

Standard

CT - 3.4-Conservation of Earth Materials

MA – Physical Gr. 6-8 #14 and #16

Don't Lose Your Cool!

Connecticut

Science

Center



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CT Science Standard 3.4 – Earth’s Resources

Earth Materials provide resources for all living things, but these resources are limited and should be conserved.

Summary

Are your students aware that earth resources can be conserved by reducing the quantities used, and by reusing and recycling materials rather than discarding them? Challenge their awareness with in-class activities about the resources they use every day. Learn about recycling and composting first hand with worm bin explorations. Visit the Connecticut Science Center classroom, where students will learn about insulating, as well as non-recycled and recycled insulation. While visiting the Science Center, your students may deepen their experience by using Trail Guides as they visit the **River of Life Gallery** and the **Energy City Gallery** to answer questions about the 3.4 Science Standard.

This package has been developed to provide you and your students with pre visit, visit, and post visit materials related to the study of conservation. Also included in this program are lessons that provide interdisciplinary connections, as well as additional resources such as websites, literature links, career information, home and school connections, and related videos.

This unit has been developed to complement some of the core themes, content standards and expected performances of the CT Core Science Frameworks, as well as the National Science Education Standards. It is a supplemental series of “hands-on” investigations that are inquiry-based and designed to engage students as well as to enhance and build upon their prior content knowledge. It may be integrated with other subjects or it may be taught in its entirety within the science classroom.

The complete CT Core Science Curriculum Frameworks is available at the website <http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320890>.

Direct link to PDF:

http://www.sde.ct.gov/sde/lib/sde/pdf/curriculum/science/pk8_science_curriculumstandards2011.pdf

Inquiry Standards

Following are the specific sections from the CT Core Science Curriculum Framework that are addressed in this unit.

Grades 3-5 Core Scientific Inquiry, Literacy, and Numeracy How is scientific knowledge created and communicated?

Content Standards	Expected Performances
<p>SCIENTIFIC INQUIRY</p> <ul style="list-style-type: none"> ◆ Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena. <p>SCIENTIFIC LITERACY</p> <ul style="list-style-type: none"> ◆ Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science. <p>SCIENTIFIC NUMERACY</p> <ul style="list-style-type: none"> ◆ Mathematics provides useful tools for the description, analysis and presentation of scientific data and ideas. 	<p>B INQ.1 Make observations and ask questions about objects, organisms and the environment.</p> <p>B INQ.2 Seek relevant information in books, magazines and electronic media.</p> <p>B INQ.3 Design and conduct simple investigations.</p> <p>B INQ.4 Employ simple equipment and measuring tools to gather data and extend the senses.</p> <p>B INQ.5 Use data to construct reasonable explanations.</p> <p>B INQ.6 Analyze, critique, and communicate investigations using words, graphs and drawings.</p> <p>B INQ.7 Read and write a variety of science-related fiction and nonfiction texts.</p> <p>B INQ.8 Search the Web and locate relevant science information.</p> <p>B INQ.9 Use measurement tools and standard units (e.g., centimeters, meters, grams, kilograms) to describe objects and materials.</p> <p>B INQ.10 Use mathematics to analyze, interpret and present data.</p>

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CT Science Standards, Grade Level Concepts & Expectations, & CMT Correlation

Science and Technology in Society - How do science and technology affect the quality of our lives?

GRADE 3

1.4 – Earth materials provide resources for all living things, but these resources are limited and should be conserved.

This content standard is an application of the concepts in content standards 3.1 and 3.3 should be integrated within one of those units.

Core Science Curriculum Framework	Underlying Concepts <i>Students should understand that...</i>	Grade-Level Expectations <i>Students should be able to...</i>	CMT Expected Performances
<p>3.4.a. Decisions made by individuals can affect the global supply of many resources.</p>	<ol style="list-style-type: none"> 1. Earth materials that occur in nature include rocks, minerals, soils, water and the gases of the atmosphere. Earth materials are natural resources that provide us with things we need to live, including food, clothing, water, air, shelter, land and energy. 2. Some natural resources are useful to people in their raw form (for example, fresh water, soil or air); other natural resources must be modified to meet human needs (for example, petroleum must be extracted from rocks and refined into gasoline, heating oil or plastics; wood from trees must be processed to make paper). 3. The supply of many natural resources such as fossil fuels, metals, fresh water and fertile soil is limited; once they are used up or contaminated they are difficult or impossible to replace. 4. Human actions can affect the survival of plants and animals. The products of the fuels people burn affect the quality of the air. Waste and chemicals from factories, farms, lawns and streets affect the quality of the water and soil. 5. Humans can extend the use of some natural resources by <u>reducing</u> the amounts they use (for example, driving less to reduce the amount of gasoline used; turning off faucets when not in use). 6. Humans can extend the use of some natural resources by <u>recycling</u>, or collecting used materials and processing them into new materials (for example, collecting waste paper or plastic bottles and making them into new products). 7. Humans can extend the use of some natural resources by <u>reusing</u> products instead of buying new ones (for example, washing containers that food is packaged in and using them again to store different foods or objects). 8. Humans can extend the use of some natural resources by <u>replacing what</u> they use (for example, planting new trees to replace those that are cut for lumber or paper; purifying dirty water from storm drains and discharging clean water back into a river). <p>SCIENTIFIC LITERACY TERMINOLOGY: natural resources, recycle</p>	<ol style="list-style-type: none"> 1. Describe ways people use earth materials, such as fossil fuels, trees, water, soils and rocks as natural resources to improve their lives. 2. Summarize nonfiction text to explain how humans use technology to access and use natural resources to produce electricity or other products (e.g., paper or concrete). 3. Explain advantages and disadvantages of renewable and nonrenewable energy sources that can be used for making electricity, fueling cars or heating homes. 4. Design and conduct experiments to evaluate the effectiveness of different insulating materials for keeping a substance (or space) warm or cold (i.e., conducting heat). 5. Use mathematics to estimate, measure and graph the quantity of a natural resource (e.g., water, paper) used by an individual (or group) in a certain time period. 6. Distinguish among reducing, reusing, recycling and replacing as conservation techniques. 	<p>B7. Describe how earth materials can be conserved by reducing the quantities used, and by reusing and recycling materials rather than discarding them.</p>

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Massachusetts Learning Standards

PHYSICAL SCIENCES (CHEMISTRY AND PHYSICS), GRADE 6-8

14. Recognize that heat is a form of energy and that temperature change, results from adding or taking away heat from a system.

16. Give examples of how heat moves in predictable ways, moving from warmer objects to cooler ones until they reach equilibrium.

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Safety Standards

1. Review expectations for appropriate behavior, handling of materials cooperative group procedures to be sure activities are accessible and safe for all students prior to beginning these investigations.
2. Make any necessary student modifications.
3. Monitor students to be sure they are acting appropriately, handling materials accordingly, and working cooperatively.
4. For more comprehensive information on science safety, consult the following guidelines:

American Chemical Society –

http://portal.acs.org/portal/PublicWebSite/about/governance/committees/chemicalsafety/publications/WPCP_012300

Council of State Science Supervisors;

Connecticut Department of Education –

http://www.csss-science.org/downloads/scisaf_cal.pdf



CT Science Standard 3.4 – Earth’s Resources

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Misconceptions and Facts

Misconceptions	Facts
Students at this age have little knowledge about agricultural and industrial production. They believe that farmers themselves consume all the products from their crops and animals.	Earth materials that occur in nature include rocks, minerals, soils, water and the gases of the atmosphere. Earth materials are natural resources that provide us with things we need to live, including food, clothing, water, air, shelter, land and energy.
Students may not have a notion of production based on the transformation of primary materials, for example, furniture from wood.	Naturally occurring materials such as wood, clay, cotton, and animal skins may be processed or combined with other materials to change their properties.
Students may think that trash simply goes away.	Discarded products contribute to the problem of waste disposal. Sometimes it is possible to use the materials in them to make new products, but materials differ widely in the ease with which they can be recycled.
Some students may wonder why the plants that died so long ago didn't just turn into soil the way the plants in their garden do.	Fossil fuels started as organisms and plant materials millions of years ago. Pressure, heat and much time led to creating these fuels. Wondering like this should be encouraged. Just realizing that fossil fuels formed under very special conditions can help students to appreciate that these fuels are not easily replaced.
Students have difficulty in identifying the sources of energy for plants and also for animals. Students tend to confuse energy and other concepts such as food, force, and temperature	The sun is the main source of energy for people and they use it in various ways. The energy in fossil fuels such as oil and coal comes from the sun indirectly, because the fuels come from plants that grew long ago.
Students may have no experience in recycling or conservation behaviors.	People try to conserve energy in order to slow down the depletion of energy resources and/or to save money.
Some students of all ages hold misconceptions about plant nutrition. They think plants get their food from the environment rather than manufacturing it internally, and that food for plants is taken in from the outside.	Plants make food from water and air, and that this is their only source of food. Understanding that the food made by plants is very different from other nutrients such as water or minerals is a prerequisite for understanding the distinction between plants as producers and animals as consumers.
Students think dead organisms simply rot away. Some students see decay as a gradual, inevitable consequence of time without need of decomposing agents	Matter from the dead organisms is converted into other materials in the environment by composting agents such as bacteria and worms.

From various sources including, *Benchmarks for Science Literacy* (Section 8B)

http://www.project2061.org/publications/bsl/online/ch8/ch8.htm#B_E

CT Science Standard 3.4 – Earth’s Resources

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Pre-Visit Activities

The visit to the CT Science Center begins in your classroom with the pre-visit activities. We encourage all teachers who bring their students to the CT Science Center to do these pre and post activities and plan to provide follow up assessments and activities which integrate your visit into a meaningful unit of study. **Pre-visit Activity #1 is available as an outreach program.**

The following highlighted GLE’s and GLC’s are covered in this section:

3.4 – Earth materials provide resources for all living things, but these resources are limited and should be conserved.			
<i>This content standard is an application of the concepts in content standards 3.1 and 3.3 should be integrated within one of those units.</i>			
Core Science Curriculum Framework	Underlying Concepts <i>Students should understand that...</i>	Grade-Level Expectations <i>Students should be able to...</i>	CMT Expected Performances
<p>3.4.a. Decisions made by individuals can affect the global supply of many resources.</p>	<ol style="list-style-type: none"> Earth materials that occur in nature include rocks, minerals, soils, water and the gases of the atmosphere. Earth materials are natural resources that provide us with things we need to live, including food, clothing, water, air, shelter, land and energy. Some natural resources are useful to people in their raw form (for example, fresh water, soil or air); other natural resources must be modified to meet human needs (for example, petroleum must be extracted from rocks and refined into gasoline, heating oil or plastics; wood from trees must be processed to make paper). The supply of many natural resources such as fossil fuels, metals, fresh water and fertile soil is limited; once they are used up or contaminated they are difficult or impossible to replace. Human actions can affect the survival of plants and animals. The products of the fuels people burn affect the quality of the air. Waste and chemicals from factories, farms, lawns and streets affect the quality of the water and soil. Humans can extend the use of some natural resources by reducing the amounts they use (for example, driving less to reduce the amount of gasoline used; turning off faucets when not in use). Humans can extend the use of some natural resources by recycling, or collecting used materials and processing them into new materials (for example, collecting waste paper or plastic bottles and making them into new products). Humans can extend the use of some natural resources by reusing products instead of buying new ones (for example, washing containers that food is packaged in and using them again to store different foods or objects). Humans can extend the use of some natural resources by replacing what they use (for example, planting new trees to replace those that are cut for lumber or paper; purifying dirty water from storm drains and discharging clean water back into a river). <p>SCIENTIFIC LITERACY TERMINOLOGY: natural resources, recycle</p>	<ol style="list-style-type: none"> Describe ways people use earth materials, such as fossil fuels, trees, water, soils and rocks as natural resources to improve their lives. Summarize nonfiction text to explain how humans use technology to access and use natural resources to produce electricity or other products (e.g., paper or concrete). Explain advantages and disadvantages of renewable and nonrenewable energy sources that can be used for making electricity, fueling cars or heating homes. Design and conduct experiments to evaluate the effectiveness of different insulating materials for keeping a substance (or space) warm or cold (i.e., conducting heat). Use mathematics to estimate, measure and graph the quantity of a natural resource (e.g., water, paper) used by an individual (or group) in a certain time period. Distinguish among reducing, reusing, recycling and replacing as conservation techniques. 	<p>B7. Describe how earth materials can be conserved by reducing the quantities used, and by reusing and recycling materials rather than discarding them.</p>

Pre Visit Activity # 1: Worm World

Investigation Summary:

Students will investigate worms and their vermicomposting environment. They will discover what worms eat, and how their castings are beneficial to the environment.

Background for the Teacher:

Red worms are commonly used in vermicomposting. Red worms consume organic materials and excrete this material as nutrients, called castings, which plants and other organisms can use. Worms do not compost inorganic materials. Waste is a by-product of the materials we use. Some wastes are easier to dispose of than others. When we throw out trash, much of it goes to garbage incinerators in Connecticut. Although this waste is burned to make electricity, much of it could have been used for other purposes. Some metals, paper, cardboard, and plastics can be recycled. These resources are used to make similar materials, for example, cans into new cans, paper into new paper, and plastic into other plastic products. Organic wastes can be disposed of by composting.

Purpose:

- To introduce students to Red worms which are used in vermicomposting
- To show students that some trash can be recycled with the help of decomposers
- Students will observe and question what they are exposed to and record such thoughts

Materials: (per group of 4 students)

- One worm per group (Red Worms (*Eisenia foetida*))
- Three Styrofoam plates
- 4 magnifying glasses
- 4 pairs of gloves
- 1 Popsicle stick
- 4 goggles (optional)
- Paper and pencils **or** Science notebooks
- 1/4 cup of “forest floor” (forest floor can be detritus, leaf litter, sticks, etc.)
- 1/4 cup worm castings
- 1 vermicomposter (this can be an opaque plastic container with bedding, soil, and worms in it)

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Teacher Procedure:

1. Discuss with the class the “3 R’s” Reduce, Reuse, and Recycle.
2. Allow students to make t-charts so that they can record their observations and questions accordingly.
3. Give each group of four students a Styrofoam plate with about ¼ cup of castings on it. Give them time to make observations and questions about it.
4. Give each group of four students a Styrofoam plate with about ¼ cup of “forest floor” on it. Allow time for students to make observations and questions about the materials.
5. Now introduce each group to the Red Wiggler worms. Show the worms in a bin. Explain what kind they are and where they come from.
6. Pass out gloves and goggles to each student.
7. Once all students have their gloves on, pass out a plate, worm, Popsicle stick, and four magnifying glasses to each group. Explain that students should not touch the worms directly but if they try to go off the plate, then one person should gently pick them up with the Popsicle stick and place them in the middle of the plate. This job can be shared among the group.
8. Allow students to make observations and questions about the worm.
9. Students can now put the worm in the “forest floor” plate. This should be done by gently flipping over the plate that the worm is on, over the “forest floor” plate.
10. Allow students to make observations and questions regarding the worm in the “forest floor” material.
11. Ask students to identify the head and mouth of the worm.
12. If available, show the students a vermicomposter. Ask students to consider what is needed in an environment in order for worms to live in it. Allow students to explore, make observations, and ask questions regarding the vermicomposter.
13. Discuss why it is important to compost.

