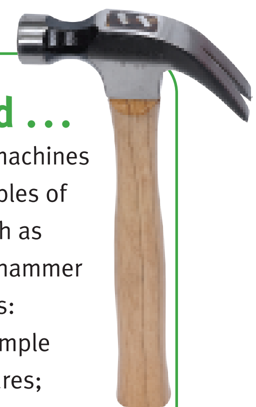
Archimedes' Principle states that flotation depends on water displacement. An object immersed in water is buoyed up by a force equal to the weight of the displaced water. If you displace enough water to equal or exceed your mass, you will float. This is why you sink in water when you curl into a ball but float when stretched out on your back. Increased surface area helps with flotation because it displaces more water.

Lesson 4
Investigate Like a Scientist — ScienceWorks: Construction Zone Explore, Make a Prediction, Investigate!

This lesson provides experiences in the Construction Zone of **ScienceWorks**. Two experiences are provided to prepare students to investigate like a scientist. Students work in their classroom to explore simple machines and structures such as bridges and arches. In the second experience they visit **ScienceWorks** to test, observe and investigate like a scientist.

Vocabulary

- bridge
- catenary arch
- gear
- inclined plane
- lever
- pulley
- simple machine
- structure
- wheel and axle
- work



You will need . . .

Books about simple machines and structures; examples of simple machines, such as scissors, pliers, claw hammer and pulleys; handouts: Construction Zone, Simple Machines and Structures; **Science Journal**.

Time

Two class periods and one day for a museum visit.

Objectives

Students will

- identify a variety of geometric shapes and construct a square and a triangle (K.5.1)
- describe an object by saying how it is similar to or different from another object (K.6.1)
- identify objects that are models and compare them with their real counterparts (1.6.1)
- construct a model structure using classroom materials (2.2.4)
- write brief descriptions that correctly portray key features of an object (2.2.5)
- observe and describe how changing one thing can cause changes in something else (2.5.3)
- recognize and explain that people are more likely to believe ideas if good reasons are given for them (2.5.4)
- identify simple machines
- work in teams to solve a problem

(indicates Indiana Science Standards)

Focus Questions

- Does a simple machine make less work?
- What are different types of simple machines?
- What structures do I know?
- What machines are used to make structures?

Lesson 4: Experience 1
Prepare for a Construction Zone Field Trip

Introduce the phrase “Construction Zone” to the class. Ask students if they have heard either one of those words before. Explain that the Construction Zone at **The Children’s Museum** is a place where visitors explore how simple machines are used to make work easier. The Construction Zone area provides everything that a young scientist needs to test ideas about how things are constructed.

Procedures
Part 1 — Pre-Visit
Work — the Science Way

- Scientists describe work in a special way. Work is the energy or force used to move an object. For example, when you *push* or *move* a rock, work is being done. The energy of your muscles pushing against the rock made it move. Ask students to demonstrate this by pushing a chair. When they push the chair across the classroom, work is being done. Repeat the demonstration while you sit in the chair. You should observe that when a student pushes (uses a force) you still do not move. In this example no work is being done because the object (you in the chair) was not moved. Even though the student pushes hard, no work is done unless the chair moves. Have students try to do work in the classroom by using a force to move objects. They should demonstrate *work* with objects they can move and *no work* with objects that cannot be moved. Have students record the results and make drawings in their **Science Journal**.

Simple Machine Search at School

Object	Type of Simple Machine
Wheels on cart	Wheel and axle
Door handle	Lever
Scissors	Lever
Stair	Inclined plane
Pencil sharpener	Wheel and axle, gears
Door stop	Inclined plane
Window blinds	Pulley
Flagpole	Pulley
Playground slide	Ramp
Teeter-totter	Lever

Indiana’s Academic Standards

Language Arts: K.4.3, K.5.1, K.5.2, K.7.2, 1.5.2, 1.7.10, 2.5.5, 2.7.9

Math: K.3.2, K.4.1, K.6.2, 1.1.10, 1.4.7, 1.6.2, 2.4.1, 2.4.3, 2.6.2

Science: K.6.1, 1.6.1, 2.2.4, 2.2.5, 2.5.3, 2.5.4

Part 2 — Pre-Visit
Simple Machines

- Tell students that there are ways to make work easier by using a simple machine. Share with students books about simple machines. (Several simple machine books are listed at the end of this lesson.) Stress to students that a machine makes work easier. There are many simple machines in our homes and classroom. For example, show the class a pair of scissors. This is an example of a simple machine called a lever. The action of the scissors creates a push (work) to cut through paper. Other examples of levers include: pliers, tongs, stapler and staple remover, nail clippers, and the nail puller on a hammer. Other examples of simple machines include pulleys, wheels and axles, gears and inclined planes. Take your students on a simple machine field trip around the school. Start by identifying some simple machines in your classroom. Tell your students that we use simple machines to make structures. Some examples that students can write in their **Science Journal** are listed on page 32.

Part 3 — Pre-Visit Structures

- Start this lesson by reading aloud a book about structures, such as *Bridges and Tunnels* by Chris Oxlade. Structures are things people build. Structures are built with different materials for different purposes and come in different sizes. A house is a structure that provides a place for us to live. A bridge is a structure that allows us to cross something. Even a paper box or bag is a structure that people build for a purpose. All around us are examples of structures. People use machines to build structures. Have students list and draw pictures of any structure they may have seen on their way to and from school. Their list should include houses, buildings, tunnels, bridges, railroad tracks, roads, barns and other objects.

- Challenge students to make a structure using classroom objects, such as books, art boxes and pencils. Ask students to work together to make a model of a bridge. When the bridge is finished they can test its strength by placing an object on top of it. Have students make drawings in their **Science Journal** of the structures they have seen and the model bridge they built.

Part 4 — Pre-Visit Communicate Like a Scientist

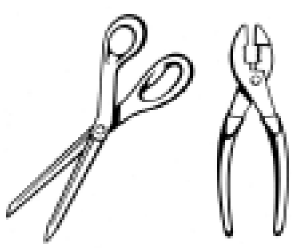
- Ask students to share short science reports with the class that describe what they have learned about simple machines. Encourage them to share the drawings and observations they have made in their **Science Journal**. This will prepare students for their visit to the Construction Zone in the **ScienceWorks** gallery.

Construction Zone
Machines and Work

Machines make work easier but they do not make less work. Work is defined as the force needed to move an object. To decrease the amount of force you need to move an object, you will have to move it over a longer distance. A simple machine reduces the amount of force needed by increasing the distance. A complex machine is any machine that contains more than one simple machine. Some machines are actually altered simple machines. For example, a screw is an inclined plane wrapped around a cylinder, and a doorknob is a wheel and axle that moves a lever and functions as a lever.

Force & Distance
F d = f D

The work is the same! A big FORCE over a small distance is the same as a small force over a big DISTANCE.

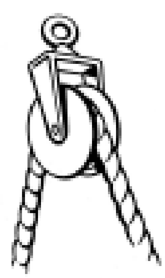


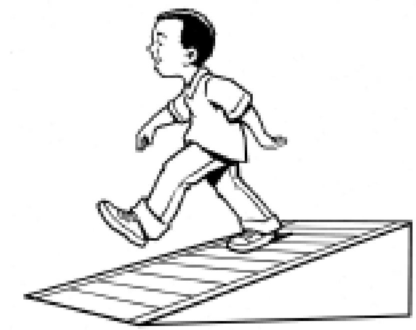
Simple Machines

Lever: A lever is made up of two parts, a bar and a fulcrum. The fulcrum is the point where the bar pivots when force is applied. A wheelbarrow is an example of a lever. There are also levers at the mulch pit and the ball machine in **ScienceWorks**.

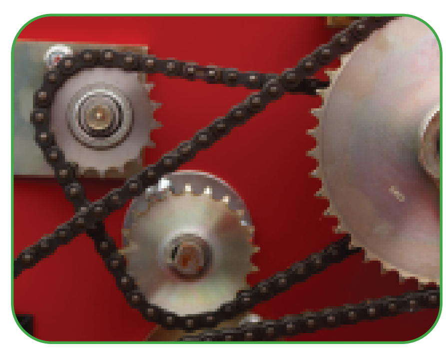
Wheel and Axle: A wheel and axle act like a rotating lever. The center of the wheel is the fulcrum. The outside of the wheel moves a long way, with little effort, but the axle moves a shorter distance. Wheels are on the wheelbarrows and the truck and other vehicles.

Pulley: A pulley is a rope around a wheel and axle. Most people find it easier to pull something down than up, because you can get your entire body weight behind the downward force. You can combine pulleys into a more complex system. More pulleys reduce the load but increase the distance, so it may take longer to move an object. Pulleys can be found at the creek, the block mover and the crane tower.





Inclined Plane: A ramp is a simple machine. A ramp can be used to move an object to a higher location. For example, you can walk up the stairs (this is a type of inclined plane) to the top floor in a building. Or you could climb a tall ladder straight up to the top. Both ways — the ladder and the stairs — take you to the same place. When you use the ladder the distance is shorter but harder to climb. When you use the stairs the distance is longer but easier to climb. An inclined plane lengthens the distance between two points by creating a slope but decreases the amount of effort needed to move a load between two points. A wedge is a movable inclined plane. In the gallery, inclined planes are found in the wheel-barrow ramps in the rock quarry. The ramp around the core of **The Children's Museum** is one large inclined plane.



