

GreenSpot Schools



***TWO OPTIONS
ONE BIG IMPACT***



Table of Contents

Introducing GreenSpot Schools	3-4
St. Mary School case study	4
Joining GreenSpot Schools	5-6
GreenSpot Schools	5
GreenSpot Classrooms	6
Introduction to Classroom Educational Commitments	7
GreenSpot Teachers Materials	7
GreenSpot & the Ohio Learning Standards	7-25
Kindergarten	8
Grade 1	9
Grade 2	10
Grade 3	11
Grade 4	14
Grade 5	16
Grade 6	17
Grade 7	18
Grade 8	21
High School	22
Appendices	26-32
Appendix A: the Greenhouse Effect	26
Appendix B: Bird Feeder	26
Appendix C: Bird Bath	27
Appendix D: Vermiculture	28
Appendix E: Environmental Law/Government	31
Appendix F: Anti-Idling	31
Appendix G: Bio-Fuel	32
Appendix E: Glaciers	32



Introduction

Our Mission:

“Help students learn how to make Columbus cleaner, healthier, and more environmentally sustainable.”

GreenSpot is a program of the Sustainable Columbus initiative. *GreenSpot* launched in 2008, by then Mayor Coleman, in response to a growing curiosity local residents and businesses expressed about what ‘going green’ really entails. Since that time over 17,000 residents and businesses have become members of the *GreenSpot* program by pledging online to actions that improve the environment.

GreenSpot Schools was developed by the Columbus Public Health Department as an offshoot of *GreenSpot* to provide support and materials to schools and classrooms who would like to become more environmentally friendly. The aim of the *GreenSpot Schools Program* is to encourage schools and classrooms K-12 to incorporate sustainability into their everyday operation and teaching practices. Sustainable schools save money, protect human and environmental health, and prepare students to succeed in a green future. The three objectives of the program are to:

1. **Make your school cleaner by reducing environmental impacts and costs by improving water, waste, alternative transportation, alternative energy systems, etc.**
2. **Improve the health and wellness of all students and staff.**
3. **Educate students on environmental sustainability in hopes of encouraging greener behaviors in the future.**

Looking Forward

Schools have the unique opportunity to introduce environmental sustainability to students as a priority from a young age.

GreenSpot Schools are forward-thinking and are focused on where our schools need to be in the future to address growing environmental challenges. Working towards the three *GreenSpot School* objectives teaches students about environmental issues

and allows them to make meaningful contributions to their community. By adopting sustainable practices, schools help to ensure that their students will grow up into a world that is sustainable, meaning that it provides as much or more promise and opportunity as the world today. The *GreenSpot Schools program* hopes to focus the boundless energy and enthusiasm of students and the continuous innovation of schools to create a better future for us all.



Introduction

Recognition

Exemplary *GreenSpot Schools* will be recognized for their sustainability achievements alongside green businesses and community members at the *GreenSpotLight Award* ceremony each spring. Factors determining the award winner may include:

- The amount of *GreenSpot* members per school.
- Activities undertaken to change behavior.
- Facility efficiency.
- Cohesion of the school administration, faculty and students.
- And, community engagement around sustainability.



St. Mary School German Village



Saint Mary School, 700 S. Third St., is the first school in Columbus to be designated as a *GreenSpot School*, after students there spearheaded a number of environmental projects the past two academic years. Students at the Catholic Preschool – 8th grade school developed a school-wide recycling project, a salsa garden, and a composting program designed to teach kids about the issue of climate change.

Student Council (pictured above) provides leadership by volunteering a portion of their lunch/recess time each day to guide their classmates in sorting their lunch waste into recycling, composting, unopened food, and trash bins, as well as, taking classroom recyclables to the school custodian each day. In the 4 months since the program was started, Saint Mary students collected over 8,000 gallons of recyclable material!

Last year, St. Mary 8th graders created a school garden where they grew tomatoes and cilantro that will be harvested and made into salsa. This year, the 8th graders have also decorated a rain barrel to water the garden, and are responsible for composting lunch food waste to fertilize their garden.