Pre-Visit Activity Conclusion:

Now that you have completed all of the pre-visit activities, your students have a number of wonders/questions that they would like to investigate.

During their field trip experience, they will be exposed to more information and will generate more questions. Students should be reminded to continually focus on their questions and write down any new information learned.

When you complete your visit to the Science Center, your students will have a number of questions and new learning. You will find a number of activities in our post visit section that will help your students investigate their questions back in your classroom.

Pre Visit Activity # 2: Reducing

Investigation Summary:

Students assess potentially wasteful activities in their school. They will discuss and examine: reducing and recycling; cafeteria waste quantities and disposal; the use of computers and lights in classrooms; and curbside idling of busses and other vehicles.

For this activity, have students write a response to the following prompt:

1. *Have your parents ever asked you to turn off the lights in a room in your house? Why do you think they are asking you to do this?*
2. *What is “waste”? What do we ‘waste’ at school?*
3. *If you throw out an apple core into the woods, what will happen to it?*

Purpose:

- Identify state mandated recyclable materials and understand how their school is disposing of these.
- Identify behaviors that lead to waste of materials.
- Use problem solving skills to modify their behavior and that of the school community to reduce waste and improve awareness.
- Use the following scientific thinking processes to conduct investigations and build explanations: observing, researching, designing investigations, using equipment and measuring tools, using data to construct graphs and explanations, and using mathematics to analyze, interpret and present data.

Science Concepts:

- Earth materials are natural resources that provide us with things we need to live, including food, clothing, water, air, shelter, land and energy.
- Humans can extend the use of some natural resources by reducing the amounts they use, recycling materials where possible, and reusing materials.

Activity Summary:

In this activity, students will observe one aspect of their school environment that is affected by wasteful behaviors. They will produce a number of observations which, hopefully, will lead them to make more conscious choices in the future at school, as well, as at home.

CT Science Standard 3.4 – Earth’s Resources

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Materials:

- Science notebooks
- Chart paper/Overhead Projector/White Board
- “Lights On/Lights Off” T-chart
- A book on energy conservation such as Why Should I Save Energy (see bibliography)

Procedure:

1. Read aloud a book on energy conservation, such as Why Should I Save Energy, and ask the kids if they ever leave the lights on. Do we leave the lights on in our classroom when we leave? Are the lights left on in other classrooms when they are empty?
2. Record on a white board/overhead projector their predications of how many classrooms might be leaving their lights on. (If your school has motion sensors in the rooms, this activity might focus on computers left on in the room.) How could the students tell if the lights were left on? When would they need to check for this behavior? Together with the students plan how they could investigate the lights in the school. If your school has motion sensors and computers are left on to allow for automatic upgrades, students could investigate how long the lights are scheduled to remain on after the room is empty – is it the same for all rooms, classrooms as well as common areas?
3. With your students, design a t-chart with headings of “Lights On/Lights Off” to use while investigating question of lights in small groups. Students may track data by floors, grade, specials, hallways, etc. With the students and a sketched map of the school, plan how best to do an assessment of the rooms in the school. The investigations should be done on at least 2-4 days to complete the data for the school. Mark each day’s data clearly.
4. Once the data is completed have them generate, in their small groups, I notice/I wonder statements in their science notebooks (I noticed that all of the first grade classrooms had their lights off while out of their classrooms, I noticed one fourth grade classroom left their lights on, I wonder why they don’t turn them off when the other fourth grade classrooms did) about what they observed.
5. Use the t-charts to create data tables of what the students observed. The teacher may model this by giving the students a chart with classroom numbers listed and a header line of the days of the week that observations were made.
6. Analyze the information collected. What conclusions can be drawn? Students might interview adult staff about their attitude about recycling.
7. From the information collected, discuss their findings and how students can inform others about conserving energy. Have books as reference to seek information about conservation. Students might create flyers, posters, power point presentations, skits, etc. that include the benefits of turning off lights (save money, lower ecological footprint, better for environment). Students should present their information to the school community (post posters, distribute flyers, present the power point show, etc.
8. Discuss with students how they will know if their presentations had any effect on school behavior. How would they know if their information worked? The students will decide that they need to survey the school again after a period of time to see if lights are being turned off.

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9. Follow-up activity (two/three weeks later): have students create another t-chart and make observations (one or several days) about the lights being left on or off inside their original classroom, hallway, floor, specials. Create a data table that reflects before and after behaviors. Do the students see any effect? Do they think that their messages have made a difference?
10. Questions to discuss: Do you think that your materials (poster, etc.) made any effects on the school community? If students tried different methods, which do you think were more effective and why? How might you improve that message to improve conservation in the school? Could similar messages in the school reduce trash? Help remind teachers/students to shut off computers? Can the students identify any other behaviors that they have noticed that could be changed?

Discovery Center Activity

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Common Core State Standards for Mathematics:

- **Measurement and Data 2.MD**
 - o **Represent and interpret data:**

10. Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put together, take-apart, and compare problems using information presented in a bar graph.

- **Measurement and Data 3.MD**
 - o **Represent and interpret data:**

3. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs. *For example, draw a bar graph in which each square in the bar graph might represent 5 pets.*

Discovery Center Activity:
Keep your cool

Activity Purpose:

- To conduct an investigation to evaluate the effectiveness of different insulating materials for keeping a substance cold.
- To consider reducing the amount of energy that is used.
- To consider recycled materials so minimal waste is created.

Background for the Teacher:

Insulation is a necessity of any house, factory, or office building. Insulation helps to keep the inside of the building a comfortable temperature for those inside. For example, warm in the winter and cool in the summer. In reality, the heating ventilation and air conditioning system (HVAC) inside of a building tries to keep the building at a comfortable ~ 70°F year round. It only seems like the building is cooler in the summer and warmer in the winter because it is compared to the outside temperature.

Any HVAC system uses energy to cool or heat the building. This energy is generated from the burning of heating oil, natural gas, propane, or electricity. With dwindling resources it is important to conserve non-renewable fuel sources. By using good insulation in a building, the HVAC system will not have to run as long or as strong as it would without insulation. The insulation helps to keep the comfortable climate in the building.

Some insulation is manufactured from glass and other non-recycled materials. Recently insulation made from recycled materials has increased in popularity and effectiveness.

Activity Summary:

Learners in this activity will have the chance to experiment with different types of insulation both non-recycled and recycled. The exploration focuses on determining the most efficient type of insulation based on amount needed and the environmental impact of using the insulation type. The non-recycled (conventional) includes roll foam, Dow Safe Touch, and aluminum/bubble insulation. The recycled insulation includes “cotton batting” (recycled denim). Conventional Insulation is commonly made from fiberglass and is therefore irritating to the skin. Dow Safe Touch is a conventional fiberglass free (plastic) insulation. Other materials can also be used such as; feathers, cotton balls, and packing peanuts. However, make sure that a similar amount of each is used.

Do not tell the learners what each insulation type is before the activity. There will be a 5 or 10 minute discussion on what they think they are composed of following the activity.

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Materials: (per group of 4 students)

- One LC strip or thermometer
- One plastic quart bag of Dow Safe Touch Insulation (Labeled as Material A)
- One plastic quart bag of Recycled Denim (Labeled as Material B)
- One 10 inch piece of aluminum foil bubble insulation (Labeled as Material C)
- One 10 inch piece of roll foam (Labeled as Material D)
- One plastic quart container with a top or large yogurt container
- One Aluminum can (18 ounce)
- Tape
- Stop Watch
- Ice cubes and water (enough to fill the can)
- Paper and pencil or Science notebooks

Teacher Procedure:

1. Explain to the students that they will have a challenge. Their challenge is to keep an “air conditioned room” cold with only one material at a time. This way we can test to see which material is the best at keeping the “room” cold. Each student will be recording the information in a bar graph or a t-chart so that results can be discussed at the end of class.
2. Pass out materials at this time; Material A, B, C, and D, metal can, plastic container, jug of ice water, and stop watch.
3. Make sure each group has four total materials, Material A, B, C, and D. Allow students in groups of four, to make observations and questions about each material. Information can be recorded in a t-chart, or in their science notebooks.
4. Allow one person from each group to fill up the metal can with ice and water. Notice what happens when the LC strip comes into contact with the ice cold metal container. Notice what happens when you touch the LC strip. What general temperature is our hand in comparison to the metal can with ice water in it?
5. What if our house had thin plastic walls like the side of this cup, while we were air conditioning our room? Would that be a good idea? Let’s find out. If we put that metal can into the plastic container, how long will it take before that plastic container will become cold? This can be done by taping the LC strip around the plastic container. After warming up the LC strip with our hands, we can use the stop watch to time how long it takes the plastic container to change color (black=cold).
6. Allow each group to conduct the investigation and time it. Each student should create a bar graph with incremental squares that represent ten seconds of time that has passed. The x-axis will be labeled for the type of material (in this case no material) that is being used, and the y-axis will be labeled for the amount of time that it takes for the LC strip to change color from warm to cold (green to black).
7. Students should repeat this investigation with all of the four materials that they have. As a group each student can take turns using the stop watch.
8. When all data is collected and bar graphs are created, allow the students to share their results as a group. Some probing questions are: Which material kept out the most cold? The least? Which material would be best to use around your house? Why? Consider how the materials were created. Can we reuse or recycle any of these materials?

CT Science Standard 3.4 – Earth’s Resources

Earth Materials provide resources for all living things, but these resources are limited and should be conserved.

Trail Guides

We have created a set of “Trail Guides” for use by you and your students. The first section consists of the trail guides with teacher notes; the second section has the exact same Trail Guides without the teacher notes. You may copy these directly as handouts.

There is also a worksheet from the Gallery Scientist Floor Program which can be scheduled after your main reservation is confirmed.

The following highlighted GLE’s and GLC’s are covered in this section:

3.4 – Earth materials provide resources for all living things, but these resources are limited and should be conserved.			
<i>This content standard is an application of the concepts in content standards 3.1 and 3.3 should be integrated within one of those units.</i>			
Core Science Curriculum Framework	Underlying Concepts <i>Students should understand that...</i>	Grade-Level Expectations <i>Students should be able to...</i>	CMT Expected Performances
3.4.a. Decisions made by individuals can affect the global supply of many resources.	<ol style="list-style-type: none"> 1. Earth materials that occur in nature include rocks, minerals, soils, water and the gases of the atmosphere. Earth materials are natural resources that provide us with things we need to live, including food, clothing, water, air, shelter, land and energy. 2. Some natural resources are useful to people in their raw form (for example, fresh water, soil or air); other natural resources must be modified to meet human needs (for example, petroleum must be extracted from rocks and refined into gasoline, heating oil or plastics; wood from trees must be processed to make paper). 3. The supply of many natural resources such as fossil fuels, metals, fresh water and fertile soil is limited; once they are used up or contaminated they are difficult or impossible to replace. 4. Human actions can affect the survival of plants and animals. The products of the fuels people burn affect the quality of the air. Waste and chemicals from factories, farms, lawns and streets affect the quality of the water and soil. 5. Humans can extend the use of some natural resources by reducing the amounts they use (for example, driving less to reduce the amount of gasoline used; turning off faucets when not in use). 6. Humans can extend the use of some natural resources by recycling, or collecting used materials and processing them into new materials (for example, collecting waste paper or plastic bottles and making them into new products). 7. Humans can extend the use of some natural resources by reusing products instead of buying new ones (for example, washing containers that food is packaged in and using them again to store different foods or objects). 8. Humans can extend the use of some natural resources by replacing what they use (for example, planting new trees to replace those that are cut for lumber or paper; purifying dirty water from storm drains and discharging clean water back into a river). <p>SCIENTIFIC LITERACY TERMINOLOGY: natural resources, recycle</p>	<ol style="list-style-type: none"> 1. Describe ways people use earth materials, such as fossil fuels, trees, water, soils and rocks as natural resources to improve their lives. 2. Summarize nonfiction text to explain how humans use technology to access and use natural resources to produce electricity or other products (e.g., paper or concrete). 3. Explain advantages and disadvantages of renewable and nonrenewable energy sources that can be used for making electricity, fueling cars or heating homes. 4. Design and conduct experiments to evaluate the effectiveness of different insulating materials for keeping a substance (or space) warm or cold (i.e., conducting heat). 5. Use mathematics to estimate, measure and graph the quantity of a natural resource (e.g., water, paper) used by an individual (or group) in a certain time period. 6. Distinguish among reducing, reusing, recycling and replacing as conservation techniques. 	B7. Describe how earth materials can be conserved by reducing the quantities used, and by reusing and recycling materials rather than discarding them.

Massachusetts Learning Standards

Physical Sciences (Chemistry and Physics), Grade 6-8

16. Give examples of how heat moves in predictable ways, moving from warmer objects to cooler ones until they reach equilibrium.

Teacher Trail Guides

Trail Guide *Overlook Balcony*. 3.4 Earth Materials

Visit the River of Life Gallery – 6th Floor South

Overlook Balcony

Water, land, air, and everything that grows or flows here is a part of our natural resources.

Look out of the window towards the Connecticut River.
Where do you see water? Do you see any examples of how we use that water?

What types of structures do you see built along the river? Why might they have been built there?

Observe and point out different uses of the land that you see. How many different uses can you spot?

Teacher notes:

Students should be guided to really look at the landscape from the window overlook. What evidence do students see that people live here? Work here? Use the land and water? Are there businesses here? Are there things growing here?

Standards GLC# 1, 4; GLE# 1

Trail Guide *Connecticut River Watershed:* 3.4 Earth Materials

Visit the River of Life Gallery – 6th Floor South

The Connecticut River Watershed

The Connecticut River has been polluted by trash and other things from the people, towns, and factories near the river.

How many ways can you think of in which “reduce”, “reuse”, or “recycle” would make a difference in the pollution of the river?

Think about your home and yard. Think about when you visit a park, pond, or the beach. What can you do to make sure that your trash doesn’t wash away down the river?

Teacher notes:

You may not see evidence of pollution on the map, but you can see where people live and work near the river.

Ask the students if they have visited a river, pond or beach. Did you notice that people had been there? How? Were there buildings near the water? Trash cans? Was all the trash in the cans?

Standards GLC# 4, 5, 6, 7, 8; GLE# 6

Trail Guide *What is Insulation?* 3.4 Earth Materials

Visit Energy City – 6th Floor South

What is Insulation?

Why is insulation used in houses and around pipes?

How does insulation save energy?

Teachers Note:

Have the students focus on the text over the insulations in the wall. Insulation is used to keep the temperature inside the house or building constant whether it is hot or cold outside. It is used around pipes to keep the water either hot or cold depending on the outside temperature.

Insulation saves energy by reducing the amount of time the air conditioner or furnace/boiler needs to stay on to cool or heat the house.

Standards GLC# 4, 5, 6, 7, 8; GLE# 6

Trail Guide *Biomass-Plant Power*. 3.4 Earth Materials

Visit Energy City – 6th Floor South

Biomass-Plant Power

Is the release of CO₂ (carbon dioxide) from burning biomass as dangerous as the release of CO₂ from burning fossil fuels?

What form of life can remove CO₂ from the atmosphere?

Think what would happen if humans kept releasing CO₂ while at the same time destroying the forests of the world. What affect would this have on the CO₂ concentrations? Write down your thoughts.