Gears: Wheels with teeth. Wheels not only change the force used but also can change the direction of force. The gears in the crane tower are exposed so visitors can see them work.

Lesson 4: Experience 2
Construction Zone at ScienceWorks

In this experience students visit **ScienceWorks** to observe, test and investigate simple machines and structures. Students use skills and strategies to investigate like a scientist. Students will identify simple machines and how they help us work to build structures. **ScienceWorks** is a popular place, so divide students into Science Teams and assign parent volunteers to each team for the museum visit. Students will use what they discovered in their science reports and classroom presentations.

Procedures
Part 1 — Pre-Visit
The Construction Zone Field Trip

- Review with the students what they observed and discovered in the first investigation. Remind them that the Construction Zone at **The Children's Museum** is a place where visitors can build different structures.

Part 2 — At ScienceWorks
Simple Machine Search

- Take students on a short tour of **ScienceWorks**. Stop in the Construction Zone. Allow students time to explore the area. Teachers may want to rotate students through Construction Zone investigations. The Construction Zone area provides everything that a young scientist needs to test ideas about how things are constructed.

- Examples of simple machines are located throughout the Construction Zone. Students should search for simple machines and draw examples in their **Science Journal**. Each Science Team should find one or more examples of an inclined plane, a wheel and axle, a pulley, a gear and a lever. Students can use the "Construction Zone Simple Machines and Structures" handout, provided on page 57, to record observations and complete investigations. Encourage students to find one or more examples of each type of simple machine. Students should investigate how one simple machine is like and different from another.

Part 3 — At ScienceWorks
Build a Structure

- The catenary arch is located at the entrance to the Construction Zone. Students must work as a team to stack the blocks to form an arch. A parent volunteer is needed to assist with the project. Begin by reading aloud the sign at the Arch. It paraphrases a quote from Leonard da Vinci: "An arch consists of two weaknesses that, when leaning against each other, become a strength." Parent volunteers can supervise the students. The arch cannot be constructed by individual students working alone. Students must work as a team to problem-solve and create the arch. Once the arch is complete, ask students to draw the structure on the "Construction Zone Simple Machines and Structures" handout.

- The catenary arch consists of 13 numbered blocks with the middle block called the keystone. A catenary is the shape made by a chain or rope hanging freely between two points. The catenary arch is a stable structure because of the direction of forces. The size of the blocks and the force of the blocks pushing down and against each other must be perfectly balanced to maintain the arch shape.

Indiana's Academic Standards

Language Arts: K.4.3, K.5.1, K.5.2, K.7.2, 1.5.2, 1.7.10, 2.5.5, 2.7.9

Math: K.3.2, K.4.1, K.6.2, 1.1.10, 1.4.7, 1.6.2, 2.4.1, 2.4.3, 2.6.2

Science: K.5.1, K.6.1, 1.6.1, 2.2.5, 2.5.3

Lesson 4: Assessment
Student Science Conference: Science Journal

Once students complete the lessons you can assess their performance in a student conference. During the conference students share their **Science Journal** and **ScienceWorks** investigation. The purpose of the student-led conference is to show the students a way to self-evaluate their science work. In the Science Conference students give examples of how they work like a scientist. A student-led science conference transfers the responsibility of thinking and working like a scientist from the teacher to the student.

Assessment for Nonreaders

Students in kindergarten may have difficulty with writing science words and questions. Experienced teachers use strategies such as reading material aloud, assisting with writing and using older students and adult volunteers to mentor in the classroom. Another method is to provide visual keys or pictures that represent science words. The student forms can be modified or teachers can use the "My Science Conference Checklist," found on page 58, during the conference, filling in the material as the student explains the science. The checklist can be used for nonreaders.

Teachers and students use their **Science Journal** and the "Science Conference Teacher Evaluation Checklist," on page 50, to present and explain their own work on simple machines and structures in the Construction Zone. For information about conducting a good conference and useful handouts, see pages 48-49.

Teacher Resources
Books

- Armentrout, David and Patricia. *How Can I Experiment With—? An Inclined Plane*. Vero Beach, FL: Rourke Publishing 2003.
  Text and photos provide many different examples of inclined planes and how they make work easier.

- Haslam, Andrew, and David Glover. *Building* (Make it Work!). New York: Thomson Learning, 1994.
  An activity book with text, illustrations and directions for student engineering projects.

- Oxlade, Chris. *Bridges and Tunnels.* New York: Franklin Watts, 1994.
  Activities, text, photos and illustrations provide examples of modern and historical bridges and tunnels.

- Rockwell, Anne and Harlow. *Machines.* New York: Macmillan, 1972.
  Text and watercolor illustrations introduce simple and complex machines.

- Simon, Seymour, and Nicole Fauteux. *Let's Try It Out With Towers and Bridges*. Hands-On Early-Learning Science Activities. New York: Simon & Schuster Books for Young Readers, 2003.
  Construction technique activities that demonstrate how towers and bridges are used.

- Walker, Sally M., and Roseann Feldmann. *Pulleys.* Minneapolis, MN: Lerner Publications, 2002.
  Text and photos provide many different examples of pulleys and how they help simple machines

Science Vocabulary

The following is a list of common science terms used by educators. Many of the terms listed are compiled from Alan Colburn's *The Lingo of Learning, 88 Terms Every Science Teacher Should Know*. This is an excellent book to better understand terms used in elementary science programs. The glossary at the end of this unit contains definitions of the science terms listed. Knowing these terms will help make your classroom the most popular place for science in your school.

- Guided inquiry
- Discrepant event
- Scientific method
- Inference
- Observation
- Evidence
- Hypothesis
- Theory
- NSTA — National Science Teachers Association
- HASTI — Hoosier Association of Science Teachers, Inc.

Web Sites

Science Netlinks: Making Objects Move
http://www.sciencenetlinks.com/lessons.cfm?BenchmarkID=12&DocID=35

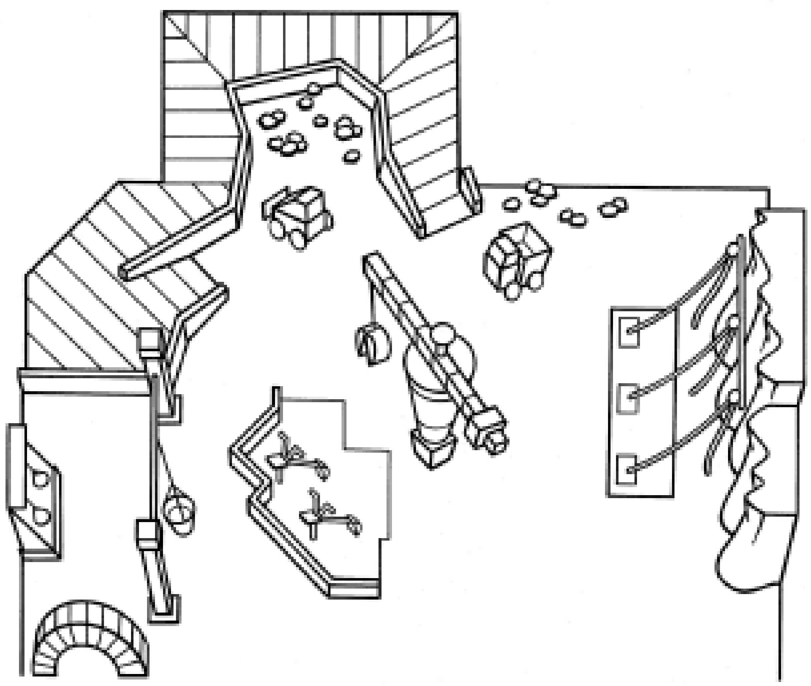
Edheads — Simple Machines Activities: Lever
http://edheads.org/activities/simple-machines/

MIKIDS — Simple Machines
http://www.mikids.com/Smachines.htm

Simple Machines (a bibliography of Web sites)
http://edtech.kennesaw.edu/web/simmach.html

Simple Machine Web Quest by Susie Throop
http://webtech.kennesaw.edu/sthroop/machinequest.htm

The Construction Zone at The Children's Museum



ScienceWorks opened in 1996 with a "working" construction site. Three years later, the popular T.V. show "Bob the Builder" premiered. Kids love construction. It may be the bright colors or the cool machines or the idea of being able to play in the dirt, but kids of all ages love construction machines and tools. The familiar sights in the Construction Zone help visitors relate concepts presented in **ScienceWorks** to science in their own lives.

The Catenary Arch

The Construction Zone is located past the Creek and starts with the Catenary Arch. The Catenary Arch consists of 13 blocks. A catenary is the shape made by a chain or rope hanging freely between two supports. It is not a parabola, even though it looks like one. The catenary is a stable structure because of the direction of forces. When you stack blocks in a straight column, gravity is the only force acting on the blocks. In an arch, gravity is pulling the blocks at a rate proportional to the distance from the ground, but there is also force from the blocks above pushing down and out, and from the blocks below pushing in. These forces must be perfectly balanced to maintain the arch shape. The top blocks are generally smaller, helping the arch form properly, but also causing what is known as a weighted catenary, which is similar to the Gateway Arch in St. Louis, Mo. A sign at the Catenary Arch displays a paraphrased quote from Leonardo da Vinci: "An arch consists of two weaknesses that, when leaning against each other, become a strength." This helps illustrate the real lesson about the arch. Students may not understand the physics of a catenary arch but will understand the idea of teamwork. The arch cannot be constructed alone. Students must work as a team to problem-solve and create the arch.