Christina Hickey, Saint Mary's Director of Marketing and Community Relations and art teacher, coordinated a school-wide presentation, where Public Health representative Stephanie Mitchell spoke on the importance of recycling and composting. Hickey also created GreenSpot necklaces for Student Council, and GreenSpot School certificates to reward

Joining GreenSpot Schools

Achieving your goals

Every classroom, school, and district is different. The two elements of GreenSpot Schools - GreenSpot Schools and GreenSpot Classrooms - help meet teachers and school administrators where they are, as well as provide reasonable opportunities and next steps on their unique sustainability journey.

Although either option can be implemented alone, we encourage implementing both options simultaneously for the most holistic educational experience and the greatest environmental benefit. Please review the requirements for each option on page 4 of this document then visit the GreenSpot website to enroll.

Option 1:

GreenSpot Schools *(for buildings and administrators)*

This option is designed to help school buildings become more energy efficient and to increase community involvement in sustainability.

STEP 1: Enroll your facility online as a [GreenSpot Business](#) and make the corresponding commitments

STEP 2: Select one or more school-wide Efficiency Commitment *(see below)*

STEP 3: Select one or more school-wide Engagement Commitment *(see below)*

Efficiency Commitments	Engagement Commitments
Replacing bulbs with CFLs or LEDs	Plant a rain garden
Purchase/use EnergyStar appliances	Build a school compost bin
Purchase/use electric maintenance equipment	Plant a vegetable garden
Install weather stripping, caulking	School plastic bag recycling
install programmable thermostat	School used clothing/toy/electronics donation drive
Clean refrigerator coils	School yard sale
Install high-efficiency water heaters	School lunch recycling/composting program
Install insulating curtains	Schedule a school-wide presentation on a sustainability topic
Purchase/Use recycled products	Establish "meatless" lunch day options
Dial back the thermostat	Establish anti-idle campaign for drop-off/pick-up lanes

Creativity welcome! Activities and projects not listed in the table can count towards your classroom's Engagement Commitment. Contact a GreenSpot representative for approval

Joining GreenSpot Schools

Option 2:

GreenSpot Classrooms *(for classrooms and teachers)*

This option is intended for individual classrooms, and teaches environmental stewardship by coupling a class project with environmental lesson plans that fulfill Ohio's Learning Standards.

STEP 1: Enroll your classroom online as a GreenSpot Community Group and make the corresponding commitments

STEP 2: Select one or more classroom Engagement Commitment *(see below)*


STEP 3: Select one or more classroom Educational Commitment *(see next page)*

Engagement Commitments	
Schedule a presentation on a sustainability topic	Visit a community garden
Reduce class car miles (bike or walk to school)	Class recycling (cans, paper, etc.)
Safe Routes to School/Walking School Bus	Visit Rumpke recycling facility
Learn how to take COTA	Set class printers default to double-sided and greyscale
Establish anti-idle campaign for drop-off/pick-up lanes	Environmental science fair projects
Perform a classroom waste audit	Poster/Photo Contest/Book report on climate change
Schedule a GreenSpot Kids presentation (grades 1 and 2)	Keep a food journal and track food miles
Schedule a visit or Skype call with a park ranger	Class rain barrel workshop/demonstration

Creativity welcome! Activities and projects not listed in the table can count towards your classroom's Engagement Commitment. Contact a GreenSpot representative for approval

Introduction to Classroom Educational Commitment

The remainder of this document is designed to assist teachers interested in enrolling as GreenSpot Classrooms. Each classroom must choose one commitment from the “Engagement Commitment” chart on the previous page AND one educational commitment for the appropriate grade level. The *GreenSpot* educational commitments below are designed to fit seamlessly into a teacher’s already busy schedule by fulfilling Ohio’s New Learning Standards.