Teachers Note:

The CO₂ released from burning biomass is chemically the same as is released from burning fossil fuels. However, the difference is where the CO₂ comes from. CO₂ that is released from burning fossil fuels been bound up in the ground for millions of years and essentially has been removed from the current carbon cycle. Therefore this CO₂ is ADDED to what is already in the carbon cycle. While CO₂ that is released from burning biomass is already within the carbon cycle and therefore, does not add anymore CO₂ than was already in the cycle.

Most plants “breathe” CO₂ and therefore remove CO₂ from the atmosphere. They incorporate the CO₂ into their body and “exhale” oxygen. When these plants are burned the CO₂ goes back into the atmosphere and the cycle starts over again.

Standards GLC # 3; GLE # 6

Trail Guide *Rooftop Garden*: 3.4 Earth Materials

Visit the Rooftop Garden – 6th Floor North

The Rolypig composter

There are many different ways that waste can be composted.

What kinds of items get put inside of the Rolypig composter?

What items get removed from the Rolypig composter?

What other ways can humans reduce the amount of waste that they produce?

Teachers notes:

Rooftop garden is open seasonally and is closed during inclement weather.

Composting can be done in many different ways whether it is in the form of piling leaves outdoors, vermicomposting, or creating a kitchen compost bin. However certain materials are not good for speedy composting. Reducing the amount of waste that humans produce is a great way to reduce the amount of trash that is created. Humans can reduce the amount of waste that they produce by doing such things as: not leaving faucets turned on and recycling.

Standards GLC # 4, 5, 6; GLE # 1, 6

Student Trail Guides

Trail Guide *Overlook Balcony*. 3.4 Earth Materials

Visit the River of Life Gallery – 6th Floor South

Overlook Balcony

Water, land, air, and everything that grows here are part of our natural resources.

Where do you see water? Do you see any examples of how we use that water?

What types of structures do you see built along the river? Why might they have been built there?

Observe and point out different uses of the land that you see. How many different uses can you spot?

Trail Guide *Connecticut River Watershed:* 3.4 Earth Materials

Visit the River of Life Gallery – 6th Floor South

The Connecticut River Watershed

The Connecticut River has been polluted by trash and other things from the people, towns, and factories near the river.

How many ways can you think of in which “reduce”, “reuse”, or “recycle” would make a difference in the pollution of the river?

Think about your home and yard. Think about when you visit a park, pond, or the beach. What can you do to make sure that your trash doesn’t wash away down the river?

Trail Guide *What is Insulation?* 3.4 Earth Materials

Visit Energy City – 6th Floor South

What is Insulation?

Why is insulation used in houses and around pipes?

How does insulation save energy?

Trail Guide *Biomass-Plant Power*. 3.4 Earth Materials

Visit Energy City- 6th Floor South

Biomass-Plant Power

Is the release of CO₂ (carbon dioxide) from burning biomass as dangerous as the release of CO₂ from burning fossil fuels?

What form of life can remove CO₂ from the atmosphere?

Think what would happen if humans kept releasing CO₂ while at the same time destroying the forests of the world. What affect would this have on the CO₂ concentrations? Write down your thoughts.

Trail Guide *Rooftop Garden*: 3.4 Earth Materials

Visit the Rooftop Garden – 6th Floor North

The Rolypig composter

There are many different ways that waste can be composted.

What kinds of items get put inside of the Rolypig composter?

What items get removed from the Rolypig composter?

What other ways can humans reduce the amount of waste that they produce?

CT Science Standard 3.4 – Earth’s Resources

Earth Materials provide resources for all living things, but these resources are limited and should be conserved.

Post-Visit Activity:

The following highlighted GLE’s and GLC’s are covered in this section:

3.5 – Earth materials provide resources for all living things, but these resources are limited and should be conserved.			
<i>This content standard is an application of the concepts in content standards 3.1 and 3.3 should be integrated within one of those units.</i>			
Core Science Curriculum Framework	Underlying Concepts <i>Students should understand that...</i>	Grade-Level Expectations <i>Students should be able to...</i>	CMT Expected Performances
<p>3.4.a. Decisions made by individuals can affect the global supply of many resources.</p>	<ol style="list-style-type: none"> Earth materials that occur in nature include rocks, minerals, soils, water and the gases of the atmosphere. Earth materials are natural resources that provide us with things we need to live, including food, clothing, water, air, shelter, land and energy. Some natural resources are useful to people in their raw form (for example, fresh water, soil or air); other natural resources must be modified to meet human needs (for example, petroleum must be extracted from rocks and refined into gasoline, heating oil or plastics; wood from trees must be processed to make paper). The supply of many natural resources such as fossil fuels, metals, fresh water and fertile soil is limited; once they are used up or contaminated they are difficult or impossible to replace. Human actions can affect the survival of plants and animals. The products of the fuels people burn affect the quality of the air. Waste and chemicals from factories, farms, lawns and streets affect the quality of the water and soil. Humans can extend the use of some natural resources by <u>reducing</u> the amounts they use (for example, driving less to reduce the amount of gasoline used; turning off faucets when not in use). Humans can extend the use of some natural resources by <u>recycling</u>, or collecting used materials and processing them into new materials (for example, collecting waste paper or plastic bottles and making them into new products). Humans can extend the use of some natural resources by <u>reusing</u> products instead of buying new ones (for example, washing containers that food is packaged in and using them again to store different foods or objects). Humans can extend the use of some natural resources by <u>replacing</u> what they use (for example, planting new trees to replace those that are cut for lumber or paper; purifying dirty water from storm drains and discharging clean water back into a river). <p>SCIENTIFIC LITERACY TERMINOLOGY: natural resources, recycle</p>	<ol style="list-style-type: none"> Describe ways people use earth materials, such as fossil fuels, trees, water, soils and rocks as natural resources to improve their lives. Summarize nonfiction text to explain how humans use technology to access and use natural resources to produce electricity or other products (e.g., paper or concrete). Explain advantages and disadvantages of renewable and nonrenewable energy sources that can be used for making electricity, fueling cars or heating homes. Design and conduct experiments to evaluate the effectiveness of different insulating materials for keeping a substance (or space) warm or cold (i.e., conducting heat). Use mathematics to estimate, measure and graph the quantity of a natural resource (e.g., water, paper) used by an individual (or group) in a certain time period. Distinguish among reducing, reusing, recycling and replacing as conservation techniques. 	<p>B7. Describe how earth materials can be conserved by reducing the quantities used, and by reusing and recycling materials rather than discarding them.</p>

Post Activity #1: Recycling and Reusing “Earth Materials and Resources” Program Activities

Investigation Summary:

Students will discuss how humans use renewable resources such as wood. Why is wood a renewable resource? Students will consider how paper is made and make samples of their own recycled content paper. Students will be able to compare different recycled papers to their original new papers. Follow-up activity for student observations of the paper and its properties will be completed in the classroom following the museum activity.

Purpose:

- Students investigate how paper is made.
- Using scientific thinking processes, they make observations and develop questions about the characteristics of their paper samples, measure materials, and compare data and observations about different papers.
- Students use data analysis to construct explanations about characteristics of paper and the practical uses of paper.

Science Concept:

Most paper products are made with some recycled content. Wood and trees, the base ingredients of most papers, as well as the water and energy used to make paper, are earth resources that should be conserved.

Background for the Teacher:

View the “How to make recycled paper” video from Teacher’s Domain (you will need to register if you have not already done so).

<http://www.teachersdomain.org/resource/ess05.sci.ess.earthsys.recycledpaper/> The video is 4:53 and the file is fairly large (14.6 MB). Ask your students to reflect on how the procedure in the video is similar and different from their experience making paper.

Dipping pans can be made by using plastic window screen sheets about 8.5”x 11” sheets and plastic embroidery hoops either 6” or 8”. Open up the hoop and place the screen sheet inside so that the entire circle is covered by the mesh. Secure the hoop tightly so that students will be able to press their recycled paper with their hands to help dry the paper faster.

CT Science Standard 3.4 – Earth’s Resources

Earth Materials provide resources for all living things, but these resources are limited and should be conserved.

Materials: (For each student)

- Blender (One for the entire class, only to be used under teacher’s supervision)
- One Dipping Pan (Can be made with plastic window screening and plastic embroidery hoops; directions above in Background for the Teacher)
- Aluminum cookie sheets for each student (This is for pressing some water out of their recycled paper)
- Warm water
- One wash cloth (for 2 students) **or** one sponge (for 4 students)
- Wax Paper (About one 8.5”x 11” sheet for each student)
- Scissors
- About 2 or 3 sheets per student of recycled office paper (Such as: newspaper, cereal box cardboard, corrugated cardboard, construction paper, etc.)
- 5 gallon bucket for soaking (Only needed if using cardboard)
- 250 ml measuring cup (1 cup)
- For each group of 4 students: One Large mixing bowl (For collecting cut paper and to drain screen over)
- One plastic tray

Procedure: (per group of 4 students)

1. Students will shred paper with their scissors by cutting paper of their choice in thin strips (about 1 inch wide and 4 inches long).
Note: To save time, extra slurry may be made in advance and then frozen and thawed for future use. Do not dispose of any paper pulp or slurry in sink drains. Strain any leftover slurry through several layers of screening to minimize the pulp content, freeze the concentrated pulp, or dry handfuls of the de-watered pulp in patties to be used in other activities.
2. Students should put about 3 or 4 cups of warm water into their mixing bowl with their shredded paper. With teacher’s assistance: Students will put all of the group’s paper and water into the blender. Mix in blender until it looks like a soup, more water may be needed.
Note: If using cardboard, let it soak about two hours before putting it in the blender.
3. Teacher will now pour soup mixture back into the mixing bowl that each group has.
4. Allow each student to collect 1 cup of the soup mixture and pour it into their dipping pan OVER the mixing bowl. One student at a time will put the soup mixture on their screen, making sure that the soup covers their entire screen evenly. After each student has poured their mixture onto their screen, they will gently press the water out of their mixture with their hands.
Note: Warn students to wipe off all of the soup mixture from their hands, because this cannot go down the drains when hands are washed after the activity.
5. After students have pressed out as much water from their paper as possible, allow them to gently take apart their presses so that they now just have their wet paper on the screen. With wash cloths the students can gently blot their paper while it is on the screen. This relatively dry paper should then be transferred to the 8.5”x11” sheet of wax paper. Teacher can then assist students in writing their name on the wax paper in permanent marker.

CT Science Standard 3.4 – Earth’s Resources

Earth Materials provide resources for all living things, but these resources are limited and should be conserved.

6. At this time, students can continue to dry their paper by blotting it gently with newspaper. Paper should be put in a place that it can stay for about 24 hours, so that it can dry.

Post Activity #1 (continued): A Closer Look at Paper

Materials: (For each student)

- Science notebooks or paper to record observations
- Magnifying glasses
- Recycled paper made from the first half of this Post Activity #1
- Different types of shredded paper in plastic quart bags

Procedure:

1. Set up observation groups of about 4 students.
2. Ask students to record their observations and questions as they examine the following materials.
3. Pass out one bag of each type of shredded paper to each group. Have students open the bags, compare, and observe the contents. Are all the papers the same? How are they different?

Note: If students are not used to writing comparison observations, lead them with some questions about how we notice differences: sight, smell, touch, etc. Students may find it difficult to use words to describe characteristics like “translucence.” Brainstorm with students to build a set of vocabulary words that they can use in making descriptions. Share out—have students share their observations and the comparisons they made with the other students in their group.

4. Next, give each group a piece of the paper they made. Allow students time to make observations, questions, and notice any similarities or differences between the paper that they made in class, and the shredded paper. Can they identify which dry papers their recycled paper was made from?

Discussion:

Different kinds of paper are better for different activities. What do we do with paper? *What activities do you think your homemade paper would be good for? What activities would it not be good for?* Ask student to write a reflection about their paper they made and what they could use it for, and why.

Ask students if they think that the paper that they made is an example of reducing, reusing, recycling, or replacing? Encourage students to discuss the difference between the “4 R’s” and debate what the made paper is.

Post Activity #2:
Extensions: Recycled Paper and the Properties of Matter

Materials:

- Five or more different paper samples such as: white paper, construction paper, cereal box, corrugated cardboard, handmade paper, origami paper, tissue paper, paper towels, toilet paper, etc.
- Science notebook **or** paper and pencil

Procedure: (Group of 2 students)

1. Provide each group with 12” squares of at least five different paper products. Allow students to compare each by make observations and questions with a t-chart in their science notebook or on a piece of paper.
2. Ask each group to try folding each type of paper. Allow time for students to record observations and questions.
3. Different papers are better for different tasks. Challenge each student to **consider** if each paper would be good to fold into an envelope or if it would be good to write a letter on.
4. Classify each paper sample that you have as to how it would likely perform the task. Discuss with your group and make a list below of best to worst type of paper to write on and a list of best to worst type of paper to fold into an envelope.
5. Write an explanation of your best and worst choices in your science notebooks. Explain why you ranked it as the best or the worst for that task.
6. As a group try to complete your challenge task with each of your papers. How did your ranking work out? Is there anything you would add or change about your decision?

CT Science Standard 3.4 – Earth’s Resources

Earth Materials provide resources for all living things, but these resources are limited and should be conserved.

Performance Task

The following highlighted GLE’s and GLC’s are covered in this section:

3.6 – Earth materials provide resources for all living things, but these resources are limited and should be conserved.			
<i>This content standard is an application of the concepts in content standards 3.1 and 3.3 should be integrated within one of those units.</i>			
Core Science Curriculum Framework	Underlying Concepts <i>Students should understand that...</i>	Grade-Level Expectations <i>Students should be able to...</i>	CMT Expected Performances
<p>3.4.a. Decisions made by individuals can affect the global supply of many resources.</p>	<ol style="list-style-type: none"> 1. Earth materials that occur in nature include rocks, minerals, soils, water and the gases of the atmosphere. Earth materials are natural resources that provide us with things we need to live, including food, clothing, water, air, shelter, land and energy. 2. Some natural resources are useful to people in their raw form (for example, fresh water, soil or air); other natural resources must be modified to meet human needs (for example, petroleum must be extracted from rocks and refined into gasoline, heating oil or plastics; wood from trees must be processed to make paper). 3. The supply of many natural resources such as fossil fuels, metals, fresh water and fertile soil is limited; once they are used up or contaminated they are difficult or impossible to replace. 4. Human actions can affect the survival of plants and animals. The products of the fuels people burn affect the quality of the air. Waste and chemicals from factories, farms, lawns and streets affect the quality of the water and soil. 5. Humans can extend the use of some natural resources by reducing the amounts they use (for example, driving less to reduce the amount of gasoline used; turning off faucets when not in use). 6. Humans can extend the use of some natural resources by recycling, or collecting used materials and processing them into new materials (for example, collecting waste paper or plastic bottles and making them into new products). 7. Humans can extend the use of some natural resources by reusing products instead of buying new ones (for example, washing containers that food is packaged in and using them again to store different foods or objects). 8. Humans can extend the use of some natural resources by replacing what they use (for example, planting new trees to replace those that are cut for lumber or paper; purifying dirty water from storm drains and discharging clean water back into a river). <p>SCIENTIFIC LITERACY TERMINOLOGY: natural resources, recycle</p>	<ol style="list-style-type: none"> 1. Describe ways people use earth materials, such as fossil fuels, trees, water, soils and rocks as natural resources to improve their lives. 2. Summarize nonfiction text to explain how humans use technology to access and use natural resources to produce electricity or other products (e.g., paper or concrete). 3. Explain advantages and disadvantages of renewable and nonrenewable energy sources that can be used for making electricity, fueling cars or heating homes. 4. Design and conduct experiments to evaluate the effectiveness of different insulating materials for keeping a substance (or space) warm or cold (i.e., conducting heat). 5. Use mathematics to estimate, measure and graph the quantity of a natural resource (e.g., water, paper) used by an individual (or group) in a certain time period. 6. Distinguish among reducing, reusing, recycling and replacing as conservation techniques. 	<p>B7. Describe how earth materials can be conserved by reducing the quantities used, and by reusing and recycling materials rather than discarding them.</p>

CT Science Standard 3.4 – Earth’s Resources

Earth Materials provide resources for all living things, but these resources are limited and should be conserved.