The Mulch Pit

The Mulch Pit is an area where diggers and toy trucks can be used to move rubber mulch from one place to another. The mulch used in the pit is the subject of many questions. It is made from recycled tires and dyed to look natural. The material is hypoallergenic and contains no latex or derivatives. It does not stain clothing or cause dust. The mulch is available through many distributors. For more information, visit www.rubberific.com.

The Galaxy Builder

The Galaxy Builder helps with hand-eye coordination. On a higher cognitive level, these constructive toys help children learn through experience about stable structures and strength in shapes. The EduBlocks are soft polyurethane blocks that students use to build structures.

The Pulley Exhibit

The Pulley exhibit consists of two weights, each connected to its own pulley system. One weight is attached to a single pulley, a rope going over one wheel. The other is attached to a block and tackle system with four pulleys. Visitors are invited to discover which weight is easier to lift. One machine system is easier to pull but takes longer to pull than the heavier system. In physical science, work is defined as a force moving a mass across a distance ($W = f \chi d$). It is important for students to understand that they are not doing work unless they use energy to move something.

The Construction Zone

The Construction Zone area contains the KiddyKat, the dump truck, inclined planes, rubber rocks, wheelbarrows and a crane. It is a high-energy, noisy play area and a great place to do physical science.

Culminating Experience
Communicate Like a Scientist
Explore, Make a Prediction, Investigate!

Getting Started

This culminating experience provides an opportunity for students to use another science skill: communication. Students should complete Experiences 1 and 2 in Lesson 2, 3 or 4 before this experience. Students use the topic or object they observed at **ScienceWorks** to complete this experience. Teachers present a science report and use a science rubric to model the process for students. Students will work in Science Teams and use a Venn diagram to compare and contrast their discoveries. Students will use the "My Science Report" form to present science ideas, observations, results and discoveries to their class. Teachers and students assess student presentations using a Science Report Rubric.

Early Readers and Nonreaders

Teachers may find it more useful to assess students' science abilities by conducting one-on-one interviews. Early readers and nonreaders should use their **Science Journal** drawings, words and observations in the interview. Teachers complete the Science Report Rubric, found on page 60, with each student during the interview, allowing the student to provide examples and the teacher to record them on the handout. Teachers then adapt the scoring rubric levels of *partial*, *essential* and *excellent* to the student's work.

You will need . . .

Completed Lesson 1 and one other completed Lesson (2, 3 or 4); handouts: My Science Report, My Science Investigation Venn Diagram and Science Report Rubric; **Science Journal.**

Procedures

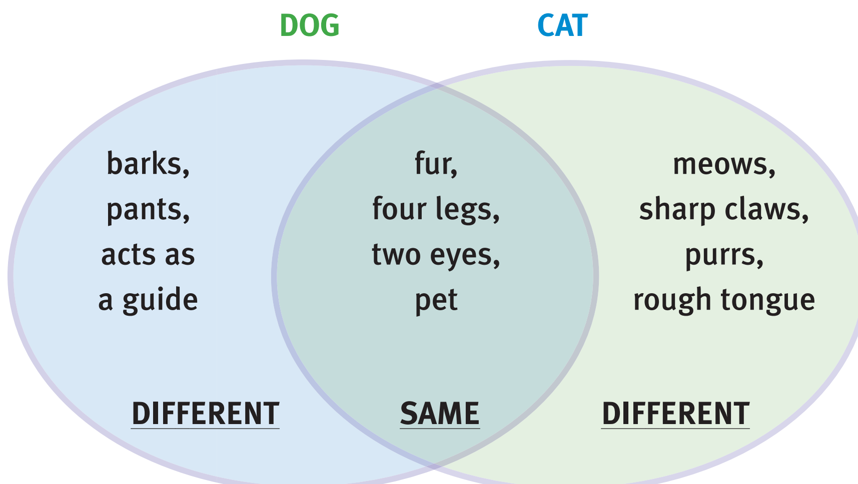
Step 1 — My Science Report

- Create Science Teams of two students each. Match students who worked on the same area in **ScienceWorks**, such as the Indiana Pond, pairing one who studied a plant with one who studied an animal. They will compare and contrast their observations and discoveries. In the Dock Shop and Construction Zone, students created boats or used machines. Match students who created different types of boats or who made different types of machines. Students work together to make a science report to present to the class. Duplicate "My Science Report," found on page 59, so each student has a copy. Work with students to help complete the report. The completed report should be put into their **Science Journal**. Meet with each Science Team to review their report and **Science Journal**. Suggest ways to improve their information and notes. Students should practice presenting their science report to their Science Team partners.

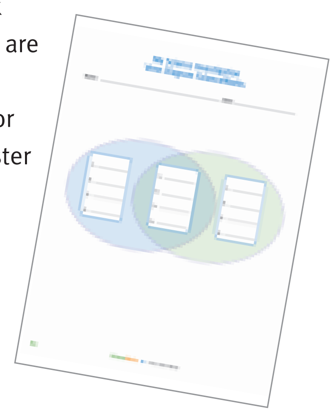
Step 2 — Venn Diagram

- Write the words "dog" and "cat" across from each other on the board. Ask students to list things about each animal. Write "barks" under the dog and "meows" under the cat. Ask students where they would put "four legs" on the board. Put it under "cat" and then erase it and put it under "dog." Students should respond by saying it should go under both headings because both animals have four legs. Rewrite it under the "cat" heading so that both headings list "four legs" under the title. Explain to students that scientists use a special diagram or drawing to show how two things are alike and different. It is called a Venn diagram. On the board draw a Venn diagram by making two circles that overlap. Write "Venn Diagram" above the drawing. Point out to the class that things that are different between two things are listed in the big circles, and things they have in common go inside the middle, overlapping area. Now draw a large circle around the "cat" list and another large circle around the "dog" list. Make sure to leave an overlapping area in the middle. Label this area "same" or "alike." Ask students what can be put in this area. They should respond with "four legs." Write "four legs" in the overlapping area. Then erase "four legs" from the cat list and the dog list. Ask students to continue naming things about each animal. Discuss where each trait should be written — in the cat list, in the dog list or in the "same" or "alike" area. For example, "tail," "pet" and "two eyes" should be written in the area where the circles overlap. Other items that are unique to a cat and a dog go in that specific circle.

Venn Diagram: Dog and Cat



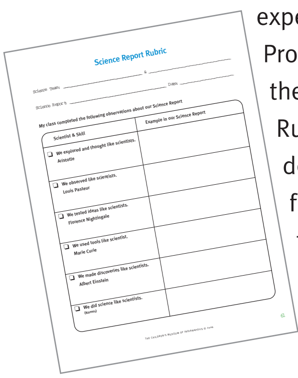
- Ask students to work with their Science Team partner to make a Venn diagram. They should work together to list ways their topics are alike and different. Each student makes one Venn diagram in his or her **Science Journal**. Provide poster paper for students to make the team Venn diagram for the class report. Practice making a Venn diagram with other pairs of objects. Use the "My Science Investigation Venn Diagram" handout, found on page 61, and have students copy their completed work into their Science Journal.

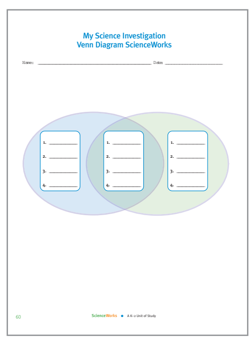


Assessment
Science Reports and Scoring Rubric

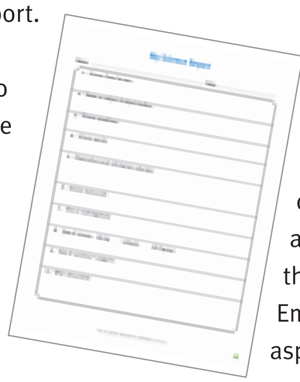
Science Report

- Each team presents their completed information to the class. Ask them to describe how their study objects are alike and how they are different using their **Science Journal**. Tell students that scientists share what they have discovered by giving reports. They give reports to other scientists. This is one way new discoveries are reported and checked for accuracy. The teacher should model a science report for the students. Teachers use their **Science Journal** and notes to present a science report. Follow the same steps that students are expected to complete. Provide students with the Science Report Rubric. This rubric is designed to be a fun way to provide feedback about the reports. Ask the class to use the "Science Report Rubric" to give you feedback about your teacher report. Model how to provide examples to complete the Science Report Rubric. Tell students that together the class will complete a Science Report Rubric for each science report.





- Allow each Science Team to present their findings to the class. Students should use and share their **Science Journal**, Venn diagram and "My Science Report" chart in the class presentation. They can each give a short oral report about the questions they asked, the observations they made and what they discovered or learned. Then together they can show the Venn diagram they made about their study object.



- Provide each team with a copy of the Science Report Rubric. Work together with the class to provide feedback as they work to complete the Science Report Rubric. Emphasize all the good aspects of the oral presentations. The goal is to provide positive feedback for the Science Team. Work to provide at least one example for each section of the rubric. Check off each box as a student provides observations about the student reports. Famous scientists are used to represent various science skills. Remind students that students and even teachers can question, explore, test, use tools and discover new things just like a scientist.

