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Environmental Protection
Agency

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Solid Waste and Emergency Response (5305W)

Science Fair Fun

Designing Environmental Science Projects

Note for Teachers:

This booklet is intended to provide students in grades 6 to 8 with ideas and resources for developing environmental science fair projects, specifically in the areas of reducing, reusing, and recycling waste materials. Environmental terminology and topics in this booklet are addressed without in-depth definition or discussion, under the assumption that students have been exposed to these topics already through a classroom environmental science unit. Some kinds of experiments require more time than others to yield results. Be sure to discuss your intended time frame when helping students decide on a project.

Note for Students:

To get you started on designing your own environmental science fair experiment, this booklet contains ideas and suggestions for projects on reducing, reusing, and recycling. You should work with your teacher to decide what kind of project you'd like to do and how to tailor an experiment to your needs. You can ask your teacher for help constructing a hypothesis, defining variables, and determining what kind of equipment is available to you. Definitions for important solid waste terms used in this booklet can be found in the glossary on page 10. Also, you should note that some kinds of experiments take longer than others to yield results, so be sure to check if you have a time limit.

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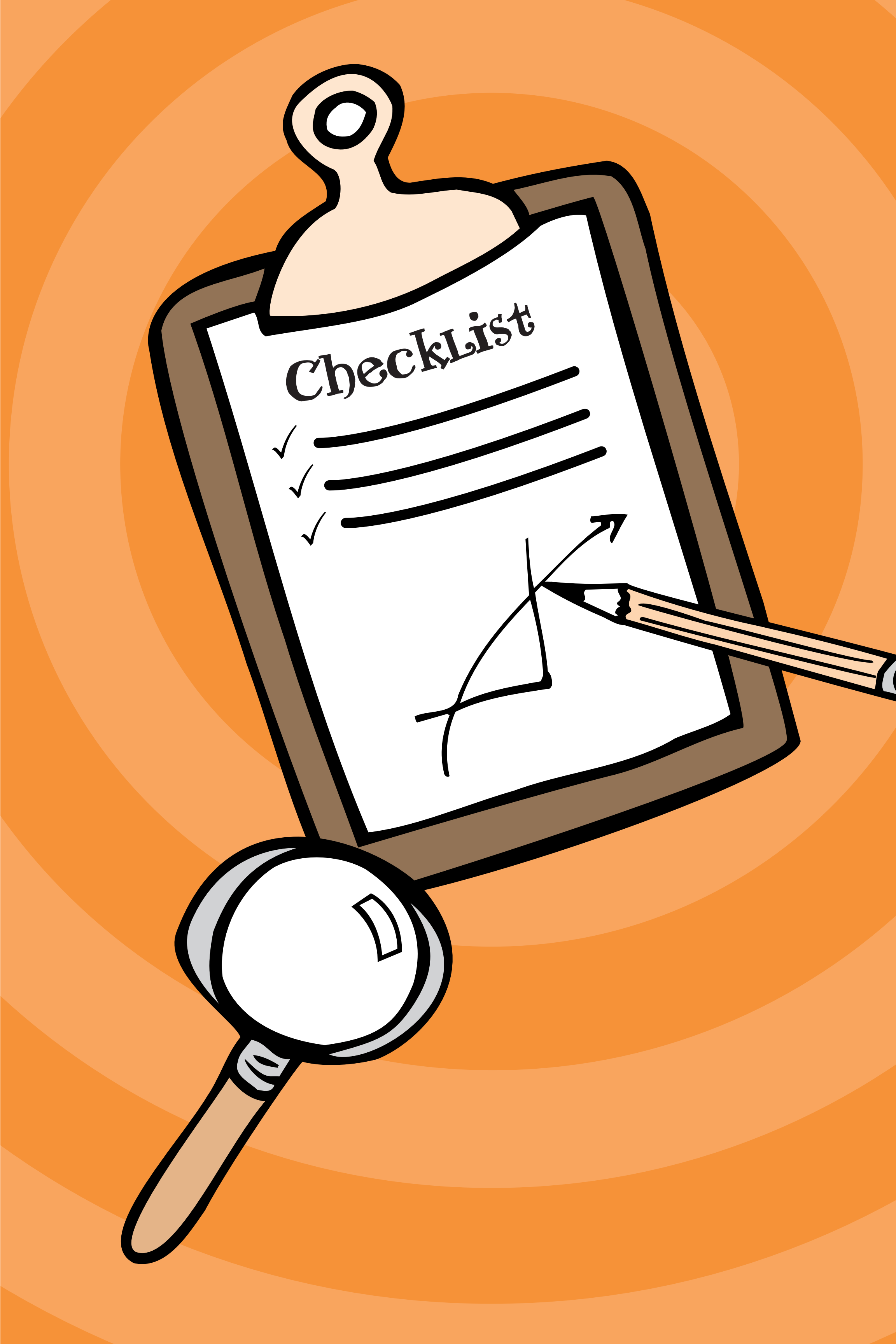
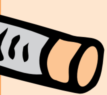