Each page contains a specific Ohio Learning Standard and a list of activities. Many activities are pulled directly from the learning standard document. These options are shown as bullet point *without* a green circle around them . The project options *with* a green circle are lesson plans from other sources that have been selected by GreenSpot to fulfill this requirement ().

Hands-on civic engagement projects have shown to improve student achievement in reading and science. Any of these lesson plans and community engagement projects may help boost the learning outcomes of students. http://www.civicyouth.org/PopUps/FactSheets/FS_Mora.Davila.pdf

Your Classroom

Certain grade levels have learning standard suggestions that better fit the *GreenSpot* goals, therefore, some classes will have more suggested lesson plans than others. Teachers can use their discretion to browse GreenSpot lesson ideas from grades above and below their own, although we can’t guarantee that lessons from other grades will fulfill your grade’s Ohio Learning Standards. Links to the Ohio Learning Standards are given below if you are unsure about this. Creativity is also welcome in the program. All lesson plans and activities not listed in this document must be approved by a *GreenSpot* representative to fulfill the Educational Commitment.

Ohio’s Science Standards—

<http://education.ohio.gov/getattachment/Topics/Ohios-Learning-Standards/Science/ScienceStandards.pdf.aspx>

Ohio’s Social Studies Standards—

<http://education.ohio.gov/getattachment/Topics/Ohio-s-New-Learning-Standards/Social-Studies/SS-Standards.pdf.aspx>

GreenSpot Teacher Materials

The online GreenSpot Kids program provides additional teacher materials, including a book, a green walking tour around a school, and a resource guide for support and funding opportunities of your GreenSpot goals. These materials and over 45 GreenSpot and non-GreenSpot activities and lesson plans for every grade level can be found at [GreenSpot Kids](#). There are also GreenSpot and the Dots books available for 1st and 2nd grade classes. Contact GreenSpot@Columbus.gov to claim a class set while supplies last.

Regional Weather Chart

Earth and Space Sciences (ESS)

Topic: Daily and Seasonal Changes

Ohio Science Standard, p. 17: *“This topic focuses on observing, exploring, describing and comparing weather changes, patterns in the sky and changing seasons.”*

- Make a weather chart or graphic that documents observed weather on a regular basis throughout the year. As a class, compare changes in temperature, precipitation, and wind and include the changes that are observed each day, each week and month to month.
- The program seeks to introduce the class to a definition of climate and explain the difference between climate and weather. Compare a regional, observed weather chart to a similar chart made with data from another part of the world. This will show the climate difference between regions. Discuss climate as a seasonal, long term trend (i.e., 30 years) vs. weather as an immediate and changing (i.e., hourly, daily) condition.

Living Things and Their Habitat

Life Science (LS)

Topic: Physical and Behavioral Traits of Living Things

Ohio Science Standard, pp. 22-23: *“Concentration is put on living things and how they/we respond to stimuli like food, light, and temperature.”*

- Design an environment that will support a classroom pet. Provide all of its needs including but not limited to food, water, air, shelter, cleanliness, and safety.” Use this opportunity to teach the lessons above.
- Ask: Which type of flower attracts more birds, butterflies, bees or moths? Investigate by growing a flower garden and keeping accurate records of which types of animals visit each chosen type of flower.
- Have students identify pictures of happy animals vs. animals who are not meeting their needs. For the animals that are not meeting their needs, have children identify what they need and what we can do to help.

The Greenhouse Effect

Earth and Space Sciences (ESS)

Topic: Sun, Energy, and Weather

Ohio Science Standard, pp. 36-37: *“The sun is the principal source of energy...Recognize that sunlight warms water, air and soil...Quantitative measurements must be used to observe...the length of time a material (including water) is exposed to sunlight and its resulting temperature must be observed, as should the amount of time for the object or material to cool down after it is taken out of the sunlight.”*