Criteria for Success

- This rubric provides a framework for evaluating the student's ability to make observations, test ideas and complete scientific investigations. The culminating experience will be evaluated based on a student's ability to use science processes and skills learned. The following criteria will be used.

Students demonstrate the ability to

- Explore and think like a scientist
- Ask questions like a scientist
- Observe like a scientist
- Record data and observations like a scientist
- Test ideas like a scientist
- Use tools like a scientist
- Understand units of measurement like a scientist
- Make discoveries like a scientist

Scoring Rubric

Teachers should work with students to evaluate and score their science reports using the “Science Report Rubric” student handout. During their reports, students will identify examples of how they can do science. Evaluations are collaborative, allowing all students to help reinforce science processes used in the lessons. Student progress can be identified at three distinct levels: partial, essential and excellent.

Partial:

- Generates no questions
- Records minimal observations in the **Science Journal**
- Uses a science tool with limited success
- Makes one science discovery
- Does not demonstrate understanding that he or she can do science

Essential:

- Generates one or two questions
- Records careful observations in the **Science Journal**
- Demonstrates a good command of three or more science tools
- Uses units of measurement correctly
- Makes personal discoveries and relates them to the experience
- Gives personal examples of doing science

Exceptional:

- Asks numerous questions
- Sees relationships between questioning and learning
- Records unique observations in the **Science Journal**
- Relates questions to observations made in the investigation
- Shows excellent command of tools, measurements and other sensory input
- Makes unique discoveries and is self-motivated to make more
- Gives multiple examples of ways to do science in everyday settings

Teacher Resource
Scientists in the Science Report Rubric

- **Aristotle** was one of the first scientists. He represents **exploring** and **thinking** like a scientist.
  The Internet Encyclopedia of Philosophy
  http://www.utm.edu/research/iep/a/aristotl.htm

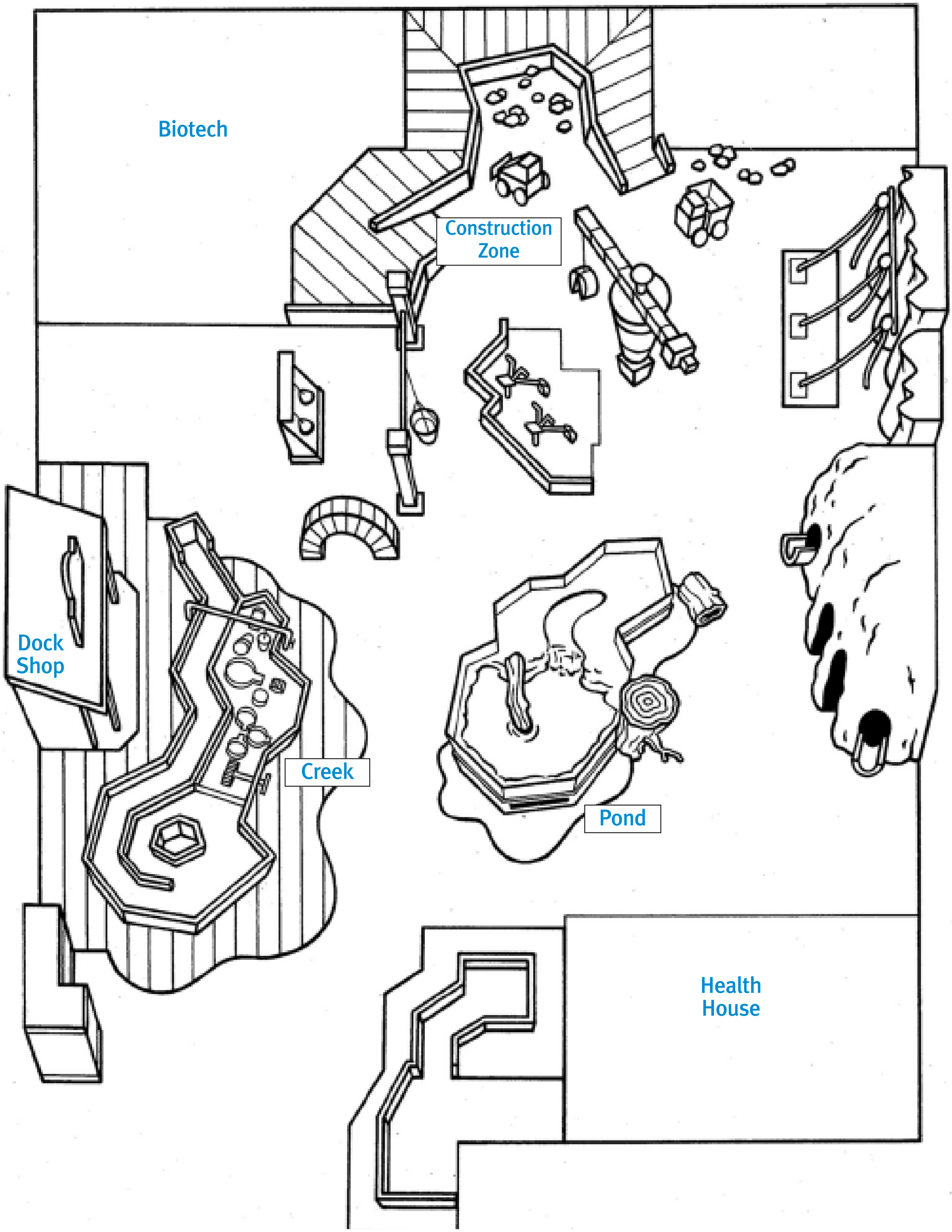
- **Louis Pasteur** made careful observations and solved many science mysteries. He represents **observing** like a scientist.
  Access Excellence, The National Health Museum
  http://www.accessexcellence.org/RC/AB/BC/Louis_Pasteur.html

- **Florence Nightingale** tested her ideas about germs and hygiene. She represents **“testing”** like a scientist.
  The Florence Nightingale Museum
  http://www.florence-nightingale.co.uk/flo2.htm

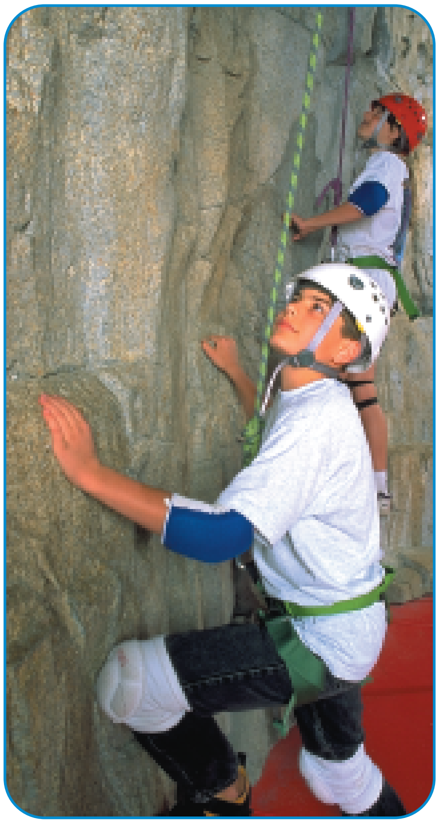
- **Marie Currie** used many science tools to make discoveries. She represents **using tools** like a scientist.
  American Institute of Physics
  http://www.aip.org/history/curie/

- **Albert Einstein** made many great science discoveries. He represents **discovering** like a scientist.
  Albert Einstein Online
  http://www.westegg.com/einstein/

ScienceWorks Map



Other ScienceWorks Areas



Mt. Pittman Rock Climbing Wall

The rock-climbing wall is one of the most popular attractions in **ScienceWorks**. Combining the science of climbing with safety, teamwork and problem solving, the wall presents a mental and physical challenge to all that attempt it. The experience is one that will stay with children and parents for many years to come.

Borden Sea Floor Fossil and Fossil Wall

One of the most impressive pieces in the gallery is a large (1.5 x 2 meters) limestone slab with amazingly well-preserved and -prepared Indiana fossils from over 330 million years ago. The rock is from the geologic era known as the Mississippian Period. The rock slab, from Crawfordsville, Ind., shows several fossilized animals called crinoids. This period is also called the “Age of the Crinoids” because these creatures were so abundant in the seas then. Crinoids are often referred to as “sea lilies” because they look so much like plants, but they are actually animals called echinoderms. Echinoderms are a group of marine creatures that includes sea stars (starfish), crinoids, sand dollars, sea cucumbers and sea urchins. Even though the crinoids preserved in the limestone rock have stems and rootlike attachments, they are really animals. Crinoids are not extinct; they survive today. Stemless crinoids, called feather stars, are commonly seen by scuba divers in places such as the Caribbean and the South Pacific. Crinoids with stems live in deep water and have been discovered off the coasts of Japan and Bermuda. Although crinoids are extremely common in the fossil record, it’s rare to find the entire creature intact. Usually after a crinoid dies its parts simply crumble and float away. You can go to many sites in Indiana and see limestone made up of millions of broken crinoid fragments. These stem pieces are often incorrectly called “Indian beads” because of their hollow centers. The limestone slab in **ScienceWorks** has 17 different species of crinoids, many of which are complete forms. Also preserved in this rock are some starfish, sponges and coral, a gastropod, a brachiopod and a small sea urchin (echinoid).