CheckList

Getting Started

Science is fun—especially when you create a science fair project focusing on the environment! Stumped on how to start or what to do? This booklet can be your guide. Good luck!

How to Use This Booklet

This booklet provides a step-by-step guide on conducting an environmental science fair project and contains several example projects. The examples focus on various aspects of the "3 Rs" (reduce, reuse, and recycle), such as measuring the amount of trash thrown away each week or determining which waste items will biodegrade when placed in a landfill. This booklet also contains a list of useful resources for developing potential projects.



Whether you are starting a science fair program in your school or are looking to expand your knowledge of the 3 Rs, this booklet will help get you started. Through science fair projects, you can learn more about the world around you and help make a difference in protecting the environment.

What is EPA?

The U.S. Environmental Protection Agency (EPA) is a federal agency that exists to protect human health and the natural environment. Within EPA, the Office of Solid Waste (OSW) is tasked with ensuring responsible management of hazardous and nonhazardous waste. OSW's goals are:

- To conserve resources by preventing waste.
- To reduce the waste that cannot be prevented.
- To ensure that all waste is disposed of properly.

To achieve these goals and further promote education and outreach, OSW encourages you to learn about the "3 Rs" (reduce, reuse, and recycle) through environmental science fair projects.

Fair Play: Steps to Conducting a Science Fair Project

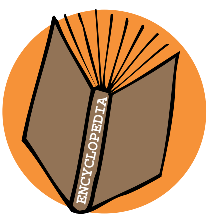
Did you ever notice something and wonder why it happens or see something and wonder what causes it? Do you ever want to know how or why something works? Do you ask questions about what you observe in the world? If so, you are on your way to conducting a science project! The following guidelines offer some steps to follow.

Make Initial Observations

Write down something interesting you noticed and want to investigate in more detail. Make a list of questions about the topic.

Gather Information

Research the topic you want to investigate. Search the Internet, go to the library, read books and magazines, or talk to others to learn about what you are studying. Keep track of where you obtained your information.



Give the Project a Title

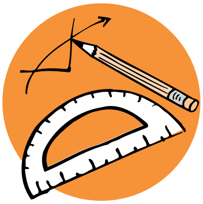
Choose a title that describes what you are investigating. The title should summarize what the investigation will cover.

State the Purpose of the Project

What do you want to find out? Write a statement describing what you want to do. Use your observations and questions to write the statement.

Craft a Hypothesis

Make a list of answers to the questions you have. This can be a list of statements describing how or why you think the subject of your experiment works. The hypothesis must be stated so that it can be tested by an experiment.

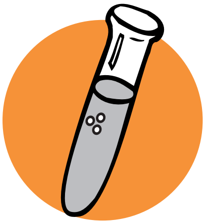


Design an Experimental Procedure to Test the Hypothesis

Design an experiment to test each hypothesis. Make a step-by-step list of what you will do to address the hypothesis. This list is called an experimental procedure.

Obtain Materials and Equipment

Make a list of items you need to do the experiments and prepare the items. Try to use everyday, household items. If you need special equipment, ask your teacher for assistance. Local colleges or businesses might be able to loan materials to you.