- Q Cut and use the top half of a soda bottle to demonstrate the greenhouse effect. Start with two glass jars, each with a thermometer standing inside. Place one of the glass jars under the soda bottle top. Set both jars in a sunny spot and check temperature in one hour. The jar with the bottle over it will be considerably warmer than the one without, because solar energy passing into the bottle turns into heat that can't escape. Explain that the Earth's atmosphere works like the bottle in this experiment. Remove the two jars from the sunny spot and observe which air cools the quickest. **See Appendix A**

Observe or Create Wildlife Habitat

Life Science (LS)

Topic: Basic Needs of Living Things

Ohio Science Standard, pp. 46-47: *“Discuss the basic habitat components necessary for life (food, water, cover, and space). Discuss that “the amount and distribution of the basic components will influence the types of animals that can survive in an area” and the effects of seasonal changes.”*

- Make pinecone bird feeders from vegetable shortening and bird seed. Observe the number of birds and different species that visit your feeders. Plan and implement a classroom investigation that answers the question: Does the type of food influence what types of birds will come to a bird feeder? **See Appendix B.**
- Explain, Draw, journal, and photograph what happens to local living and non-living environments over the course of a year.
- Q Make a classroom birdbath out of three terra cotta pots and a saucer. Have student decorate/ personalize it. The bath will provide water and relief to birds in the spring and summer months. Observe the number of birds and different species that visit your bird bath. **See Appendix C**

Build a Worm Farm

Life Science (LS)

Topic: Interactions within Habitats

Ohio Science Standard, p. 66: “Discuss how living things can cause changes in their environment, which can be observed. Conduct investigations to document specific changes and the results of the changes.”

- Ohio Learning Standards suggest that 2nd grade classes build a worm composting bin that can be used to observe the activity of worms breaking down food into soil. Plan and conduct an investigation that will compare identical soil samples, one with earth worms and one without earthworms, over an extended period of time. Include data about temperature, amount of moisture, appearance, materials added, materials removed and/or odor. Record the data over time and present in a chart, table, or pictograph. **See Appendix D.**

How Humans Change the Environment

Social Studies: People Working Together

Topic: Geography—Human Systems

Ohio Social Studies Standard, p.14: “Human activities alter the physical environment, both positively and negatively.”

- Q Briefly discuss the various ways that humans are changing the environment today and explain solutions to some environmental issues, such as recycling, composting, not littering, or remembering to turn off the light when leaving a room. If you’d like to further teach this point visit BrainPop.com and watch their video titled Humans & the Environment. They also have an educational sorting game that pairs with the video. <https://www.brainpop.com/science/ourfragileenvironment/humansandtheenvironment/>
- Q Download Ohio Department of Natural Resources’ “Pollution Search” activity and complete with your class. This activity teaches students what pollution is, its sources, and how they can reduce it, through a discussion and worksheet. http://forestry.ohiodnr.gov/portals/forestry/pdfs/pl/activity/36_PollutionSearch.pdf

Renewable Energy

Earth and Space Science (ESS)

Topic: Earth's Resources

Ohio Science Standard, pp. 80-81: *“Students should be able to distinguish between renewable and nonrenewable resources. Discuss the development of new renewable energy technologies in Ohio, and how Ohio compares to other states regarding energy sources.”*

- Research, design and/or construct a model of a simple energy collection system for a specific location (use locations in Ohio or areas near water/prairies/rivers/mountains). Use everyday materials, rather than a preplanned kit, to allow student-led investigation.
- Develop a plan to determine the most effective method of collecting renewable energy (e.g. shapes, number/materials used in wind or water turbines, locations that allow solar panels to collect the most energy from the sun).
- Research the efficiency and cost of different types of energy resources (renewable and/or nonrenewable).
- 🕒 Learn about the pros and cons of different energy sources including the costs to land and ecosystems. Visit the Ohio Energy webpage and have students complete the “Energy I Used Today” worksheets under the “Energy Efficiency” headline. For energy related activities, look under the “10 Sources of Energy” headline. <https://www.ohioenergy.org/educators/teachers/elementary-resources>
- 🕒 Download the Ohio Department of Natural Resources “Renewable or Not” activity and complete with your class. Students will learn how to identify and define renewable and nonrenewable resources, through demonstrations and a provided worksheet. Students will discover why sustainable use of natural resources is important. http://forestry.ohiodnr.gov/portals/forestry/pdfs/plr/activity/14_renewableornot.pdf