ScienceWorks has many unique areas to explore and make science discoveries including the Ball Machine, Garage, Nature’s Backyard and Fall Creek Watershed.

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  Text and photos provide many different examples of inclined planes and how they make work easier.

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  Text and illustrations provide examples of boats big and small floating in water.

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- Fowler, Allan. *Life in a Pond*. Rookie Read-About Science. New York: Children's Press, 1996.
  Introduces the animal and plant life in and around ponds through text and photos.

- Ganeri, Anita. *Ponds and Pond Life*. Nature Detective. New York: Franklin Watts, 1993.
  Introduces pond life through the seasons by looking at the insects, mammals, birds and flowers that live in and around ponds.

- Haslam, Andrew, and David Glover. *Building* (Make it Work!). New York: Thomson Learning, 1994.
  An activity book with text, illustrations and directions for student engineering projects.

- Lincoln, Margarette. *Amazing Boats*. New York: A.A. Knopf, 1992.
  An introduction to the history of boats, from simple floating logs and dugout canoes to high-tech fishing boats, icebreakers and floating airports, in text and illustrations.

- Morrison, Gordon. *Pond*. Boston: Houghton Mifflin, 2002.
  Examines how a glacial pond and the abundance of plants and animals that draw life from it change over the course of a year.

- *NSTA Pathways to the Science Standards: Guidelines for Moving the Vision Into Practice, Elementary School Edition*, 2nd ed., eds. Lawrence F. Lowery, et al. 3 vols. Arlington, VA: NSTA Press, 2000.

- Oxlade, Chris. *Bridges and Tunnels*. New York: Franklin Watts, 1994.
  Activities, text, photos and illustrations provide examples of modern and historical bridges and tunnels.

- Reid, George. *Pond Life: A Guide to Common Plants and Animals of North American Ponds and Lakes,* rev. ed. New York: St. Martin's Press, 2001.
  Text and drawings provide concise information about plants, animals and insects found in a pond.

- Rockwell, Anne and Harlow. *Machines*. New York: Macmillan, 1972.
  Text and watercolor illustrations introduce simple and complex machines.

- *Scientific American Science Desk Reference*. New York: John Wiley & Sons, 1999.

- Silver, Donald. *Pond*. New York: Learning Triangle Press/McGraw-Hill, 1994.
  An up-close look at mammals, insects, plants, birds, fish, amphibians, bacteria and the ecosystems in a pond through drawings, diagrams and text.

- Simon, Seymour, and Nicole Fauteux. *Let's Try It Out With Towers and Bridges*. Hands-On Early-Learning Science Activities. New York: Simon & Schuster Books for Young Readers, 2003.
  Construction technique activities that demonstrate how towers and bridges are used.

- *Visual Dictionary of Ships and Sailing*. Eyewitness. New York: Dorling Kindersley, 1991.
  Text, definitions and illustrations provide extensive information about all aspects of ships and sailing.

- Walker, Sally M., and Roseann Feldmann. *Pulleys*. Minneapolis, MN: Lerner Publications, 2002.
  Text and photos provide many different examples of pulleys and how they help simple machines work.

Web Sites

Students, teachers and parents can find useful science information on the following Web sites.

The Children's Museum of Indianapolis
http://www.childrensmuseum.org

National Science Teachers Association, NSTA
http://www.nsta.org

Hoosier Association of Science Teachers, Inc., HASTI
http://www.hasti.org

National Science Resource Center, The National Academies and Smithsonian Institution, NSRC
http://www.nsrconline.org/

HowStuffWorks — Learn How Everything Works!
http://www.howstuffworks.com/

Science Project Ideas, Information and Support
http://www.scienceproject.com/

American Museum of Natural History Presents OLogy
http://ology.amnh.org/

The Art and Science of Investigation: Observation and Inference
http://www.units.muohio.edu/dragonfly/teach/barman.htmlx

Observations at the Pond
http://oregonstate.edu/precollege/GK12/Activities/ACT_EnvironStudies/ENVIRON_68_PondObservations/PondObservations.html

ExplorA-Pond
http://www.uen.org/utahlink/pond/

Pond Life Animal Printouts — Enchanted Learning
http://www.enchantedlearning.com/biomes/pond/pondlife.shtml

Pond Explorer (A Virtual Pond Dip)
http://www.naturegrid.org.uk/pondexplorer/pondexplorer.html

Create a Pond (A Virtual Pond Activity)
http://www.geocities.com/sseagraves/createapond.htm

PBS Teacher Source: Boats
http://www.pbs.org/teachersource/prek2/theme/boats.shtm

Transportation Arts and Crafts Project Ideas
http://www.artistshelpingchildren.org/transportationartscraftstvehiclescarstrucksboatstrainskids.html

HowStuffWorks — Why Can Boats Made of Steel Float on Water ... ?
http://science.howstuffworks.com/question254.htm

Science NetLinks: Sink or Float?
http://www.sciencenetlinks.com/lessons.cfm?BenchmarkID=4&DocID=164

Science Netlinks: Making Objects Move
http://www.sciencenetlinks.com/lessons.cfm?BenchmarkID=12&DocID=35

Edheads — Simple Machines Activities: Lever
http://edheads.org/activities/simple-machines/

MIKIDS — Simple Machines
http://www.mikids.com/Smachines.htm

Simple Machines (a bibliography of Web sites)
http://edtech.kennesaw.edu/web/simmach.html

Simple Machine Web Quest by Susie Throop
http://webtech.kennesaw.edu/sthroop/machinequest.htm

The Internet Encyclopedia of Philosophy
http://www.utm.edu/research/iep/a/aristotl.htm

Access Excellence, The National Health Museum
http://www.accessexcellence.org/RC/AB/BC/Louis_Pasteur.html

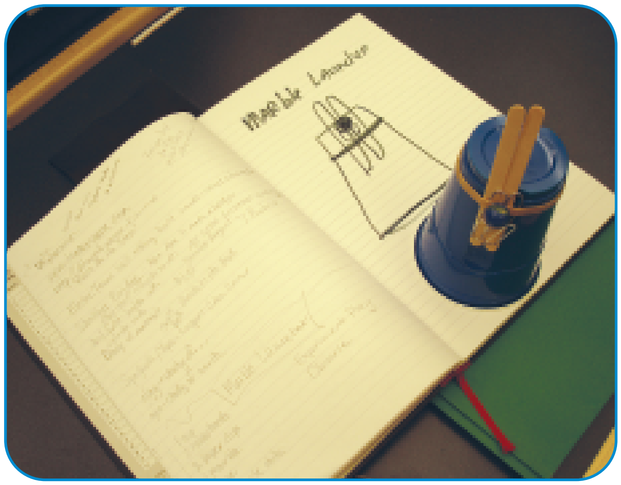
The Florence Nightingale Museum
http://www.florence-nightingale.co.uk/flo2.htm

American Institute of Physics
http://www.aip.org/history/curie/

Albert Einstein Online
http://www.westegg.com/einstein/

Science Glossary

Teachers benefit from understanding the vocabulary used in science education. There are many ways to participate in science and many ways to teach it. The following is a list of common science terms that all teachers should understand. The list was compiled from Alan Colburn's *The Lingo of Learning, 88 Terms Every Science Teacher Should Know*. Knowing these terms will help make your classroom the most popular place for science in your school.



A **guided inquiry activity** is one in which the teacher gives students the problem to investigate and the materials to use. Students must determine the procedure for the investigation and then generalize from the data collected.

Creating a **discrepant event** can be a surprising and motivating way to introduce a science principle. For example, using a concealed magnet to make an object appear to float will certainly hold students' attention. The demonstration does not appear to follow basic rules on how things are supposed to behave. Students will want to know how this works. The demonstration is useful to start a class and to generate good follow-up activities. A good discrepant event will force students to question ideas and explanations. It may help lead to better understanding of scientific principles or to the awareness and rejection of science misconceptions.

The **Scientific Method** is often incorrectly used to imply that there is only one path to scientific knowledge. Students and scientists may follow different paths in an investigation to generate evidence to support an idea. "Scientific method" describes the ways scientists solve problems — making observations, drawing conclusions, and testing and evaluating ideas.

Science teachers look for ways to help students distinguish between **inferences** and **observations**. An observation represents information taken directly through the eyes, ears or other sense organs or through instruments that extend the senses. Inferences are observations combined with the observer's prior knowledge or biases. For example, "I see a red crayon," is an example of an inference. "I see a cylindrically shaped object, red in color, with a length of 5 centimeters," is an example of an observation. The goal is to teach students to observe in ways that are as free from bias as possible.

Empirical Data are based on direct observation and experimentation. If a conclusion is not based on empirical data it is not scientific.

Evidence can be either direct or indirect. **Direct evidence** is what a student directly observes that supports a conclusion. For example, direct evidence is when water is heated to 100°C and observed to boil. **Indirect evidence** is circumstantial yet very important to science. All evidence of past events is indirect, such as fingerprints or dinosaur behavior.

A **hypothesis** means different things depending on how the word is used. It can mean any tentative scientific conclusion that includes patterns or trends in data and an explanation for the observed pattern or trends. **Hypothesis** can also be used in a nonscientific way to mean *prediction*. A true scientific hypothesis is different from a prediction. For example: "Thicker paper towels have more spaces to hold liquid" is an explanatory scientific hypothesis. "Because Brand X is the thickest paper towel available, it will hold the most liquid" is a nonscientific prediction.