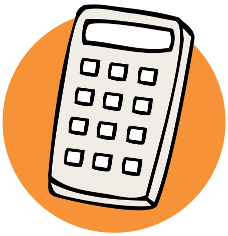


Perform the Experiment and Record Data

Conduct the experiment and record all numerical measurements made, including quantity, length, or time. If you are not measuring something, you probably are not doing an experimental science project.

Record Observations

Record all your observations while conducting your science project. Observations can be written descriptions of what you noticed during an experiment or the problems encountered. You can also photograph or videotape your experiment to create a visual record of what you observed. Keep careful notes of everything you do and everything that happens. Observations are valuable when drawing conclusions and useful for locating experimental errors.



Perform Calculations

Perform calculations that turn raw data recorded during experiments into numbers you will need to make tables or graphs to draw conclusions.

Summarize Results

Summarize what happened. This summary could be a table of numerical data, graphs, or a written statement of what occurred during the experiments.

Draw Conclusions

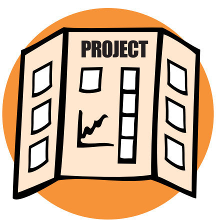
Using the trends in your experimental data and your experimental observations, try to answer your original questions. Is your hypothesis correct? Now is the time to pull together what happened and assess the experiments you conducted.

Prepare a Presentation

To prepare a presentation, ask yourself, "What is most interesting about this project, what will people want to read about, and how can I best communicate this information?" Most of the time, students prepare a poster or three-sided display to give their audience a quick overview of the question asked, the method used, results, and conclusions. You can draw charts, diagrams, or illustrations to explain your information.

What to Do if a Project Does Not Work

No matter what happens, you will learn something. Science is not only about finding "the answer." Knowing that something did not work is actually quite valuable. Experiments that do not turn out as planned are an important step in finding an answer.



Some science fairs require oral presentations. Use an outline or note cards to assist you in your presentation. Although individual science fairs might have different rules, you will most likely be required to introduce yourself and your topic; state what your investigation attempted to discover; describe your procedure, results, and conclusions; and acknowledge those who helped you.

Sample Projects: The Science of the 3 Rs

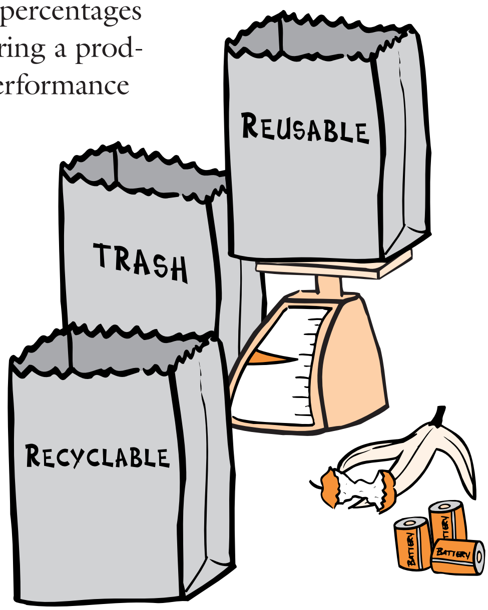
The following sample projects were created to provide you with a basis for designing your own environmental experiment. You must expand on any of these ideas by coming up with your own hypothesis and exact experimental procedure. You can also design an experiment to test a different aspect of any of the topics discussed, or use one of the sample procedures to conduct an experiment on a different environmental topic.

Soap Box Opera

Usually, it is more economical to buy larger rather than smaller sizes of products. Purchasing larger quantities is known as "buying in bulk." For example, a 5-ounce box of brand X laundry detergent might cost $3. Dividing 5 into $3 gives us a cost of 60 cents per ounce. A 10-ounce box might only cost $5, making the cost 50 cents per ounce. Buying in bulk might have advantages other than cost savings. Examine the ratio of carton material to the product quantity. Does buying in larger quantities also require less packaging material per unit measure of the product? Could people lessen their impact on the environment by buying in bulk?

Test Your Strength!