Conservation of Resources

Earth and Space Science (ESS)

Topic: Earth's Resources

Ohio Science Standard, pp. 83-84: *“Some of Earth’s resources become limited due to overuse and/or contamination. Reducing resource use, decreasing waste and/or pollution, recycling and reusing can help conserve these resources. Reducing or limiting the use and/or waste of resources should be emphasized (rather than concentration only on recycling of resources).”*

- Design and carry out a plan to reduce the use of specific resources at the school, school district, or community. Data collection can include water use, paper use, soil erosion, composting (food waste), and hazardous waste. Once the data is analyzed and plans are chosen, present findings to school and/or community officials.
- Conduct a [waste audit](#) to determine what types of materials have a high recycling rate and which have low rates (and reasons why). Graph and present findings to officials.
- Research different types of recycling (paper, plastics, metal, glass) and make a comparison table to document methods, effectiveness, recycling rates and benefit and/or problems.
- 🕒 Download and complete the green education foundation’s “Energy Activity Book.” This is a beginner level introduction to renewable and nonrenewable resources, and how we use them in our daily lives. Once the class is introduced to the topic, you should guide them in voting on a class project to reduce their energy footprint. This can be as simple as turning off the lights and appliances when they are not in use or starting a recycling program. <http://www.greeneducationfoundation.org/institute/lesson-clearinghouse/540-Energy-Activity-Book.html>

Human Modification of the Environment

Social Studies: Communities: Past and Present, Near and Far

Topic: Geography—Places and Regions & Human Systems

Ohio Social Studies Standard, p. 15: *“Daily life is influence by the agriculture, industry, and natural resources in different communities...Evidence of human modification of the environment can be observed in the local community”*

- Visit the Columbus GreenSpot Kids website to download the Columbus Green Walks School Tour & Activities. This walk will show students how they use resources every day and how they affect the environment around their school.

<https://www.columbus.gov/publichealth/programs/Healthy-Places/Art-Walks/Green-Walks/>

Conservation of Resources

Social Studies: Communities: Past and Present, Near and Far

Topic: Government—Roles and Systems of Government

Ohio Social Studies Standard, p. 15: *“Governments have authority to make and enforce laws. The structure of local governments may differ from one community to another.”*

- Discuss environmental law in Ohio vs. other states e.g. renewable energy standards/commitments, Endangered Species Act, or recycling laws. Compare Columbus to other cities or the US to other countries.
- Invite a guest speaker who works on environmental issues either inside or outside government to discuss their job and what they do for that level of government. **See Appendix E.**

Ecosystem Changes in Ohio

Life Science (LS)

Topic: Earth's Living History

Ohio Science Standard, pp. 117-118: *“Ecosystems can change gradually or dramatically. When the environment changes, some plants and animal survive and reproduce and others die or move to new locations. Major changes over a short period of time can have a significant impact on the ecosystem and the populations of plants and animals living there.”*

- Critique plans (written and oral) from different organizations to reintroduce species back into Ohio. Write a newspaper article in support or against the reintroduction of the species based upon scientific facts.
- Read a firsthand description and view drawings of Ohio ecosystems as first observed by explorers. Compare the historical environmental descriptions to the current environment. Explain the changes that occurred in the biotic and abiotic components of the ecosystem.
- Describe the immediate consequences of rapid ecosystem change for organisms within an ecosystem and describe the consequences this change will have on an ecosystem a decade or more later (e.g., flooding, wind storms, snowfall, volcanic eruptions).
- Research Ohio environments 200 years ago and compare them to now. How have Ohio's ecosystems changed over the years. Complete one of the three suggested learning activities below. Discuss how major environmental changes can be caused naturally or by humans e.g. more frequent and intense storms are formed as a result of human caused climate change.