In science, a **theory** is a widely accepted explanation. Theories are well-supported by data but differ from the data or generalizations that come from data. Outside of science, a "theory" is a tentative idea. Use of the phrase "scientific theory" will help students understand the difference.

Indiana's Academic Standards

Kindergarten Language Arts Standards
K.1.20 Identify and sort common words in basic categories.
K.4.3 Write using pictures, letters, and words.
K.5.1 Draw pictures and write words for a specific reason.
K.5.2 Draw pictures and write for specific people or persons.
K.7.2 Share information and ideas, speaking in complete, coherent sentences.

Grade 1 Language Arts Standards
1.5.2 Write brief expository (informational) descriptions of a real object, person, place, or event, using sensory details.
1.7.10 Use visual aids, such as pictures and objects, to present oral information.

Grade 2 Language Arts Standards
2.5.5 Use descriptive words when writing.
2.7.9 Report on a topic with supportive facts and details.

Kindergarten Math Standards
K.1.9 Record and organize information using objects and pictures.
K.3.2 Identify, copy, and make simple patterns with numbers and shapes.
K.4.1 Identify and describe common geometric objects: circle, triangle, square, rectangle, and cube.
K.5.1 Make direct comparisons of the length, capacity, weight, and temperature of objects and recognize which object is shorter, longer, taller, lighter, heavier, warmer, cooler or holds more.
K.6.2 Use tools such as objects or drawings to model problems.

Grade 1 Math Standards
1.1.10 Represent, compare, and interpret data using pictures and picture graphs.
1.4.7 Identify geometric shapes and structures in the environment and specify their location.
1.5.4 Measure and estimate the length of an object to the nearest inch and centimeter.
1.6.2 Use tools such as objects or drawings to model problems.

Grade 2 Math Standards
2.4.1 Construct squares, rectangles, triangles, cubes, and rectangular prisms with appropriate materials.
2.4.3 Investigate and predict the result of putting together and taking apart two-dimensional and three-dimensional shapes.
2.5.1 Measure and estimate length to the nearest inch, foot, yard, centimeter, and meter.
2.6.2 Use tools such as objects or drawings to model problems.

Kindergarten Science Standards
K.1.1 Raise questions about the natural world.
K.1.2 Begin to demonstrate that everybody can do science.
K.2.2 Draw pictures and writes words to describe objects and experiences.
K.3.2 Investigate that things move in different ways, such as fast, slow, etc.
K.4.1 Give examples of plants and animals.
K.4.2 Observe plants and animals, describing how they are alike and how they are different in the way they look and in the things they do.
K.5.1 Use shapes, such as circles, squares, rectangles and triangles, to describe different objects.
K.6.1 Describe an object by saying how it is similar to or different from another object.

Grade 1 Science Standards
1.1.1 Observe, describe, draw and sort objects carefully to learn about them.
1.1.2 Investigate and make observations to seek answers to questions about the world, such as "In what ways do animals move?"
1.1.4 Use tools, such as rulers and magnifiers, to investigate the world and make observations.
1.2.5 Demonstrate that magnifiers help people see things they could not see without them.
1.2.6 Describe and compare objects in terms of number, shape, texture, size, weight, color and motion.
1.2.7 Write brief informational descriptions of a real object, person, place or event using information from observations.
1.3.4 Investigate by observing and then describe how things move in many different ways, such as straight, zigzag, round-and-round and back-and-forth.
1.4.2 Observe and describe that there can be differences, such as size or markings, among the individuals within one kind of plant or animal group.
1.4.4 Explain that most living things need water, food and air.
1.6.1 Observe and describe that models, such as toys, are like the real things in some ways but different in others.

Grade 2 Science Standards
2.1.1 Manipulate an object to gain additional information about it.
2.1.2 Use tools, such as thermometers, magnifiers, rulers or balances, to gain more information about objects.
2.1.3 Describe, both in writing and orally, objects as accurately as possible and compare observations with those of other people.
2.2.4 Assemble, describe, take apart and/or reassemble constructions using such things as interlocking blocks and erector sets. Sometimes pictures or words may be used as a reference.
2.2.5 Draw pictures and write brief descriptions that correctly portray key features of an object.
2.3.7 Investigate and observe that the way to change how something is moving is to give it a push or a pull.
2.4.1 Observe and identify different external features of plants and animals and describe how these features help them live in different environments.
2.5.3 Observe that and describe how changing one thing can cause changes in something else such as exercise and its effect on heart rate.
2.5.4 Begin to recognize and explain that people are more likely to believe ideas if good reasons are given for them.

National Science Standards (Grades K–4)

Science Content Standard 6
Understands relationships among organisms and their physical environment.
Level Pre-K (Grades Pre-K)
• Understands that living things have similar needs (e.g., water, food).
Level I (Grades K–2)
• Knows that plants and animals need certain resources for energy and growth (e.g., food, water, light, air)
• Knows that living things are found almost everywhere in the world and that distinct environments support the life of different types of plants and animals.

Science Content Standard 8
Understands the structure and properties of matter.
Level Pre-K (Grades Pre-K)
• Knows vocabulary used to describe some observable properties (e.g., color, shape, size) of objects.
• Sorts objects based on observable properties.
• Knows that the physical properties of things can change.
Level I (Grades K–1)
• Knows that different objects are made up of many different types of materials (e.g., cloth, paper, wood, metal) and have many different observable properties (e.g., color, size, shape, weight).

Science Content Standard 11
Understands the nature of scientific knowledge.
Level I (Grades K–2)
• Knows that scientific investigations generally work the same way in different places and normally produce results that can be duplicated.

National Standards for Science Education (Grades K–4)

Content Standard A — Scientific Inquiry (Grades K–4)
Fundamental concepts and principles that underlie this standard include scientific inquiry:
• Ask a question about objects, organisms, and events in the environment.
• Plan and conduct a simple investigation.
• Employ simple equipment and tools to gather data and extend the senses.
• Use data to construct a reasonable explanation.

Content Standard B — Physical Science (Grades K–4)
Fundamental concepts and principles that underlie this standard include physical science:
• Properties of objects and materials — Objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances. Those properties can be measured using tools, such as rulers, balances, and thermometers.
• Positions of motion of objects — Objects are made of one or more materials, such as paper, wood, and metal. Objects can be described by the properties of the materials from which they are made, and those properties can be used to separate or sort a group of objects or materials.

Content Standard D — Earth and Space Science (Grades K–4)
Fundamental concepts and principles that underlie this standard include
Properties of Earth materials:
• Earth materials are solid rocks and soils, water, and the gases of the atmosphere. The varied materials have different physical and chemical properties, which make them useful in different ways, for example, as building materials, as sources of fuel, or for growing the plants we use as food. Earth materials provide many of the resources that humans use.
• Soils have properties of color and texture, capacity to retain water, and ability to support the growth of many kinds of plants, including those in our food supply.
• Fossils provide evidence about the plants and animals that lived long ago and the nature of the environment at that time.
Changes in the earth and sky:
• The surface of the earth changes. Some changes are due to slow processes, such as erosion and weathering, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.
• Weather changes from day to day and over the seasons. Weather can be described by measurable quantities, such as temperature, wind direction and speed, and precipitation.

Content Standard F — Personal and Social Perspectives (Grades K–8)
Fundamental concepts and principles that underlie this standard include Personal and Social Perspectives:

Science and technology in local challenges:
• People continue inventing new ways of doing things, solving problems, and getting work done. New ideas and inventions often affect other people; sometimes the effects are good and sometimes they are bad. It is helpful to try to determine in advance how ideas and inventions will affect other people.
• Science and technology have greatly improved food quality and quantity, transportation, health, sanitation, and communication. These benefits of science and technology are not available to all of the people in the world.

Content Standard G — History and Nature of Science (Grades K–8)
Fundamental concepts and principles that underlie this standard include History and Nature of Science:

Science as a human endeavor:
• People have practiced Science and technology for a long time.
• Men and women have made a variety of contributions throughout the history of science and technology.
• Although men and women using scientific inquiry have learned much about the objects, events, and phenomena in nature, much more remains to be understood. Science will never be finished.
• Many people choose science as a career and devote their entire lives to studying it. Many people derive great pleasure from doing science.

Science Journal, Conference and Rubrics for Success

Student Science Conference: Science Journal

Once students complete the lessons you can assess their performance in a student conference. During the conference students share their **Science Journal** and **ScienceWorks** investigation. The purpose of the student conference is to show the students a way to self-evaluate their science work. In the Science Conference students give examples of how they work like scientists. A student-led science conference transfers the responsibility of thinking and working like a scientist from the teacher to the student.

The **Science Journal** is the product used to present students' work in the conference. Several important things are needed to make a student-led conference a success. These include organization, time to plan the conference, rehearsal time for the student and role-model examples by the teacher. Teachers use the "Science Conference Teacher Evaluation Checklist" to organize the student-led conference. Students use the "Science Conference Teacher Evaluation Student Checklist" form to help them self-evaluate their science progress. Model for your students how to complete the form using your **Science Journal**. Make sure to provide them time to organize their material and to practice sharing.