Scenario:

Connecticut has started a new plan to conserve Earth’s materials. Each town or region will be responsible for setting up an organization that will turn reusable materials into usable products. Materials that towns will collect include the following:

- Paper
- Metal
- Glass
- Plastics
- Wood

Choose one of the materials and describe the following:

1. What kind of products are the sources of the waste?
2. Describe at least 10 new products that could be made from the waste.
3. How could each of those new products be used and who might use them?

Draw a diagram of the cycle of your material, from source material to wasted product, through your manufacturing of one new product, to how that product will be reused in the future.

CT Science Standard 3.4 – Earth’s Resources

Earth Materials provide resources for all living things, but these resources are limited and should be conserved.

Scoring Rubric

Criteria	Self-assessment	Peer assessment	Teacher assessment
Selected a material			
Identified products that were the source of the waste			
Described 10 new products			
Described how each of 10 products could be used			
Described who could use each of the 10 products			
Drew a clear diagram			
Diagram traced these steps: 1. source of material, 2. the waste product, 3. manufacture into a new product and 4. how the product will be used			

Engineering Activity

Problem:

The amount of aquatic life that is living in the Dirt River is not as abundant as it was twenty years ago. This could be due to the condition of the river. You and your team mates must design a filter to clean the river’s water. Hopefully this will help the population of the aquatic life.

Design:

Materials:

- | | |
|--------------------------------------|---|
| - 2 Liter soda bottles (cut in half) | - Gravel |
| - Other plastic containers | - Coal |
| - Cotton balls | - Any other materials |
| - Fabrics of different thread count | - Dirty water (This can be from a natural source or created by adding tap water to dirt, sand, woodchips, leaf litter, or any other items of different sizes) |

Testing:

With your team design a diagram that can explain what materials and design choice you will use to create your filter. After your design is fully completed, each group may continue by collecting their required materials and creating their filter. Record any observations or questions that you may have, especially if you are changing your design during this step. Finally, obtain some dirty water and make observations and questions about it (This will be compared to the water that has gone through the filter). Now pour some dirty water through your group’s filter and record any observations or questions that you may have.

Data Analysis:

How can you prove to another group that your water is cleaner than the original source? What makes you consider water to be clean?

Design Revision:

Can you change your filter so that it will make the water even cleaner? This may consist of changing your filter entirely, or adding more items to your current filter.

Retest:

Run some new dirty water through your revised filter. Record observations and questions regarding the investigation. Which filter cleaned the water better? How can you tell?

Communicate Results:

Discuss as a class, how your filter was built and what materials were used in the process. Explain why your filter cleaned the water as best as it could. Discuss why your team’s filter looks the way it does currently. Did anything change to the filter when you ran the dirty water through it? Did any group create a filter that looked different then the ones that your group made? Can any of your recorded questions be answered by examining another group’s filter?

CT Science Standard 3.4 – Earth’s Resources

Earth Materials provide resources for all living things, but these resources are limited and should be conserved.

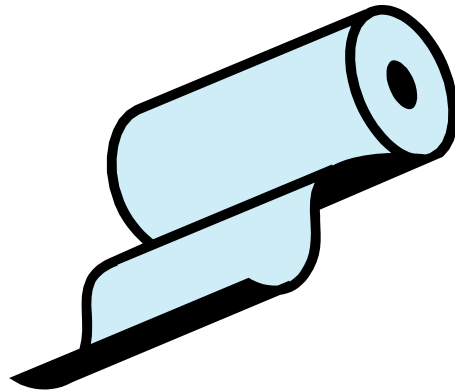
Embedded Task

Discussion and observations about the Science Center insulation and comparisons, along with the Post-Visit activities of paper making and comparisons with other papers may be linked with your classroom work on 3.1 of the CT Science Framework, Properties of Matter.

The papers you make (up to 4 different pulps) could be used in place of paper towels in the “Soggy Paper” Embedded Task. The teacher manual for this task may be found in the next section or at http://www.sde.ct.gov/sde/lib/sde/word_docs/curriculum/science/cmtgr3taskteacher.doc

Be aware that students will have far less material to work with if you are using the paper samples that were made in the Post-Visit activity, than if they have endless rolls of paper toweling. You may wish to have the students do the traditional Embedded Task first before experimenting with their sample paper. This will allow them to reflect on any adjustments that will need to be made to their experiment procedure compared to what they did with the paper towel samples.

Curriculum Embedded Performance Task
Elementary School Science
Content Standards 3.1, 3.2 or 3.4



Soggy Paper

Teacher Manual

Connecticut State Department of Education
Bureau of Curriculum and Instruction

CT Science Standard 3.4 – Earth’s Resources

Earth Materials provide resources for all living things, but these resources are limited and should be conserved.

Acknowledgement

The Connecticut State Department of Education is grateful to the many dedicated science educators who contributed to the development of the elementary, middle and high school curriculum-embedded performance tasks and teacher manuals. Beginning with the initial ideas for tasks, through the classroom field testing and editing, to the guidelines for classroom implementation, these inquiry teaching and learning activities are the result of the creativity, experiences and insights of Connecticut’s finest science educators. We thank all of you, too numerous to list, who gave your time and energy so generously to this project.

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OVERVIEW OF CURRICULUM-EMBEDDED PERFORMANCE TASK MODEL THE ELEMENTARY AND MIDDLE SCHOOL

The Connecticut State Board of Education approved the Core Science Curriculum Framework in March of 2009. The framework promotes a balanced approach to PK-12 science education that develops student understanding of science content and investigative processes.

WHAT IS A CURRICULUM-EMBEDDED PERFORMANCE TASK?

Curriculum-embedded performance tasks are examples of teaching and learning activities that engage students in using inquiry process skills to deepen their understanding of concepts described in the science framework. Developed by teachers working with the Connecticut State Department of Education, the performance tasks are intended to influence a constructivist approach to teaching and learning science throughout the school year. They will also provide a context for CMT questions assessing students’ ability to do scientific inquiry.

The three elementary performance tasks are conceptually related to Content Standards in Grades 3 to 5 and the three middle school performance tasks are related to Content Standards in Grades 6 to 8. The elementary performance tasks provide opportunities for students to use the Inquiry Expected Performances for Grades 3 to 5 (see Science Framework B.INQ 1-10 skills) to understand science concepts. The middle school performance tasks provide opportunities for students to use the Inquiry Expected Performances for Grades 6 to 8 (see Science Framework C.INQ 1-10 skills) to understand science concepts.

Teachers are encouraged to use the state-developed curriculum-embedded performance tasks in conjunction with numerous other learning activities that incorporate similar inquiry process skills to deepen understanding of science concepts. Students who regularly practice and receive feedback on problem-solving and critical thinking skills will steadily gain proficiency.

HOW ARE THE PERFORMANCE TASKS STRUCTURED?

Each performance task includes two investigations; one that provides some structure and direction for students, and a second that allows students more opportunity to operate independently. The goal is to gradually increase students’ independent questioning, planning and data analysis skills. The elementary performance tasks introduce students to understanding and conducting “fair tests”. The middle school performance tasks focus on designing investigations that test cause/effect relationships by manipulating variables.

Mathematics provides a useful “language” for quantifying scientific observations, displaying data and analyzing findings. Each curriculum-embedded performance task offers opportunities for students to apply mathematics processes such as measuring, weighing, averaging or graphing, to answer scientific questions.

Not all science knowledge can be derived from the performance of a hands-on task. Therefore, each curriculum-embedded task gives students opportunities to expand their understanding of concepts through reading, writing, speaking and listening components. These elements foster student collaboration, classroom discourse, and the establishment of a science learning community.

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A useful structure for inquiry-based learning units follows a **LEARNING CYCLE** model. One such model, the “5-E Model”, engages students in experiences that allow them to observe, question and make tentative explanations before formal instruction and terminology is introduced. Generally, there are five stages in an inquiry learning unit:

- **Engagement:** stimulate students’ interest, curiosity and preconceptions;
- **Exploration:** first-hand experiences with concepts without direct instruction;
- **Explanation:** students’ explanations followed by introduction of formal terms and clarifications;
- **Elaboration:** applying knowledge to solve a problem. Students frequently develop and complete their own well-designed investigations;
- **Evaluation:** students and teachers reflect on change in conceptual understanding and identify ideas still “under development”.

The performance tasks follow the “5-E” learning cycle described above. However, the teacher can decide the role the performance task will play within the larger context of the entire learning unit. Early in a learning unit, the performance task can be used for engagement and exploration; later in a learning unit, the performance task might be used as a formative assessment of specific skills.

HOW ARE PERFORMANCE TASKS USED WITH YOUR CLASS?

Curriculum-embedded performance tasks are designed to be used as part of a learning unit related to a Framework Content Standard. For example, while teaching a unit about human body systems (Content Standard 7.2,) the teacher decides the appropriate time to incorporate the “Feel the Beat” performance task to investigate factors affecting pulse rate. In this way, the natural flow of the planned curriculum is not disrupted by the sudden introduction of an activity sequence unrelated to what students are studying.

The performance tasks are NOT intended to be administered as summative tests. Students are not expected to be able to complete all components of the tasks independently. Teachers play an important role in providing guidance and feedback as students work toward a greater level of independence. Performance tasks provide many opportunities for “teachable moments” during which teachers can provide lessons on the skills necessary for students to proceed independently.

There is no single “correct” answer for any of the performance tasks. Students’ conclusions, however, should be logical, or “valid” interpretations of data collected in a systematic or “reliable” way. Variations in students’ procedures, data and conclusions provide opportunities for fruitful class discussions about designing “fair tests” and controlling variables. In the scientific community, scientists present their methods, findings and conclusions to their peers for critical review. Similarly, in the science classroom, students’ critical thinking skills are developed when they participate in a learning community in which students critique their own work and the work of their peers.

Performance tasks should be *differentiated* to accommodate students’ learning needs and prior experiences. The main goal is to give all students opportunities to become curious, pose questions, collect and analyze data, and communicate conclusions. For different learners, these same actions will require different levels of “scaffolding” as they move toward greater levels of independence. For

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example, if students have had experiences creating their own data tables, the teacher may decide to delete part or all of the data table included in the performance task. Other possible adjustments include (but are not limited to):

- Text readability;
- Allowing students to control all or some of the variables;
- Whether the experimental procedure is provided or student-created;
- Graph labels and scales provided or student-created;
- Expectations for communication of results; or
- Opportunities for student-initiated follow-up investigations.

There are many science investigations that are currently used in schools that provide inquiry learning opportunities similar to those illustrated in the performance tasks. Students need a variety of classroom experiences to deepen their understanding of a science concept and to become proficient in using scientific processes, analysis and communication. **Teachers are encouraged to use the state-developed curriculum-embedded performance tasks in conjunction with numerous other learning activities that incorporate similar inquiry processes and critical thinking skills.**

HOW ARE THE PERFORMANCE TASKS RELATED TO THE CMT?

The new Science CMT for Grades 5 and 8 will assess students’ understanding of inquiry and the nature of science through questions framed within the CONTEXT of the curriculum-embedded performance tasks. Students are not expected to recall the SPECIFIC DETAILS OR THE “RIGHT” ANSWER to any performance task. The questions, similar to the examples shown below, will assess students’ general understandings of scientific observations, investigable questions, designing “fair tests”, making evidence-based conclusions and judging experimental quality.

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Here is an example of the type of multiple-choice question that might appear on the Grade 5 Science CMT. The question is related to the “Soggy Paper” performance task:

Some students did an experiment to find out which type of paper holds the most water. They followed these steps:

1. Fill a container with 25 milliliters of water.
2. Dip pieces of paper towel into the water until all the water is absorbed.
3. Count how many pieces of paper towel were used to absorb all the water.
4. Repeat with tissues and napkins.

If another group of students wanted to repeat this experiment, which information would be most important for them to know?

- a. The size of the water container
- b. The size of the paper pieces *
- c. When the experiment was done
- d. How many students were in the group

Here is an example of the type of constructed-response question that might appear on the Grade 8 Science CMT. The question is related to the “Feel the Beat” performance task:

Imagine that you want to do a pulse rate experiment to enter in the school science fair. You’ve decided to investigate whether listening to different kinds of music affects people’s pulse rate.

Write a step-by-step procedure you could use to collect reliable data related to your question. Include enough detail so that someone else could conduct the same experiment and get similar results.

NOTE THAT THE CMT QUESTIONS DO NOT ASSESS A CORRECT “OUTCOME” OF A PERFORMANCE TASK OR STUDENTS’ RECOLLECTION OF THE DETAILS OF THE PERFORMANCE TASK. Students who have had numerous opportunities to make observations, design experiments, collect data and form evidence-based conclusions are likely to be able to answer the task-related CMT questions correctly, even if they have not done the state-developed performance tasks. However, familiarity with the context referred to in the test question may make it easier for students to answer the question correctly.

INTRODUCTION TO “SOGGY PAPER”

In this performance task, students will explore the water-holding properties of different types of paper. Through observation, a guided investigation and the design of their own experiment, students will learn that to make a fair test of different properties, certain things should be kept the same so that results are more reliable.

SAFETY NOTES:

- Review expectations for appropriate behavior, handling of materials and cooperative group procedures prior to beginning this investigation.
- Water spills on tile floors can make the floors slippery. Provide each group with a damp sponge so that any water spills can be immediately mopped up.
- For more comprehensive information on science safety, consult the following guidelines from the American Chemical Society - http://portal.acs.org/portal/PublicWebSite/about/governance/committees/chemicalsafety/publications/WPCP_012300 and the Council of State Science Supervisors -

FRAMEWORK CONTENT STANDARD(S): Soggy Paper can relate conceptually to any of the following learning units:

3.1 Materials have properties that can be identified and described through the use of simple tests:

Soggy Paper allows students to investigate some of the properties of paper. Although *absorbency*, or the ability to hold water, is the property focused on in the investigations, students will be observing the physical properties of different papers and theorizing about which properties might be related to the paper’s ability to hold water.

3.2 Organisms can survive and reproduce only in environments that meet their basic needs. Plants and animals have structures and behaviors that help them survive in different environments.

A unit on plant adaptations may focus on the study of trees. In the context of learning about the parts of trees (roots, trunks, leaves, bark) and how they help the tree survive, students may learn that people use the parts of trees to make things such as paper, furniture or houses. If your students are learning about how paper is made from trees, Soggy Paper can be used as an interesting investigation comparing different types of paper.

3.4 Earth materials provide resources for all living things, but these resources are limited and should be conserved.

Soil, water and air are all “earth materials” that support the growth of plants. In this learning unit, students will be learning that people use plants for food, shelter, fabrics, medicines and other useful materials such as paper.