Some people question whether products made from recycled materials can perform their jobs as well as products made from entirely new materials. Plastics, paper products, aluminum cans, and some clothing are all commonly available with both new and recycled content. Choose a product, such as writing paper, and compare the strength and performance of the "virgin" (new) product to ones made with different percentages of recycled content. Does manufacturing a product with recycled materials alter its performance (e.g., strength, durability)?



Garbage Away

Much of what we throw away can be returned to the earth to provide nutrients for the soil rather than going to a landfill. Evaluate and record each item your family throws away for 1 week by collecting, weighing, and categorizing them as recyclable, reusable, biodegradable, or trash. How much of what we throw away could be recycled or is biodegradable and could be returned to the earth?

A Trashy Survey

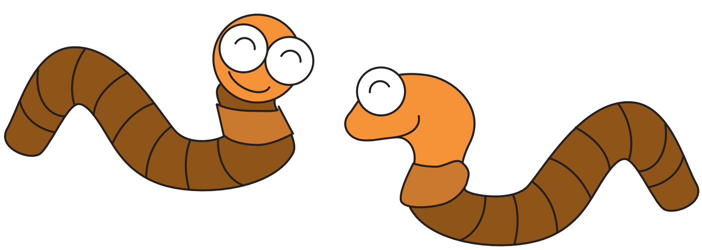
How many people around you save newspapers, bottles, and other items to recycle? How many people around you compost their food scraps or yard trimmings in their kitchen or backyard? How many people reuse grocery bags and scrap paper, donate clothes and books instead of throwing them away, or conduct other waste reduction activities? Try to determine what percentage of the population around you participates in these and other waste reduction activities. Survey a select number of people, including your neighbors, teachers, friends, local store owners, relatives, and others. Extrapolate these figures to obtain a percentage for your entire community.

Creating the Perfect Compost

Composting can be a good way for gardeners to reuse food scraps and yard trimmings while making their gardens healthier. In order to work properly, a compost pile needs the right balance of air, moisture, carbon, and nitrogen. Build several different compost piles and vary the amounts of air, moisture, carbon, and nitrogen in each (e.g., one that is very dry, one carbon-rich, and one nitrogen-rich). For example, a carbon-rich pile would mostly contain dead leaves or coffee grounds while a nitrogen-rich pile would mostly contain grass clippings or fruit and vegetable peels. Make sure you also build a "perfect" compost pile with good air circulation and a balance of ingredients to control the experiment. What effect will differences in the ingredients have on the finished compost?

Secrets of Gardening Success

Compost can help plants grow by adding important nutrients to the soil. You can test the effectiveness of compost as a soil amendment by planting two small potted gardens, adding compost to one and using only soil for the other. Fast growing seeds, such as sunflower or bean seeds, will allow you to see results in a matter of days. Make sure both pots receive the same amount of moisture and sunlight to control the experiment. Compare the root structures and stems from plants from the two pots. Does adding compost to the soil result in healthier, stronger, faster-growing plants?



Maid in the Shade

Paints, cleaners, and other toxic, corrosive, ignitable or reactive products used at home may be hazardous to human health and the environment. There are, however, a number of natural alternatives that can do the same job with less risk. Choose several household cleaners, such as glass cleaner, silver polish, laundry bleach, or furniture polish, and compare their effectiveness with natural do-it-yourself alternatives. When handling household hazardous products, be sure to follow label instructions and always request adult supervision. Do the natural cleaners perform as well as the hazardous ones?

How Does Your Garden Grow?

The number of chemical combinations that have been invented is staggering and continues to grow each year. Many common, everyday items are made from these chemicals, including clothing, appliances, food wrappers, and containers, to name a few. Do these items decompose naturally when buried in a landfill, or will they remain as they are for long periods of time? Plant a throwaway garden. Do products made purely from natural substances break down faster than those produced with human-made chemical combinations?

References

Bonnet, Robert L., and G. Daniel Keen. *Environmental Science: 49 Science Fair Projects*, Blue Ridge Summit, PA: TAB Books, 1990.

Brisk, Marion A. *1001 Ideas for Science Projects*, MacMillan: New York, NY, 1994.