Assessment for Nonreaders

Students in kindergarten may have difficulty with writing science words and questions. Experienced teachers use strategies such as reading material aloud, assisting with writing, and using older students and adult volunteers to mentor in the classroom. Another method is to provide visual keys or pictures that represent science words. The student forms can be modified or teachers can use the "Science Conference Checklist" during the conference, filling in the material as the student explains the science.

Steps for a Good Science Conference

The goal of the conference is to give examples of how the student

- ❑ Writes and uses words like a scientist
- ❑ Makes and uses drawings like a scientist
- ❑ Makes observations like a scientist
- ❑ Asks questions like a scientist
- ❑ Does investigations like a scientist
- ❑ Makes discoveries like a scientist

Before the Science Conference

Work with each student to prepare each of the following areas. Teachers should help students:

- ❑ List strengths and areas to improve
- ❑ Make sure their **Science Journal** is complete and organized
- ❑ Share their **Science Journal** with a friend or parent
- ❑ Pick their best science example to share and practice at home
- ❑ Think about some things they want to improve or do better in the **Science Journal**
- ❑ Role-play what a conference looks and sounds like
- ❑ Give students time to practice doing a conference with each other
- ❑ Create a schedule for students to sign-up for their Science Conference

During the Science Conference

- ❑ Teachers should not talk. Remember, this is a student-led conference.
- ❑ Afterward, teachers should be positive and supportive and point out the science examples that students have accomplished.

After the Science Conference

Teacher reflection questions

- ❑ Were my students prepared?
- ❑ Was I positive with each student?
- ❑ Was the conference effective?
- ❑ How would I improve it?
- ❑ Did the students demonstrate criteria for success?

Science Conference — Teacher Evaluation Checklist
ScienceWorks Investigation

(Check one)

❏ **The Pond** ❏ **Dock Shop** ❏ **Construction Zone**

Student Name: ______________________________ **Teacher:** ____________________ **Date:** ____________

1.	Student is organized and uses Science Journal.	❏ Partial	❏ Essential	❏ Excellent
2.	Student uses and writes words like a scientist.	❏ Partial	❏ Essential	❏ Excellent
3.	Student makes and uses drawings like a scientist.	❏ Partial	❏ Essential	❏ Excellent
4.	Student makes observations like a scientist.	❏ Partial	❏ Essential	❏ Excellent
5.	Student asks questions like a scientist.	❏ Partial	❏ Essential	❏ Excellent
6.	Student does an investigation like a scientist.	❏ Partial	❏ Essential	❏ Excellent
7.	Student completed the science investigation.	❏ Partial	❏ Essential	❏ Excellent
8.	Student makes a discovery like a scientist.	❏ Partial	❏ Essential	❏ Excellent
9.	Student worked well with science partner.	❏ Partial	❏ Essential	❏ Excellent
10.	Student is meeting science standards.	❏ Partial	❏ Essential	❏ Excellent

Criteria for Success

This rubric provides a framework for evaluating the student's ability to make observations, test ideas and complete scientific investigations. The investigation will be evaluated based on a student's ability to use science processes and skills and to demonstrate this knowledge in a student-led conference. The following criteria will be used to demonstrate the student's science skills:

- Explores and thinks like a scientist
- Asks questions like a scientist
- Makes observations like a scientist
- Records data like a scientist
- Tests ideas like a scientist
- Uses tools like a scientist
- Understands units of measurement like a scientist
- Makes discoveries like a scientist
- Completes an investigation like a scientist

Scoring Rubric

Teachers work with students to evaluate and score their Science Conference using the Science Conference Teacher Evaluation Checklist. During the conference, identify examples of how the students use their **Science Journal** to do science. Student progress can be identified at three distinct levels: partial, essential and excellent.

Partial:

- Generates no questions
- Makes minimal observations
- Uses a science tool with limited success
- Makes one science discovery
- Does not demonstrate understanding that he or she can do science
- Incomplete and missing work in the **Science Journal**
- Science investigation not complete

Essential:

- Generates one or two questions
- Makes careful observations that are recorded in the **Science Journal**
- Demonstrates a good command of three or more science tools
- Uses units of measurement correctly
- Makes personal discoveries and relates them to the experience
- Gives personal examples of doing science
- Work in **Science Journal** is complete
- Science investigation is complete

Exceptional:

- Asks numerous questions
- Sees relationships between questioning and learning
- Records unique observations in the **Science Journal**
- Relates questions to observations made in the investigation
- Shows excellent command of tools, measurements and other sensory input
- Makes unique discoveries and is self-motivated to make more
- Completes high-quality work in **Science Journal**
- Completes high-quality science investigation

Assessment for Nonreaders

Students in kindergarten may have difficulty writing science words and questions. Experienced teachers use strategies such as reading material aloud, assisting with writing, and using older students and adult volunteers to mentor in the classroom. Another method is to provide visual keys or pictures that represent science words. The student handout can be modified or teachers can use the "Science Conference Checklist" during the conference, filling in the material as the student explains the science. In addition, a "My Science Conference: Student Checklist" form for nonreaders is included on page 58. Teachers meet with the students and explain the checklist. Students cut out each strip of the checklist and place each one at the correct example in their **Science Journal**. Each strip represents one of the criteria for success in the written rubric. Two special strips are located at the bottom for the "best work" and for areas that might not be finished.

Science Journal: What do I see? Feel? Hear?

Name: ______________________ **Date:** ______________

My science observations:

My science drawings:

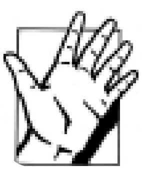
Tools I use to do science:

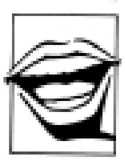
Living things:

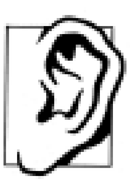
Nonliving things:

Science questions:

Senses I use to do science:



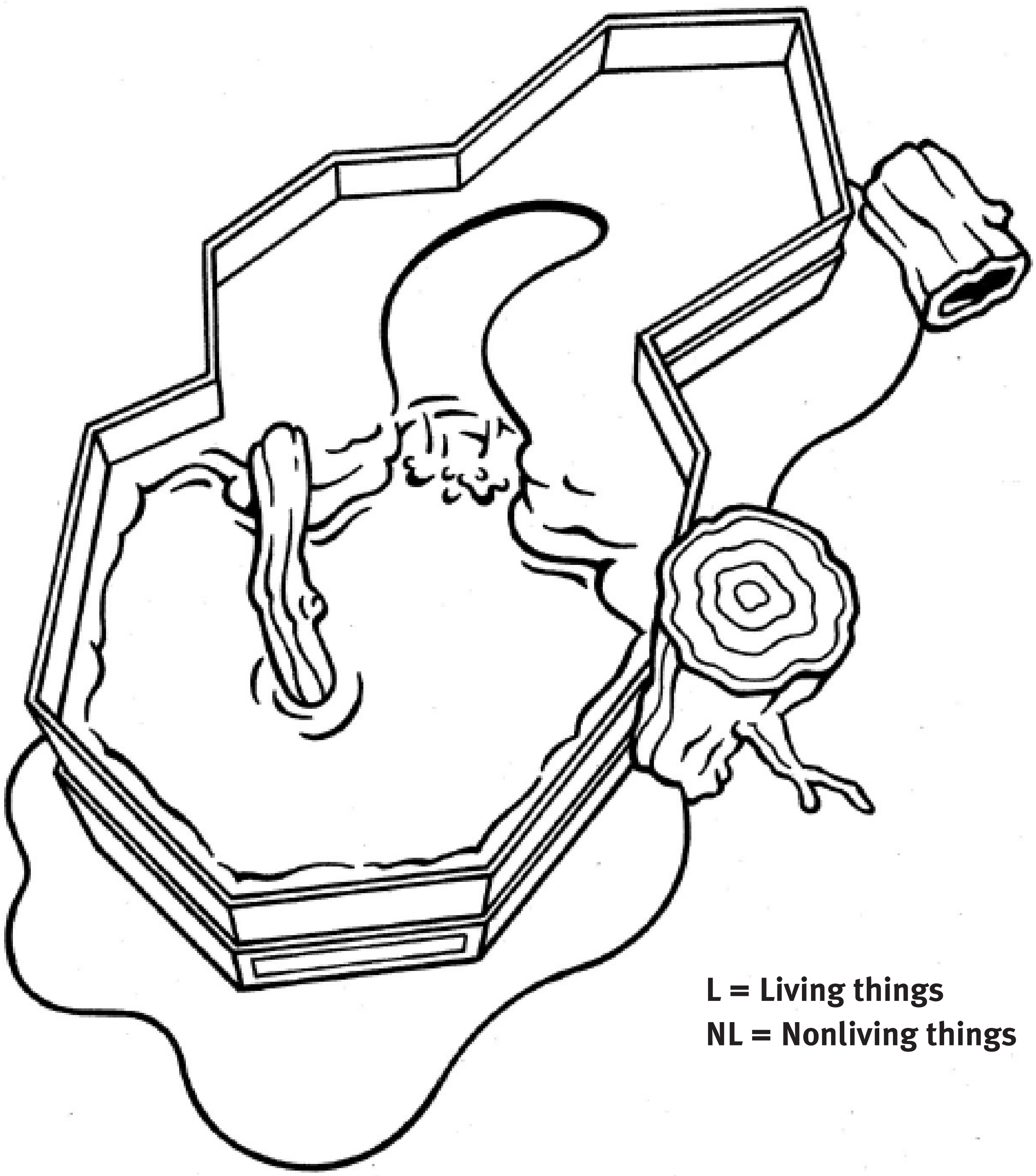




ScienceWorks Indiana Pond Map

Name: ______________________________ **Date:** ____________________

Draw what you see. Put an "L" for living things you see. Put "NL" for nonliving things you see.