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UNDERLYING SCIENCE CONCEPTS (KEY IDEAS):

- Observing means using the senses to get information.
- All substances have properties that can be observed and used to identify them.
- Some properties of matter are called “physical” properties. Physical properties can be observed using the five senses.
- Examples of physical properties are shape, color, texture, absorbency, transparency, and stretch ability.
- Some physical properties can be observed directly (e.g., color or shape), while others are revealed through interactions with other materials (e.g., absorbency or magnetic attraction).

KEY INQUIRY SKILLS:

- Make scientific observations and recognize the difference between an observation and an opinion, a belief, a fact or a name.
- Identify steps to make a scientifically “fair test”.
- Use a magnifying lens to make close observations.
- Use a graduated cylinder to accurately measure the metric volume of a liquid (in milliliters).
- Record data in an organized way.
- Use addition, subtraction, multiplication or division to process data.
- Use oral and written language to describe observations, ideas, procedures and conclusions.

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MATERIALS NEEDED: Listed below are all the materials needed to complete the two experiments in Soggy Paper. Some materials are supplied in starter kits provided by the Connecticut State Department of Education. These materials are marked with an asterisk (*). The remaining materials are supplied by the school district:

For each group:

- 12 squares of paper towel
- 12 squares of tissues
- 12 squares of napkin
- 3 zip-loc plastic bags (sandwich size)
- 3 plastic cups (8 oz)
- 1 plastic bottle of water (capped)
- 3 plastic plates (6”- 8” size)
- 1 plastic forceps *
- 1 plastic graduated cylinder (25 mL) *
- A damp sponge to clean up accidental spills

For each student:

- Magnifying lens *
- Metric ruler
- Crayons/colored pencils for bar graph
- Scissors (optional-see Advanced Preparation)

For Experiment #2:

- Several brands of paper towels

Teacher may want to use chart paper or an overhead transparency to display class data tables and graphs.

ADVANCE PREPARATION FOR THE TEACHER:

1. Carefully read through all teacher and student materials. Modify the Student Materials based on the needs of your students. Then print and photocopy Student Materials.
2. Obtain paper towels, tissues, napkins, plastic cups, plastic plates and bottled water. Since students will have preconceptions about which paper is most absorbent, it’s a great idea to choose papers that will give unexpected outcomes. For example, you might use the paper towels found in the school lavatories compared to a premium tissue – results may be a surprise!
3. To conduct a fair test, it is important that all the paper samples be the *same size*. 12cm x 12cm works well with a 6-8” plate. But...
 - a. If your students are experienced at designing fair tests, **OR IF YOU WANT TO USE THIS AS A “MINI-LESSON” TO TEACH ABOUT FAIR TESTS**, you may want to give students one sheet of paper towel, tissue and napkin and allow the students to recognize the need to create equal-size and equal-ply paper samples. If the students will be cutting their own paper samples, check to see that the scissors they are given are sharp enough to cut the different papers; **OR**
 - b. You may pre-cut equal-size paper samples and talk with students about why they think this is important.

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- c. Place the samples of each paper type in a labeled zip-loc bag. This will keep them dry during the experiment. Students or parent volunteers can be helpful in doing the advance cutting.

MATERIALS DISTRIBUTION:

Get students involved in distributing and returning materials. This saves time for the teacher and also teaches students collaborative skills and self-reliance. One way to distribute materials is through a “cafeteria style” distribution center. All materials are laid out on a table or counter, and each group sends a representative to pick up the required materials. Trays or plastic shoeboxes work well for transporting materials from the center to the lab groups.

ESTIMATED COMPLETION TIME AND PACING SUGGESTIONS: (45 minute blocks)

- Day 1: Observation of paper types and completion of chart
- Day 2: Experiment #1 – Data collection
- Day 3: Experiment #1 – Data analysis (graphing) and discussion
- Day 4: Experiment #2 - Planning
- Day 5: Experiment #2 – Data collection
- Day 6: Experiment #2 – Data analysis and discussion
- Day 7/8: Communicate Your Learning – letter writing

PEDAGOGY: Consult the teacher notes accompanying each step of the performance task for suggestions related to classroom implementation, differentiation, assessment and extension strategies. The ▲ symbol is used to indicate a differentiation opportunity. Each Teacher Note is followed by a reference to the Framework inquiry skill featured in that task component. For example, the notation “**B INQ.3**” indicates an inquiry skill related to designing or conducting a simple investigation.

Teacher Notes

Soggy Paper

A Guided Exploration of Properties of Different Papers

ENGAGE:

Look around the room. How many things can you see that are made of paper? Is all paper the same? Can you find different kinds of paper?

Teacher notes: Encourage students to notice different kinds of paper, such as notebook paper, newspaper, poster paper, or textbook paper. Ask students to examine the papers and notice some of their properties. For example, Xerox paper is pure white while newspaper is off-white. Students will notice properties such as glossy, rough, smooth, soft, etc. You may want to list students’ “Noticings” and “Wonderings” about the different papers in a 2-column chart. B INQ.1

EXPLORE:

In this activity, you will explore some of the properties of different kinds of paper.

1. GATHER these materials for your group:

- | | |
|--------------------------------------|---------------------------------|
| 12 squares of paper towel | Magnifying lens (1 per student) |
| 12 squares of tissue | Ruler (1 per student) |
| 12 squares of napkin | Crayons or colored pencils |
| 1 plastic graduated cylinder (25 mL) | Damp sponge (1) |
| 1 plastic forceps | Scissors (1 per student) |
| 3 zip-loc plastic bags | |
| 3 plastic cups | |
| 1 plastic bottle of water | |
| 3 plastic plates | |

2. OBSERVE the properties of the different papers with and without the hand lens. Record your words and drawings in the following table:

Teacher notes: Help students understand that a scientific observation is an objective description of a feature that can be observed with the 5 senses. It is different from an opinion, a fact or a name. Adjectives that are objective (a “white” towel, for example) are appropriate for a scientific observation; but adjectives that are subjective (a “pretty” towel, for example) are not. Sometimes students will struggle to find the right word to describe what they’ve observed. In many cases, a diagram or a picture is “worth a thousand words”. For example, although the paper towel company

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may say its product is “quilted”, the towel does not really have an insulating layer in the middle. More objectively, the towel may have a “pattern of crossing lines”. This is a good opportunity to develop language fluency and introduce new vocabulary that will help the students express what they observe.

Some students may need prompting to expand their observations. Ask questions such as:

- *What do you see on the surface?*
- *How does the paper feel?*
- *Does it stretch?*
- *Can you see through it?*
- *How are the papers alike? How are they different?*

▲ *Have students record their observations in an organized table, similar to the one shown here. If your students are experienced at using observation tables, they may want to design their own table. If so, delete the table shown here and leave space for students’ own table designs. **B INQ.1***

PAPER TYPE	Properties Observed Without Magnifier	Properties Observed With Magnifier
Paper towel		
Tissue		
Napkin		

*Teacher notes: After students have had time to observe, ask students to share their findings and record a class list of the observed properties of each type of paper. As you record each observation, this is a good time to ask students to judge whether it is a “scientific observation” or a fact, a name or an opinion. **B INQ.1***

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3. THINK about the properties you observed. Which properties might be related to how well the paper can hold water? This property is called “**absorbency**”.

*Teacher notes: This may be a good time to discuss the concept of absorbency. Students can generate examples of other objects that are absorbent (e.g., a sponge, a cotton ball, a towel, etc.) and discuss their ideas about properties that all absorbent objects seem to have. **INQ.1***

4. PREDICT which paper type might hold the MOST water, and which one might hold the LEAST water:

Most: _____ Least: _____

I think this because I noticed that _____

Teacher notes: Encourage students to think about which of the properties they observed might be related to the paper’s ability to hold water. Students’ predictions will be based on their prior experiences and preconceived notions about absorbency. Predictions are neither “correct” nor “incorrect”; they are, however, supported by students’ explanations of the reasons for their ideas. For example, if a student predicts that white paper will be more absorbent than brown paper, ask the student to “Tell us why you think that.”

Now you’re ready to test your prediction.



EXPERIMENT #1: WHICH TYPE OF PAPER HOLDS THE MOST WATER? In this activity, you are going to compare different types of paper to find out which one holds the most water. You will pour some water onto a plate and then count how many squares of each paper type it takes to soak up all the water.

Teacher notes: This is a great opportunity to help students understand that scientific claims are based on evidence. Influenced by prior experiences or television commercials, students may have a preconceived idea that paper towels are more absorbent than tissue or napkin. In fact, paper absorbency depends on the properties of each paper rather than on the name of the paper. For example, a one-ply, smooth paper towel (like the type found in institutional lavatories) is not very absorbent; while a 3-ply, thick napkin may be highly absorbent. To encourage students to develop a respect for data, despite what they might expect, it’s a good idea to use a variety of high-quality and low-quality towels, napkins and tissues so that students will see unexpected results that will lead them to make conclusions supported by evidence.

▲ The main goal of this activity is to help students learn to think scientifically by conducting a fair test. There is no “right answer” that students will get by following directions. More important is the opportunity students will have to think about what makes a test “fair” so that accurate data can be collected in a consistent way. If you tell students to make all the paper squares the same size, to pour the same amount of water, and to keep the squares in the water for the same amount of time, they may get a predicted outcome but they may not learn why it is important to keep variables the same in a fair test. To differentiate this activity, you may want to modify the procedure below to remove SOME or ALL of the given quantities. For example, you might pre-cut all squares the same size, but allow students to decide the plate size, the spill amount or the soak time. During a class discussion comparing the methods and results of different groups, students will note variations in the findings. One group may have found paper towels to be most absorbent, while another group may have found tissues to be most absorbent. Ask students to think about possible explanations for these differences. Students will intuitively note that some groups used larger paper squares or smaller amounts of water, and these differences make it difficult to compare results. Ask students “What can we do differently to make our results more alike?” Then allow students to repeat the experiment once the class has agreed upon consistent quantities to use. By allowing the “unfair” test to occur, you’ve created an opportunity for students to solve the problem by creating a fair test. **B INQ.3**

1. Label three plastic cups: “towel”, “tissue” and “napkin”. You will use the cups for storing the wet paper squares.
2. Measure 25 milliliters (mL) of water into the graduated cylinder. Decide which paper you want to test first.
3. Pour 25 mL of water onto the plastic plate.

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4. Lay one paper square over the water spill, and leave it there until you can tell that it is not absorbing any more water.
5. Pick up the wet paper square with the forceps, and hold it over the plate until it stops dripping. Put the wet paper square in the labeled cup.
6. Keep using squares until there is no more water left in the plate.
7. Count how many paper squares you use to soak up all the spilled water. Record the number of squares you use for each paper type in a data table:

Type of Paper	Amount of Water Spilled	Number of Squares Used
Paper Towel	25 mL	
Tissue	25 mL	
Napkin	25 mL	

8. Repeat Steps 3 to 7 with the other paper types.

*Teacher notes: ▲ If your students are experienced data collectors, you may want to increase the challenge in this task by removing all (or parts) of the data table above and requiring students to create their own data table to record important information about their experiment. **B INQ.4***

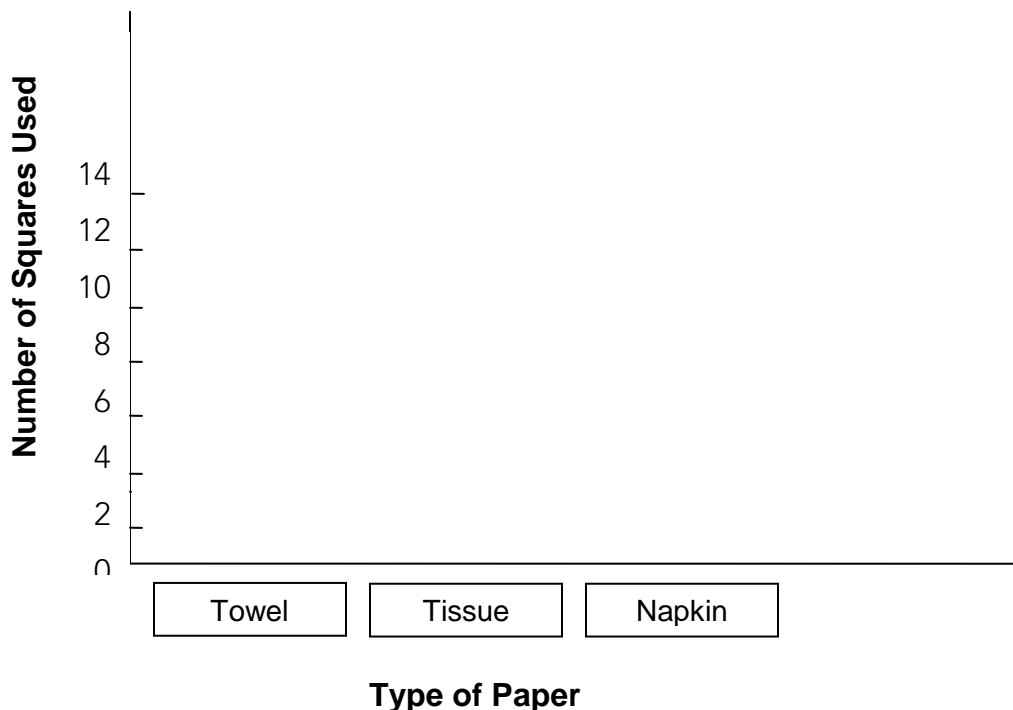
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Graph Your Data:

Make a bar graph to compare how many squares of each paper type were needed to absorb 25 mL of water:

Water Absorbency of Different Paper Types



*Teacher Notes: ▲ The graph shown here has most of the work already done for the student. All that is required is correct plotting. Depending on your students’ experience creating and using bar graphs to compare data, you may differentiate the difficulty level of this step by removing all (or parts) of the graph shown here, and requiring your students to label axes correctly, identify an appropriate scale, or create a title. This is a good opportunity to use an overhead projector to do a mini-lesson on parts of a bar graph. **B INQ.10***

EXPLAIN

Think About Your Data:

1. Which paper type used the fewest squares to soak up all the water? _____

Which paper type used the most squares to soak up all the water? _____

Teacher notes: In this step, students simply report the data they recorded. **B INQ.5**

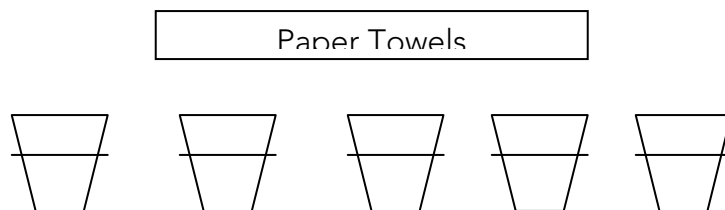
2. Which paper type is the most absorbent? _____

Which paper type is the least absorbent? _____

Explain your conclusion: _____

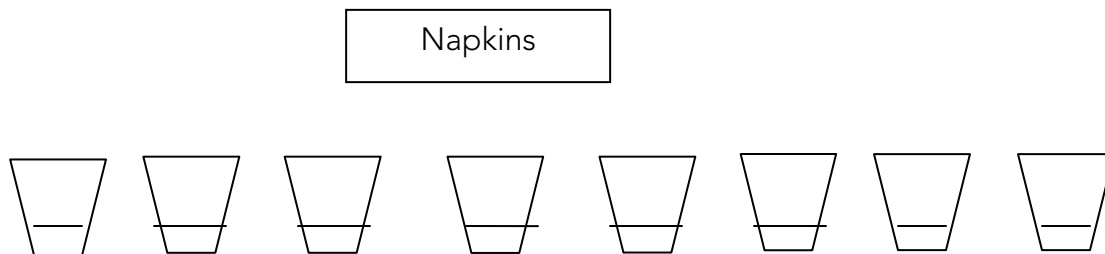
Teacher notes: There is no “correct” answer for this investigation since the outcomes depend on the properties of the different papers students are using. There should be, however, a logical (“valid”) conclusion based on reliable data. For example, some students might make the invalid conclusion that tissues were the most absorbent because they had the “highest score”. In fact, the paper with the “lowest score” is the most absorbent because less of it was required to soak up 25 mL of water. **B INQ.5**

▲ Students who do not recognize this “inverse relationship” may need a first-hand experience. A concrete way to help students visualize the amount of water held by each paper square is to use plastic cups to represent the number of paper squares used. Then pour 25 mL of water into the cups so as to get equal amounts of water in each cup (this may take some “adjusting”). For example, suppose students’ data tables show they used 5 squares of paper towel and 8 squares of napkin to soak up 25 mL of water. Here is how that data looks in “cups”:



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This visual demonstration will help students to see that when FEWER cups (or paper squares) are used to hold 25 mL of water, there is MORE water in each cup. It is also a useful strategy for developing a conceptual understanding of division.