Project Learning Tree Environmental Education Activity Guide: Pre K-8, American Forest Foundation, 1997.

Glossary

Biodegradable—materials that decompose, usually by bacteria or sunlight, into their original organic components within a reasonably short period of time. Most organic materials (paper, grass clippings, food scraps), under the right conditions, are biodegradable.

Compost—a crumbly, earthy, sweet-smelling mixture of decomposing organic matter (e.g., leaves, food scraps) that is often used to improve the texture, water-retaining capacity, and aeration of soil.

Corrosive—a substance capable of dissolving or breaking down other substances (especially metals) or causing skin burns. A corrosive substance has a pH level below 2 or above 12.5.

Decompose—to break down into basic components, given the right conditions of light, air, and moisture; refers to materials such as food and other plant and animal matter.

Ignitable—capable of burning; will catch fire at temperatures less than 140° F.

Reactive—tending to: react spontaneously with air, solids, or water; explode when dropped; or emit toxic gases.

Natural resources—materials used to make products, generate heat, produce electricity, or perform work.

Toxic—containing compounds that pose a substantial threat to human health and/or the environment.

Virgin materials—previously unprocessed materials. A tree that is cut down and shredded to make paper is an example of a virgin material. Wood fiber recovered from used paper to make new paper is not a virgin material but a recovered material.

Recyclable—material that still has useful physical or chemical properties after serving its original purpose and can be reused or remanufactured to make new products. Plastic, paper, glass, steel and aluminum cans, and used oil are examples of recyclable materials.

Landfill—disposal sites for non-hazardous solid wastes spread in layers, compacted to the smallest practical volume, and covered by material applied at the end of each operating day. Hazardous wastes are taken to special disposal sites selected and designed to minimize the chance of a hazardous substance release into the environment.

Household hazardous waste—small quantities of unused or leftover hazardous products used in the home that become waste. Paints, pesticides, and some cleaners are examples of household hazardous waste. Caution must be taken when handling, storing, or disposing of these products.

Trash—items that are discarded because they no longer work and are uneconomical or impossible to reuse, repair, or recycle.

Resources

OSW Publications

The following documents are available from EPA's toll-free Hotline (800 424-9346) at no charge; reference the following publication numbers when ordering:

The Quest for Less: A Teacher's Guide to Reducing, Reusing, and Recycling. EPA530-R-00-008.

Planet Protectors Club Kit (workbooks, certificate, badge, board game). EPA530-E-98-002.

A Resource Guide of Solid Waste Educational Materials: Second Edition. EPA530-B-99-018.

Adventures of the Garbage Gremlin: Recycle and Combat a Life of Grime (comic book). EPA530-SW-90-024.

Ride the Wave of the Future: Recycle Today! (poster). EPA530-SW-90-010.

Service-Learning: Education Beyond the Classroom (brochure). EPA530-K-99-001.

Let's Reduce, Reuse, and Recycle! (CD-ROM). EPA530-C-00-001

OSW Online Resources

- http://www.epa.gov/epaoswer/osw/careers/

Online Resources for Environmental Science Projects

- http://www.isd77.k12.mn.us/resources/cf/SciProjIntro.html
- www.isd77.k12.mn.us/resources/cf/SciProjIntro.html
- www.detroit.lib.mi.us/is/science_fair.htm
- http://faculty.washington.edu/chudler/fair.html

Other Resources for Teachers

The Environmental Education Collection: A Review of Resources for Educators, Volume 1, North American Association for Environmental Education (1997).

The Environmental Education Collection: A Review of Resources for Educators, Volume 2, North American Association for Environmental Education (1998).

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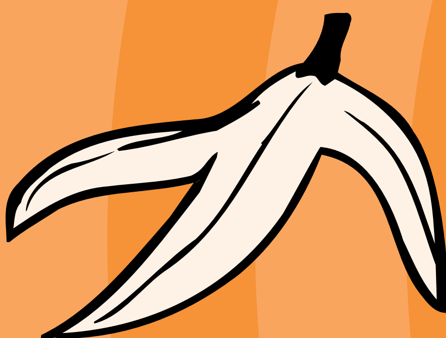

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