L = Living things
NL = Nonliving things

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What's in an Indiana Pond?

Name: ______________________________ **Date:** ______________

List, draw and name things found in a pond:

Things in a pond:

____

____

Things in the water of a pond:

____

____

Things on the edge of the pond:

____

____

Things in the air by a pond:

____

____

Living things found in a pond:

____

____

____

Nonliving things found in a pond:

____

____

____

Other notes, drawings or observations:

____

____

____

Indiana Pond Observation Sheet

Name: ________________________________ **Date:** ____________________

Outline of an Indiana Pond

Living things

Water animals: ________________________________

Land animals ________________________________

Other animals: ________________________________

Plants: ________________________________

Nonliving things:

____

____

Other notes, drawings or observations:

____

____

Other notes, drawings or observations:

____

____

Pond Plant or Animal Observation Sheet

Name: ______________________________ Date: ______________

Name of organism: ______________

Type of object: ______________

☐ plant ☐ animal

Type of animal: ______________

☐ fish ☐ mammal

☐ reptile ☐ amphibian

☐ bird

Description and drawing: colors; number of legs; body covering; mouth parts; how it moves; where found — water, air or land; food; shelter; length; other.

____

____

____

Unusual habits, markings or body parts:

____

____

____

Type of plant: ______________

☐ edge of the pond

☐ floats in the pond

☐ underwater in the pond

Other notes, drawings or observations:

____

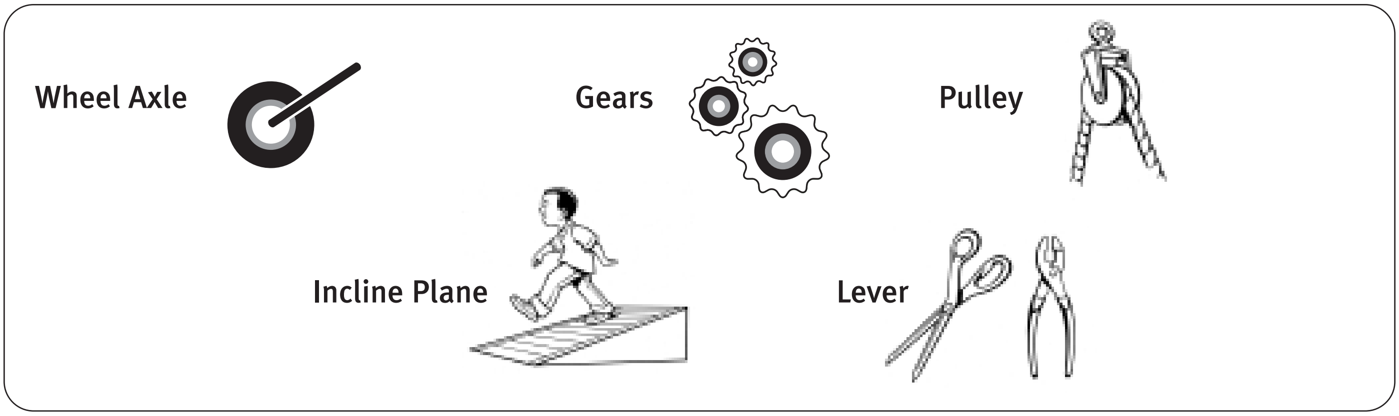
____

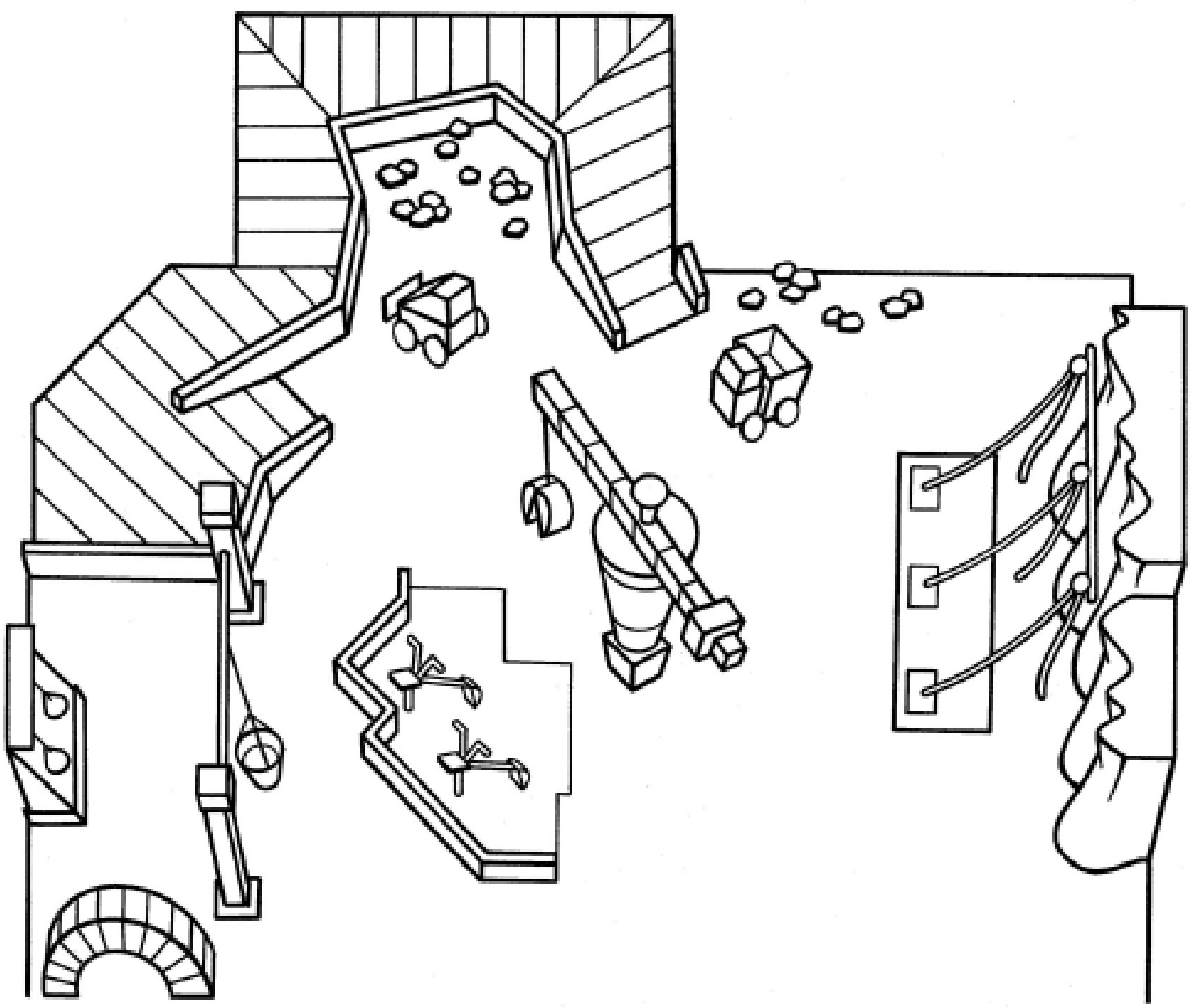
Construction Zone Simple Machines and Structures

Name: ______________________________ **Date:** ____________________

Directions: Search ScienceWorks to find simple machines.

Draw, color or label each simple machine you find. Use the key below.





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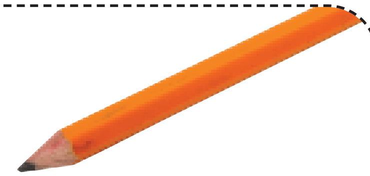
My Science Conference Checklist
ScienceWorks Investigation

Have non-reading students cut out each strip from the checklist and tape or paste them in their ***Science Journal*** to identify examples of their work

My Good Work: I use science words.



My Good Work: I make drawings.

My Good Work: I make observations.

My Good Work: I ask questions.

My Good Work: I investigate.

My Good Work: I make discoveries.

My Best Work: I'm proud of this

More work needed:

My Science Report

Name: ______________________________ **Date:** ____________________

1. Science Team Partner:
2. Name or subject of object studies:
3. Science questions:
4. Science words:
5. Observations and information collected:
6. Science tools used:
7. Tests or investigations:
8. Type of science: ❑ Life ❑ Earth ❑ Physical
9. Type of scientist ("-ologist"):
10. What I discovered:

Science Report Rubric

Science Team: ______________________________ & ________________________________

Science Report: _____________________________________ **Date:** ____________________

My class completed the following observations about our Science Report

Scientist & Skill	Example in our Science Report
❑ We explored and thought like scientists. Aristotle	
❑ We observed like scientists. Louis Pasteur	
❑ We tested ideas like scientists. Florence Nightingale	
❑ We used tools like scientist. Marie Curie	
❑ We made discoveries like scientists. Albert Einstein	
❑ We did science like scientists. (Names)	

My Science Investigation • Venn Diagram ScienceWorks

Name: ______________________ **Date:** ______________