*An alternative way to help students analyze the data is to use division to calculate how many mL of water was held by each paper square (e.g., $25 \div 8 = 3\frac{1}{8}$). **B INQ.10***

Help students understand that when they are asked to explain a conclusion, they need to do more than just restate the numerical data (e.g., 12 paper towels were used to soak up the spill). They need to interpret the data to describe an idea. For example, after examining the data in their data table, students might conclude that napkins are more absorbent than tissues because it took fewer napkins to soak up the same amount of water.

*Some students might conclude that all paper towels are more absorbent than napkins because it took fewer paper towels to soak up the water in this experiment. Is this a reasonable conclusion? This is a good time to lead a class discussion about the need for many more tests to be conducted on different brands of paper towels and napkins to support such a generalized conclusion. Students may be interested in conducting tests to explore whether all paper towels are more absorbent than napkins. **B INQ.6***

3. What properties did the absorbent paper have that the less absorbent paper did not have?

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*Teacher notes: Encourage students to relate the results of the experiment to their initial observations and predictions. Were they surprised by any of their results? Ask them to compare the properties of the most absorbent paper (e.g., texture), stretchiness, color, size, or transparency) to the least absorbent paper. In light of their experiment, ask them again to consider what properties may be related to the paper’s ability to hold water. Accept all reasonable theories that are supported by evidence. **B INQ.6***

4. SHARE your data and discuss your conclusions with the whole class.

*Teacher notes: Lead a class discussion by asking questions such as: Was the data from other groups similar to yours, or was it different than yours? What might explain these differences? What changes can be made to the experiments to make everyone’s results more similar? Questions such as these will help students develop their understanding of experiments that are “fair tests”. **B INQ.6***

ELABORATE THROUGH RESEARCH

Learn more about paper, trees or conservation

Teacher notes: Some questions cannot be answered through observations or experiments. This is a good time to pursue students’ interest in ideas related to Soggy Paper. For example, they may be interested in learning more about forests or paper and how it is made or recycled. Perhaps they’re interested in the properties of some unusual materials. Incorporate the reading of nonfiction trade books related to the Soggy Paper task into your reading and writing instruction. Teach the literacy skills you are focusing on in the context of reading, writing and speaking about students’ science investigations. You may ask students to do short research reports, poster presentations or skits to present what they learn.

*You may want to have students read the following passage to introduce the connection between paper and trees. If you have other resources to accomplish this, simply delete the passage: **B INQ.7***

Many things we use every day are made of paper. We cut down trees and chop them into tiny pieces to make different kinds of paper. It takes many trees to make enough paper for all the things we use.

Trees are important to people and our environment in many other ways. People and animals eat the nuts and fruits that grow on trees. Birds, squirrels and other living things make their homes in trees. The roots of trees keep the soil from being washed away by rain. Many other plants grow in the soil.

We can conserve trees by using less paper. This can be done by recycling old paper or by reducing the amount of paper we use.

ELABORATE THROUGH INVESTIGATION

EXPERIMENT #2: WHICH PAPER TOWEL BRAND IS BEST?

You may have seen TV commercials that claim that a certain brand of paper towel is the “quicker picker upper”. But, can you believe everything you hear on TV? Is one brand of paper towel really better than the others? In this experiment, you will use what you learned in Experiment #1 to find out more about the properties of different paper towels.

Teacher notes: ▲ This experiment allows students to work more independently to plan and conduct a fair test to find the “best” paper towel. Feel free to change the experimental question to WHICH TOILET PAPER OR TISSUE IS BEST? (Students get a kick out of working with bathroom products!) Lead a class discussion about other ways to define the “best” paper product. Students may suggest properties such as the strength of different papers or their ability to stand up to scrubbing (durability). There are many other questions that have probably emerged during class discussions, and you are encouraged to use Experiment #2 as a chance for students to frame their own questions that can be investigated through an experiment. **B INQ.1**

1. Cut squares from several brands of paper towels. Gather the same materials you used for Experiment #1.

Teacher notes: You can supply students with samples of three different paper towel brands, or you can ask the students to bring in samples from home. It works well to include “Brand X” towels, school towels, as well as premium brands. Students may be surprised at their results. Remind students about the importance of using the same size paper squares to make this a “fair test”. **B INQ.3**

2. OBSERVE and COMPARE the properties of different brands of paper towels. Make an observation chart in your science notebook, and record your observations. TALK with your partners about which properties might make the paper towels absorbent.

Teacher notes: Students will draw on their experiences in Experiment #1 as they observe three different brands of paper towels. **B INQ.1**

3. PREDICT which towel brand will be the most absorbent. To make your prediction, think about the results of Experiment #1 and your observations of the different paper towels.
4. WRITE the question you are investigating in your science notebook.

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*Teacher notes: Help students to distinguish between a question that cannot be answered through an experiment (e.g., who invented paper towels?) and a question that can be answered through an experiment (e.g., which paper towel is the strongest when wet?). Some questions are best answered by looking up the information in a book, while others can be answered by collecting data. **B INQ.1***

5. PLAN an experiment that will compare different brands of paper towels to find out which brand is the most absorbent.

*Teacher notes: Circulate and talk with lab groups about which parts of the experiment they will keep the same to make this a “fair test”. Their experiences in Experiment #1 will enable them to consider aspects such as paper towel size, amount of water, length of time in the water, etc. **B INQ.3***

6. WRITE in your science notebook a list of the steps you will follow.

*Teacher notes: Explain to students the importance of including enough details and measurements so that anyone could repeat their experiment exactly the way they did it. **B INQ.3***

7. DO your experiment, and record your findings in an organized way in your science notebook. Your data table from Experiment #1 will give you ideas for making your new data table.

*Teacher notes: Suggest to students that they look back at the data table from Experiment #1 to get ideas for constructing their own data table for this experiment. **B INQ.4***

8. SHOW your paper towel absorbency data in a bar graph in your science notebook.

*Teacher notes: Suggest to students that they look back at the bar graph from Experiment #1 so they can construct their own bar graph for this experiment. **B INQ.10***

9. What **conclusion** can you make based on your data? Are all paper towels the same? Is the most expensive brand also the most absorbent? WRITE about your findings in your science notebook. Then share and compare your findings with those of other groups in your class.

*Teacher notes: Lead a class discussion in which students share their findings. You can compare the data of different groups if they have all tested the same paper towels and used the same size squares. If your lab groups tested different paper towels or determined their own square size, you can help students recognize that these differences are responsible for the different findings and conclusions. **B INQ.5***

CT Science Standard 3.4 – Earth’s Resources

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Communicate Your Learning:

You now have some important information to share with the person in your family who shops for groceries! Write a letter to this person and tell:

- What questions about paper products you explored;
- What you did to find answers to your questions;
- What you found out about different types and brands of paper products. Tell about some of the data you recorded in your experiments;
- What type of paper you recommend for use in the kitchen, and which brand you recommend buying;

You may want to draw a diagram of your experiment to include in your letter.

Teacher notes: Here is an opportunity to teach literacy skills in the context of the science investigation. You may want to do a mini-lesson on writing a friendly letter. You may also expect students to use their process writing skills to write a narrative account of their experiment, following the above prompts, with an introduction, body and conclusion.

B INQ.7

“Soggy Paper” Teacher Resources

3.1 Properties of Matter:

Websites – Third Grade Water Cycle

http://www.epa.gov/safewater/kids/flash/flash_watercycle.html

Animated description of the water cycle covering clouds, rain, water storage and water vapor

Nonfiction Trade Books:

- A Closer Look, Lewis, Natalie. Newbridge Publishers (big book)
- Bendy and Rigid, Royston, Angela. Heinemann Library, Chicago, IL. 2005
- Properties of Matter. Pearson Scott Foresman Leveled Readers.

Plant/Tree Adaptations:

Nonfiction Trade Books:

- Green and Growing. Hammonds, Heather. Rigby/Harcourt Achieve, Austin, TX. 2004.
- Plants and Trees Growing. Race-Moore, Kara. Pearson Scott Foresman Leveled Readers.
- Tree Life., Black, Kara. Pearson Scott Foresman Leveled Readers.
- Forest Plants. Giesecke, Ernestine. Heinemann Library, Chicago, IL. 2005.
- New Plants. FOSS Science Stories. Delta Education, 2003.

3.4 Natural Resources & Conservation

Websites –

- “Paper University” <http://www.tappi.org/>
- Science Advisory Board <http://www.straightdope.com/mailbag/mpapermaking.html>
- Energy Kids
<http://www.eia.doe.gov/kids/energyfacts/saving/recycling/solidwaste/paperandglass.html>

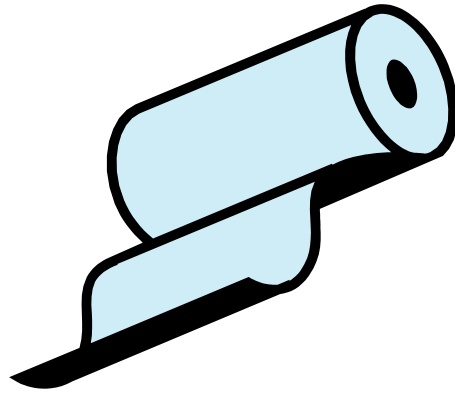
Nonfiction Trade Books:

- How We Use Paper. Oxlade, Chris. Raintree, Chicago, IL. 2005.
- Paper., Oxlade, Chris. Heinemann Library, Chicago, IL. 2005.
- You Can Recycle. Walsh, Patricia. Pearson Scott Foresman Leveled Readers.

Curriculum Embedded Performance Task

Elementary School Science

Content Standards 3.1, 3.2 or 3.4



Soggy Paper

Student Manual

Connecticut State Department of Education
Bureau of Curriculum and Instruction

Soggy Paper

A Guided Exploration of Properties of Different Papers

ENGAGE:

Look around the room. How many things can you see that are made of paper? Is all paper the same? Can you find different kinds of paper?

EXPLORE:

In this activity, you will explore some of the properties of different kinds of paper.

1. GATHER these materials for your group:

12 squares of paper towel

12 squares of tissues

12 squares of napkin

1 plastic graduated cylinder (25 mL)

1 plastic forceps

3 zip-loc plastic bags

3 plastic cups

1 plastic bottle of water

3 plastic plates

Magnifying lens (1 per student)

Ruler (1 per student)

Crayons or colored pencils

Damp sponge (1)

Scissors (1 per student)

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2. OBSERVE the properties of the different papers with and without the hand lens. Record your words and drawings in the following table:

PAPER TYPE	Properties Observed Without Magnifier	Properties Observed With Magnifier
Paper towel		
Tissue		
Napkin		

3. THINK about the properties you observed. Which properties might be related to how well the paper can hold water? This property is called “**absorbency**”.

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4. PREDICT which paper type might hold the MOST water, and which one might hold the LEAST water:

Most: _____ Least: _____

I think this because I noticed that

Now you’re ready to test your prediction.



EXPERIMENT #1: WHICH TYPE OF PAPER HOLDS THE MOST WATER? In this activity, you are going to pour 25ml of water onto a plate. Then you will count how many squares of each paper type it takes to soak up all the water.

1. Label three plastic cups: “towel”, “tissue” and “napkin”. You will use the cups for storing the wet paper squares.
2. Measure 25 milliliters (mL) of water into the graduated cylinder. Decide which paper you want to test first.
3. Pour 25 mL of water onto the plastic plate.
4. Lay one paper square over the water spill, and leave it there until you can tell that it is not absorbing any more water.
5. Pick up the wet paper square with the forceps, and hold it over the plate until it stops dripping. Put the wet paper square in the labeled cup.
6. Keep using squares until there is no more water left in the plate.
7. Count how many paper squares you use to soak up all the spilled water. Record the number of squares you use for each paper type in a data table:

Type of Paper	Amount of Water Spilled	Number of Squares Used
Paper Towel	25 mL	
Tissue	25 mL	
Napkin	25 mL	

8. Repeat Steps 3 to 7 with the other paper types.

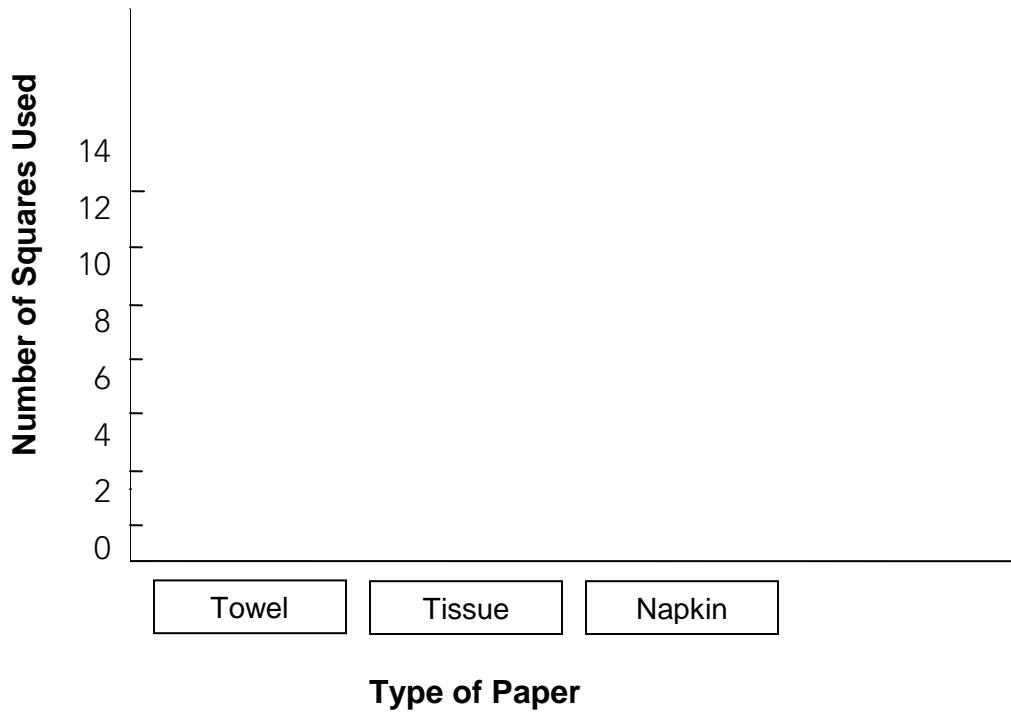
CT Science Standard 3.4 – Earth’s Resources

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Graph Your Data:

Make a bar graph to compare how many squares of each paper type were needed to absorb 25 mL of water:

Water Absorbency of Different Paper Types



Teacher Resources

Teacher Background

Connecticut has mandated recycling. From the CT Department of Environmental protection: (http://www.ct.gov/dep/cwp/view.asp?a=2714&q=324926&depNav_GID=1645):

What Should be Recycled?

In Connecticut, recycling is state law! This means that everyone must recycle including all public and private schools. The items required to be recycled in accordance with Section 22a-208v and Section 22a-256a of the Connecticut General Statutes and Section 22a-241b of the Regulations of the Connecticut State Agencies include:

- Glass & metal food & beverage containers
- Newspaper
- White office paper
- Corrugated cardboard
- Scrap metal
- Waste oil
- Lead acid storage batteries
- Ni-Cd rechargeable batteries
- Leaves (must be composted)

Although Connecticut has mandated recycling these materials, it is a law that is seldom enforced. Recycling is often under-used in our schools. The challenges to good recycling are complex; including changing private or municipal waste disposal contracts and practices, shifting marketplaces that change demand for recycled materials, and often the most challenging—human behaviors. Consistent good recycling, like energy efficiency, are behaviors that need constant reinforcing, streamlining of everyday tasks and processes to help us to do these things as part of our normal day, and a bit of a “watch dog” to keep us in line.

Why Should We Recycle?

Natural resources provide us with things we need to live, including food, clothing, water, air, shelter, land and energy. These resources are all finite. We don’t have unending fresh water, or world surpluses of food, land or fuels. Human use of our natural resources often pollutes their sources. Pollution runoff, pesticides, and overuse affect our land and water resources. In many parts of the world, clean water is not readily available. Human activities, including fossil fuels used for making electricity and powering our vehicles, have led to climate change.

As we assess our wastes, we can take actions to reduce our use of natural resources. There are uses for many recycled materials. Taking these materials out of the trash stream helps to reduce disposal costs. Some materials, like aluminum, have high resale values. This led to early recycling programs for aluminum cans in the 1970’s. Other materials have varying markets for reuse. Their values sometimes change with market shifts. Even a low-valued material costs less to recycle than wasting that material—either in disposal in landfills, or trash incinerators.

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Much of the resources that we use are not things we usually think about. These include water, food waste, packaging materials, and electricity for our appliances and lighting. Everyday behaviors can affect how much we waste and our awareness of our use of natural resources. Dripping faucets and running toilets waste water. If that drip is hot water, it is a waste of both water and heating energy. Food not eaten is thrown away. Some cafeterias allow students to not take food items on the menu, or to choose an alternate. Buying things with recyclable packaging, or reusable containers helps to keep our trash cans less full. Choosing energy efficient appliances, and remembering to turn them off when they are not being used, are also smart behaviors. This includes our lights and computers in schools.

Fuel for our vehicles—especially when you don’t go to the gas pump—is often forgotten. Energy used in transportation is another area of waste. Many schools have a no-idling rule for school busses at the curb, limiting how long they can run while parked. Diesel busses emit pollution in the form of particulates (soot), sulfur dioxide and nitrogen dioxide. These pollutants can add to breathing problems for sensitive people, including those with asthma. Parents also idle at the curb, waiting to pick up students. Some towns have posted no idling signs at their schools to prevent this pollution and waste of fuel.

Your Town’s Policies and Resources

Municipalities set their recycling regulations. They may require that more things be collected than are on the state list. For more information on your town’s requirements, you should talk with the recycling coordinator in your town. CT Department of Environmental Protection has a list of local recycling coordinators. (http://www.ct.gov/dep/cwp/view.asp?a=2714&q=324868&depNav_GID=1645)

Safety Disclaimer:

The content of this Teacher’s Resource section is intended to serve as an educational resource for teachers and students.

Preparing for the safety of yourself and your students is a critical step in planning for any hands-on science- related activities. Prior to conducting any of the activities included in this resource section, please familiarize yourself and your students with any potential hazards, and take the necessary precautions appropriate for each specific activity.

Connecticut Science Center is not responsible for the contents of any books, videos, websites or other resources to which we provide a reference and does not necessarily endorse the opinions, activities, services, products or information expressed within them.

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Professional Development

Come be a student for a day! Prior to bringing your class to the CT Science Center, you are encouraged to spend time at the Center and explore the exhibits and programs available to you and your students by participating in our Field Trip Professional Development Workshop.



During this day, you will have an opportunity to explore the River of Life Gallery and Exploring Space Gallery and other relevant galleries using our standards based Trail Guides. These guides will lead you and your students on the pathway toward enjoying the museum while maintaining focus on your grade level or content standard.

Afterward, you will process the various activities and discuss their applications in your classroom and in your students’ learning.

Introduction to Inquiry

The Connecticut Science Center’s Introduction to Inquiry Professional Development workshop was launched in the summer of 2005 and funded by the GE Education Foundation. Based upon the Exploratorium’s Institute for Inquiry in San Francisco, our Science Center’s professional development workshop is a five day immersion experience in inquiry-based learning and teaching plus an additional two days at the Annual Follow Up Conference.

The Center’s Introduction to Inquiry workshop is tied directly to the CT Science Framework Connecticut adopted in 2004. The workshop’s programming addresses requirements in Connecticut’s Common Core of Teaching and Common Core of Learning as well. Please visit <http://www.CTScienceCenter.org/pd> for more information and to register.

Interdisciplinary Connections/Extensions

MUSIC

RECYCLED INSTRUMENTS

Use found materials to make a recycled instrument band. These may include a variety of percussion instruments, wind instruments, and string instruments. Your school music teacher may be a resource for this activity. Some examples with directions for making simple instruments may be found at:

Make musical instruments~

<http://www.satisfied-mind.com/index.htm> Includes directions for making a banjo, bass, dulcimer, drum, rain stick, and thumb piano; Making Nigerian instruments~

<http://www.uni.edu/gai/Nigeria/Lessons/Instruments.html> includes directions for a drum, shaker, leg rattle, lute, and tambourine, as well as teacher background with social studies links.

RECYCLED ART

Use found materials to make art. Sculptures, mosaics, collages, puppets, recycled greeting cards and more. Your school art teacher may be a resource for this activity.

MATH

HOW MUCH TRASH DO YOU MAKE?

Assess the waste from student lunches at school. (Alternatively, students may examine their snack waste and trash.) Have the class collect, log, and weigh the waste from carried in lunches as well as purchased lunches. What observations do they make from this data? Chart or graph findings. Extend the collection to create an average calculation. Work with students to analyze their findings, develop solutions to any problems that they identify, and to present to the administration, parents or other interested groups their solutions.

Each of us creates waste everyday. From food wrappers, to water bottles, scrap paper and other refuse, it all adds up. Have students collect their dry, clean waste in a bag for a day or longer. Make a recycled booklet from cardboard and recycled paper to log their wet and smelly wastes. Calculate mass of the waste, and create data charts on what students are throwing out. Extend the collection to create an average calculation. Work with students to analyze their findings, develop solutions to any problems that they identify, and to present to the administration, parents or other interested groups their solutions.

LEARNING ABOUT LITTER

From the Solid Waste Management Resource Guide for Massachusetts Schools (1996):

<http://www.p2pays.org/ref/11/10517.pdf>, author Kristen Walser

THEME: Litter is a serious problem that we can all help solve.

GOAL: Students will realize that their actions can help solve litter problems.

METHOD: Litter walk and discussion

SUBJECTS: Art, Social Studies

SKILLS: Analyzing, examining, identifying

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MATERIALS: A rough scale map of the school grounds, divided into four or five areas; gloves; trash bags for collecting litter

TIME: 1 hour

GETTING STARTED

Do you see litter on your way to school or on the school ground? What kind? Why do you think people litter?

PROCEDURE

1. Divide the children into four or five groups and distribute trash bags and gloves. Send each group to a designated area of the school yard, as shown on the map. Have students collect the litter in their area (excluding broken glass or other dangerous items).
2. Have each group sort through their bag and identify the types of litter they collected and the number of pieces in each category.
3. Discuss the following questions after each group has recorded its data.
 - a. What kinds of litter did you find in your area? How much was there? Did you expect to find more? Less?
 - b. Where do you think it came from?
 - c. Did some areas have more litter than others? Why?
 - d. Were different kinds of litter found in different areas?
 - e. What are some of the negative impacts of littering? (e.g., it’s ugly, it pollutes the earth, it may be dangerous)
4. As a class, brainstorm ways to reduce litter in and around your school. Start a campaign to educate your school about litter. Have students design anti-litter posters, write and perform skits for other students, or campaign for more trash cans at school.

Language Arts EXTENSIONS

1. Have students read (or read aloud to each other) *The Wartville Wizard* by Don Madden (New York: MacMillan Press. 1986.). This book tells the story of a man given the power to make litter fly back onto the person who threw it away.

WISE USE OF PAPER

From the Solid Waste Management Resource Guide for Massachusetts Schools (1996): author Kristen Walser

THEME: Many of our daily habits are wasteful regarding the use of paper.

GOAL: Students will recognize how much paper is wasted and how it accumulates over time.

METHOD: Collecting and weighing paper, graphing the results

SUBJECTS: Math, Social Studies

SKILLS: Analyzing, comparing, measuring

MATERIALS: Waste paper; two cardboard boxes; scale

TIME: 2 weeks

GETTING STARTED

Ask the students how much paper they think they use. How much do they think they waste?

PROCEDURE

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1. Each day have the students place in boxes all paper that would normally have been thrown away. In one box, place paper that has been completely used (i.e., written on both sides). In the other, pile paper that has been only partially used or not used at all. Students might set this experiment up in another classroom where the users would not be aware of the experiment.
2. At the end of the day select a student to weigh each stack of paper and have the class graph the results.
3. Follow this procedure every day for a week and discuss the following: Were you surprised at the amount of paper that was wasted? What is the effect of this waste on our natural resources and landfills? How can people change their habits so that there is less waste?
4. Repeat the same activity for a second week. How different were the results? List on the board the different ways the students tried to conserve paper. Are there other items that are sometimes thrown away before they are completely used?

EXTENSIONS

1. Using the results obtained above, have the class determine how much paper it would waste in a month. In a year? How much paper would the class save in a month or a year if it reduced its paper consumption by one half? By one-quarter?
2. Working in small groups, have the class list the paper products they use at home or at school. In a parallel column, have them list products that could be used in their place (e.g., dishcloths instead of paper towels, handkerchiefs for paper tissues).

From the Solid Waste Management Resource Guide for Massachusetts Schools (1996): from Washington, *A-Way With Waste*.

Language Arts Extensions

Venn Diagrams

Use Venn Diagrams to compare two pieces of paper. What is different and the same? Have the class compare their diagrams to create one diagram for the whole class.

Descriptive Vocabulary

Create headings on paper for different categories (color, shape, texture, smell, etc.) This may be directed by the teacher or in collaboration with the class. Give each student a sample of the paper made at the Science Center. Have them write as many descriptive words about their sample under the headings. Compare the words the class wrote down to make a master list. Have students re-evaluate their observations of their piece of paper to see how many words fit their sample.

Autobiography of Paper

Have students write an autobiography, pretending that they are a piece of paper. When and how were you ‘born’, how did you ‘live’, did you ‘die’ or go on to have another life?

Mathematics Extensions

Mass and Measure

Measure and cut different paper samples into a standard size using a centimeter ruler (10 cm size works well) Provide different paper types, including tissue, writing paper, wrapping paper, cardboard,

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etc. Use a gram scale to mass different paper samples. Create a chart and a graph with the information the group measures. Compare the different samples.

Social Studies Extensions

Paper Money

Compare paper money. Compare older US bills to the new style bills. What is different and what stayed the same? Provide hand lenses for close examination. Are bills for \$1, \$5, \$10 and \$20 all the same? Find out if international bills are available, have the students examine them. What is the value of the different bills compared to the US dollar?

Research

If your class is studying other cultures, research how paper is used there (crafts, etc)

Research the history of paper; investigate how paper is made in paper mills.

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Websites

Connecticut Clean Energy Fund

For programs to increase awareness of clean energy:

<http://www.ctcleanenergy.com/EducationalPrograms/tabid/61/Default.aspx>

See an electron microscope picture of toilet paper, magnified 500x

<http://www.mos.org/sln/sem/tpaper.html>

Recycling IQ Game. <http://www2.ci.seattle.wa.us/util/RecyclingIQ/recyclingiqgame.swf>

Designed for the Seattle recycling program, this game has a beginners and advanced level.

US EPA’s “Tools to Reduce Waste in Schools” A 44 page booklet

This guide provides schools, school districts, and school business officials with audience-specific information for starting or expanding an existing waste reduction program.

Solid Waste Management Resource Guide for Massachusetts Schools (1996): The guide includes great information and lots of activities, including: What is Waste? ; Sizing Up Waste: Volume vs. Weight ; Be a Garbage Detective One Person’s Garbage Can Is Another’s Gold Mine ; Creating Crayons; Taking Care of Our Land and Hazards at Home.

The Connecticut Resource Recovery Authority CRRA has a trash museum and recycling educational materials - info at: <http://www.crra.org/pages/education.htm>

A storytelling and magic performance that teaches children the magic in recycling. Through a combination of make-believe and real-world information, this program ensures children understand the power they have to make the old into the new through recycling.

Information on America Recycles Day (ARD) can be found at <http://www.americarecyclesday.org/>
Recycling 101 – The Basics, The Benefits is the focus of this website. It usually happens on November 15th.

US DOE’s Energy Hog program Teacher’s Guide <http://www.energyhog.org/pdf/teacherguide.pdf>

The Energy Hog Challenge is a fun way to educate students in grades 3-6 about how they use energy in their homes and how to become responsible, smart energy users. The Challenge Guide uses the home as a real-world laboratory. As students become aware of ways energy is used and how it can be saved at home, they can expand that awareness to their schools.

Literature Links

ISBN Numbers are available online-use Google Search: type in search ISBN-Book title and Author

TITLE	AUTHOR(S)	PUBLISHER	*How resource has been used in the unit
Why Should I Save Energy?	Green, Jen	Barron's Educational Series	Children take electricity and other energy sources for granted, until one day their community has a power blackout. They come to realize that in lighting homes and keeping houses warm, we are using up natural resources. (Gr. K-4)
<u>Recycle: A Handbook for Kids</u>	Gibbons, Gail	Little, Brown Young Readers	This book explains the process of recycling from start to finish and discusses what happens to paper, glass, aluminum cans, and plastic when they are recycled into new products. (Gr. 2-4)
<u>Where Does the Garbage Go?</u>	Showers, Paul	Harper Trophy	Follow that garbage truck to the landfill to see how trash keeps piling up, to the incinerator to see how trash can be turned into energy, and to the recycling center to see how a soda bottle can be turned into a flowerpot. This book is filled with graphs, charts, and diagrams. (Gr. 2-4)
<u>Crashed, Smashed, and Mashed: A Trip to Junkyard Heaven</u>	Mitchell, Joyce	Tricycle Press	With a glossary full of junkyard talk and a page of recycling facts, this book is one that readers will pick up to learn the lingo and to understand a bit about the salvage process. (Gr. 3-6)
<u>Recycling & Reusing Metal</u>	Thomson, Ruth	Franklin Watts Ltd	(Gr. 3-6)
<u>Recycling & Reusing Paper</u>	Thomson, Ruth	Franklin Watts Ltd	(Gr. 3-6)
<u>Recycling & Reusing Glass</u>	Thomson, Ruth	Franklin Watts Ltd	(Gr. 3-6)
<u>Recycling & Reusing Plastics</u>	Thomson, Ruth	Franklin Watts Ltd	(Gr. 3-6)
<u>The Wartville Wizard</u>	Madden, Don	Aladdin	An old man fights a town of litterbugs by magically sending each piece of trash back to the person who dropped it. (Gr. K-3)
<u>Common Ground: The Water, Earth, and Air We Share</u>	Bang, Molly	Blue Sky Press	Imagine a village in which there are too many people consuming shared resources and discusses the challenge of handling our world's environment safely. (Gr. 3-7)

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TITLE	AUTHOR(S)	PUBLISHER	*How resource has been used in the unit
<u>Trashy Town</u>	Zimmerman, Andrea & Clemesha, David	HarperCollins	This jaunty look at garbage collection makes a backbreaking job look like fun. They show a brightly colored, if somewhat messy, town—definitely in need of the trash collector's cheerful care. (Gr. K-3)
<u>Hansel & Diesel</u>	Gordon, David	Laura Geringer	Hansel and Diesel are sibling pickup trucks who wander from their junkyard home in search of fuel (trailing bolts in lieu of bread crumbs) and into the clutches of the Wicked Winch. She lives in the most beautiful gas station they could have imagined...right in the middle of the junkyard! When the thirsty little vehicles help themselves to deep glugs of her warm gasoline, the Winch inquires, Guzzle, guzzle, drip and drool, who is drinking all my fuel? (Gr. K-2)
<u>The Lorax</u>	Seuss Dr.	Harper Collins Children	Long before saving the earth became a global concern, Dr. Seuss, speaking through his character the Lorax, warned against mindless progress and the danger it posed to the earth's natural beauty. After reading the book, students might like to visit the Seuss website and try the Lorax game to catch Truffula seed and plant trees. http://www.seussville.com/games/lorax/ (Gr. K-3)

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Video

How Aluminum is Made

View an online video short about how aluminum is made from bauxite ore.

http://www.alcoa.com/global/en/about_alcoa/dirt_video.asp

Wormfarm

View the how to make a worm farm video by Dragon Fly

<http://pbskids.org/dragonflytv/show/wormfarm.html>

Wake Up, Freddy

One man's morning routine reveals the hidden energy costs of everyday life.

Grade Level: 2-7 ISBN (VHS): 1-56029-568-6 800/543-FROG (3764)

info@bullfrogfilms.com

Here's My Question: Where Does My Garbage Go?

A fun film to teach kids about waste and recycling - 26 minutes

Grade Level: K-5 ISBN (VHS): 1-56029-819-7 ISBN (DVD): 1-59458-446-X

800/543-FROG (3764) info@bullfrogfilms.com

Recycling is Fun!

Children discover their power to save the world – 12 minutes

Grade Level: Grades K-4 ISBN (VHS): 1-56029-365-9 800/543-FROG (3764)

info@bullfrogfilms.com

Toast

A classic energy film that reveals our underlying dependence on fossil fuels.

Grade Level: 3-12, College, Adult ISBN (VHS): 1-56029-286-5 ISBN (DVD): 1-59458-604-7 800/543-

FROG (3764) info@bullfrogfilms.com

Classroom Kits

Worm-A-Way Kit The easy-to-use Worm-a-Way Kit system demonstrates the principles of conservation and recycling. Students bury food scraps, harvest compost, and finally grow a plant in the rich compost soil. Deluxe Kit includes complete system, *Worms Eat My Garbage* book, and a mail-in living materials card for 1 lb of red worms. \$94.95 from www.delta-education.com

Dirt Makers: The World of Earthworms, Carolina Biological (95-1630)

Introduce your class to the life cycle of the earthworm. Students collect food to feed the worms and learn how recycling leftover food makes soil. They also learn to maintain the worm habitat. Each kit comes with red worms, a 1 1/2-gal terrarium with lid, soil, worm closet (for keeping worms in the dark), rocks, and a fork for stirring food into the soil. Complete with teacher information on habitat and feeding. Grades K–3. Price: \$21.25

Classroom Worm Composter, Carolina Biological (14-1560) Introduce students to the importance of decomposers in the food web as well as the concept of recycling through composting. As students add kitchen waste to this 14-gal "vermi-composter," they observe the quick and efficient conversion of organic matter into enriched soil components by red worms. The composting container has 3 vents for proper air flow. The **Complete Kit** includes the WW-14-1562 Composter, worm bedding, red worms, and the classroom activity book *Worms Eat Our Garbage*. The **Composter** is constructed of recycled plastic and is about 22" W x 17" D x 12" H. Kit contains coupon for prepaid delivery of live materials; live materials can be delivered with kit on request.

Grade K and up. Price: \$96.50

[The Technology of Paper Unit Kit](#), Carolina Biological (97-3301AV) Exploring paper and the papermaking process can be a great way to teach science concepts about substances, their properties, the role of science and technology in society, and more. During this hands-on unit, students test common types of paper for various properties (like opacity and smoothness), then make recycled paper and alter variables that affect its properties. As a final assessment, students develop specifications for making a recycled paper product—greeting card, piece of stationery, or postcard—and then follow those specifications to create it. Grade 6 Price: \$1399.95

CRRA Loan Kits, books and videos are available on a free-loan basis from CRRA Trash Museum in Hartford (860) 757-7765 and The CRRA Garbage Museum in Stratford (203) 381-9571 there is a required, refundable deposit fee of \$20 per item. The deposit is returned by mail after the museum staff has inventoried the material. Materials are lent for a two-week period

Each museum has a collection of Loan Kits, books, and videos on various aspects of waste management. Each Loan Kit includes things like activities, lesson plans, books, videos, background information, artifacts, games and other materials. The items are in a trunk, awaiting your imagination to put them to use in your own way. Kits available include:

WORM COMPOSTING: Explore the life and workings of vermicomposting worms through the use of the worm composting bin. Along with the bin, the kit includes: an instructional guide, videos and lots of materials

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to discover how special red wigglers create rich “humus” called compost. The kit is lent out for a month so the cycle of compost making can be fully realized. (CRRRA)

ARTS & CRAFTS: "What can you make with...? Let your imagination go!" In this kit you will find many materials for children to use in new and imaginative ways. Materials include fancy hole punches, markers and various discarded items. The children are challenged to create something using the contents of the Mystery Bag. The kit also includes a giant bulldozer puzzle, wipe-off boards/posters and audio tapes all relating to the concepts of Reduce, Reuse, and Recycle. *(Also available at The CRRRA Garbage Museum in Stratford)* (CRRRA)

TRASH DETECTIVE: Be a trash detective and explore the world of trash, recycling and litter. A lunch box and tote bag set the example for reducing waste. Age-appropriate games explore the different types of trash. The kit includes picture books, video, hands-on objects and teacher guides. *(Also available at The CRRRA Garbage Museum in Stratford)* (CRRRA)

TRASH EXPLORERS: Trash often makes children giggle. But what is trash and where does it go? Put on a hard hat and be a trash explorer. This kit explores recycling, composting and garbage. This kit includes picture books, videos, flannel board, hands-on objects and background information for teachers. (CRRRA)

TRASH TALK: This informative primer on the topic of trash and the 3Rs (reduce, reuse, recycle) educates and stimulates young children to explore where their garbage goes. This kit is a good discussion starter and works as an expressive art stimulus. How can we make less garbage? Includes: video, picture story books, write-and-wipe boards and products that demonstrate reusing and recycling. (CRRRA)

RECYCLING FASHION HITS THE RUNWAY: This kit contains a wide variety of clothing and accessories made from recycled materials, as well as a complete fashion show script. Add your favorite music and let the show begin! *(Also available at The CRRRA Garbage Museum in Stratford)* (CRRRA)

RECYCLE MATCH GAME: Did you know that soda bottles can be recycled into carpeting? Test your recycling I.Q. and see if you can match the new product made from its recycled source. *(Also available at The CRRRA Garbage Museum in Stratford)* (CRRRA)

PETE'S PACK PLUS: When is a soda bottle not a soda bottle? When it is recycled into new products. This kit examines the advantages and innovation in plastic recycling. It includes interesting samples of recycled plastic: sleeping bag, carpet, fabric and egg carton. (CRRRA)

PLASTIC PRIMER PLUS: Plastic: What is it? Where does it go? This kit is an introduction to the positive aspects of plastic, including recycling. It identifies and defines plastic resins and their uses. What do the code numbers on the bottom of plastic containers mean? The answer is in this kit. (CRRRA)

PLASTIC INNOVATION: Take an interesting look at innovations in plastic recycling. Samples and explanations of what's new in recycled plastic products: soda bottles become carpets and clothing, milk jugs become park benches, PVC piping becomes toys. (CRRRA)

GLASS RECYCLING: What makes glass an ideal environmental package? Glass is a "closed loop" recycling material. It is 100 percent recyclable again and again. This kit defines and explores contamination, cullet, secondary markets and new inventions. Learn how glass containers are manufactured and recycled, then analyze the advantages of glass. Glass recycling makes both sense and cents. Included are videos, posters, background information, Brandt colorcoat bottles and recycled glass articles. (CRRRA)

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VIEWPOINTS ON RECYCLING: Stop! Is it really trash? This kit provides information and viewpoints on recycling: recyclability, recycling content, the economics of recycling and how to set up a school recycling program. It includes EcoRaggs recycled hats, video and audio tapes, books, comics and curriculum. (CRRA)

ALUMINUM RECYCLING: Some people call aluminum the "magic metal." This versatile metal can be recycled in an endless loop. Look at the story and uses of aluminum with an emphasis on recycling. It includes video, teacher guide, bauxite and aluminum samples and suggested experiments. (CRRA)

PAPER RECYCLING: Can you really recycle waste paper into decorative paper or works of art? Yes. Probably no current product has been recycled longer than paper. This kit includes tin can paper recycling equipment, posters, videos, activity books and samples of recycled paper pens, pencils and other products. (CRRA)

RECYCLING OVERVIEW: This kit identifies the how, why and what of recycling. This overview defines and clarifies the terms "recyclable," "recycled," "pre- and post-consumer recycled content." This kit includes teacher background information, activity books and samples of products made from recycled material (jewelry, toys, Deja shoes). (CRRA)

STEEL CAN RECYCLING: Yesterday’s can is today’s car ... Today’s car is tomorrow’s can. Steel cans are an integral part of curbside recycling. Explore the world of steel can recycling with student work sheets, videos, public service announcements, photo display and posters. (CRRA)

THE GARBAGE DUMP DILEMMA: This is a role-playing simulation of a real world garbage dump dilemma. Follow two students as they learn about the trash crisis facing their town and explore the possible solutions. (CRRA)

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Software

The Adventures of Herman included in the Schools Online CD from the University of Illinois Extension. \$16.99 for entire CD which guides kids as they learn about the genealogy of worms, a worm's eating habits, and discover how annelids manage without noses, eyes, arms or legs.

<http://www.urbanext.uiuc.edu/SchoolsOnline/CD/default.cfm?site=worms>

Home and School Connection

INCORPORATING REUSE INTO SPECIAL PROJECTS OR ACTIVITIES AT SCHOOL , From the Connecticut Department of Environmental Protection “Tips on Waste Reduction and Reuse for Schools (http://www.ct.gov/dep/cwp/view.asp?a=2714&q=324928&depNav_GID=1645)

You may also want to incorporate reuse into special projects or activities at the school. A few examples of this type of project are listed below.

1. Hold a "SWAP DAY". Have student bring in items from home to swap with other children. (Of course parental permission will be needed.) You may want to limit the types of items that can be brought in to items such as books or small toys to facilitate "even" trading. This can be made part of **Social Studies** lesson in the development of trade and monetary systems.
2. Collect other reusables such as clothing for local charities.
3. Maintain a free listing service of used musical instruments and sporting equipment in your school newsletter. Parents will appreciate this effort! It may encourage some children to try an activity that their family might not be able to otherwise afford.
4. Incorporate the use of reusables into your science program by hosting an inventor fair. Have the children design some machine or other contraption from found items. You will be amazed at what the children come up with!
5. Establish a bird feeding/observation area with feeders made from containers that have already been used once for another purpose such as milk jugs, paper milk cartons, soda bottles, etc. Establish a site where these feeders can stay for an extended period of time. Allow the children some observation time to record which birds frequent the different feeders.

SNEAKER RECYCLING

Participate in the Nike Reuse a Shoe program that collects old sneakers to turn into athletic surfaces such as tracks and playgrounds.

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Career Information

Energy and Recycling Careers

Interview school district personnel who work with the energy and waste use in the school (fiscal department, maintenance staff, and town recycling coordinator) What decisions are made, how do they affect the students and their families, and what jobs are there in this field? What could students do to help make these jobs easier and more effective in the school?

Check your local or regional recycling center for tours and discussions of jobs.

Vocational Biographies

<http://www.vocbio.com>

This is a fee site. Perhaps your school system already has access. They explore careers by telling the stories of persons working in those careers. Our biographies track workers from their school experiences through their current jobs and lifestyles. It is set up as a 4 page newspaper article-easy to read.

Conservation Careers

www.soils.org

Finding a major to match your interests and goals can be confusing. This guide serves as a reference to the wide variety of study paths available to students entering the conservation and environmental arenas.

Conservation Career Gateway

<http://www.nwf.org/careergateway/>

Listing of intern, volunteer and paid positions to give students an understanding of all the opportunities available in the field of conservation.

Student Resources

Safety Disclaimer:

The content of this Student’s Resource section is intended to serve as an educational resource for students.

Preparing for the safety of yourself is a critical step in planning for any hands-on science- related activities. Prior to conducting any of the activities included in this resource section, please familiarize yourself with any potential hazards, and take the necessary precautions appropriate for each specific activity.

Connecticut Science Center is not responsible for the contents of any books, videos, websites or other resources to which we provide a reference and does not necessarily endorse the opinions, activities, services, products or information expressed within them.

Websites

Connecticut Clean Energy Fund

For programs to increase awareness of clean energy:

<http://www.ctcleanenergy.com/EducationalPrograms/tabid/61/Default.aspx>

The Adventures of Herman Learn about worm history, anatomy, feeding, and care from Squirmin' Herman. University of Illinois Extension. <http://urbanext.illinois.edu/worms/>

Yucky Worm World From Discovery Kids, Learn all about earthworms and visit with Mary the Worm Woman. <http://yucky.discovery.com/flash/worm>

Washington State Department of Ecology’s Kids Recycle Page Learn about recycling, play some games www.ecy.wa.gov/programs/swfa/kidspage

US Department of Energy’s **Energy Kid’s Page**, Learn about energy, energy facts, fun and games. <http://www.eia.doe.gov/kids/>

Join the **Energy Hog** to save energy, from Alliance to Save Energy. <http://www.energyhog.org>