Minimizing Waste Products

Physical Science (PS)

Topic: Electricity, Heat and Matter

Ohio Science Standard, pp. 124-125: *“When an object is broken into smaller pieces, when a solid is dissolved in a liquid or when matter changes state (solid, liquid, gas), the total amount of matter remains constant.”*


- Evaluate research data on the decomposition time for paper, glass, plastic, and aluminum. Propose a sustainable plan that might be adopted by a larger population of citizens for minimizing waste products and reserving more space in our landfills. Develop a presentation that could be for an outside audience with the authority to implement the plan within a community.
- 🔄 Visit the Garbology website and download “The Great Pacific Garbage Patch” fact sheet for students. Teach students that plastics can breakdown into micro-plastics that are harmful to animals. Complete one of the Garbology lessons, such as the “Waste-Less Lunch” lesson, to give students the tools to reduce their plastic waste impact. <https://naturebridge.org/garbology/teachers>

Ecosystem Improvement

Life Science (LS)

Topic: Interconnections within Ecosystems

Ohio Science Standard, pp. 146-147: *“Energy entering ecosystems as sunlight is transferred and transformed by producers into energy that organisms use through the process of photosynthesis. That energy then passes from organism to organism.”*


- Design and build a self-sustaining ecosystem (e.g., terrarium, bottle biology). Considerations for the ecosystem include the size of the container, the location to create the proper temperature, light and humidity, and organisms that will support one another.
 - Explain ways that humans can improve the health of ecosystems (e.g., recycling wastes, establishing rain gardens, planting native species. Map or model what a community doing these things might look like.
-  Download the Ohio Department of Natural Resources “Web of Life” activity and complete with your class. Students will learn about how energy is passed from organism to organism and that these organisms are interdependent. http://forestry.ohiodnr.gov/portals/forestry/pdfs/plt/activity/45_WebOfLife.pdf

Human Influence on Ecosystems

Social Studies: Regions and People of the Western Hemisphere

Topic: Geography—Human Systems

Ohio Social Studies Standard, p. 19: *“Variations among physical environments within the Western Hemisphere influence human activities. Human activities also alter the physical environment.”*

-  Download the Ohio Department of Natural Resources “Invasive Species” activity and complete with your class. Students will learn about how humans intentionally and unintentionally moved plant and animal species to new environments. These species often cause environmental and economic harm. Have students choose an invasive species and learn about what humans are doing to prevent harm to the physical environment.

Additional Resources: Ohio Native Plants <http://ohiodnr.gov/gonative>
Ohio Invasive Plants <http://ohiodnr.gov/invasiveplants>

Ohio's Learning Standards | Grade 6

Human Activity and the Environment

Social Studies: Regions and People of the Eastern Hemisphere

Topic: Geography— Places and Regions & Human Systems

Ohio Social Studies Standard, p. 21: *Places and Regions- “Regions can be determined, classified and compared using various criteria (e.g., landform, climate, population, cultural, or economic.”*

Human Systems- “Variations among physical environments within the Eastern Hemisphere influence human activities. Human activities also alter the physical environment.”

- Q Discuss how human activity and the resulting climate change are changing the criteria of regions. Then download and complete the Green Education Foundation lesson plan “Calculating Your Foodometer.” This lesson plan has student calculate their carbon footprint based on the foods they cook and eat. <http://www.greeneducationfoundation.org/institute/lesson-clearinghouse/277-Calculating-Your-Foodometer.html>

Minerals

Earth and Space Science (ESS)

Topic: Rocks, Minerals and Soil

Ohio Science Standard, p. 159: *“Minerals are naturally occurring, inorganic solids that have a defined chemical composition. Minerals have properties that can be observed and measured. Minerals form in specific environments.”*

- Q Explain that rocks, minerals, and soil (including fossil fuels) are all nonrenewable resource that must be conserved through management. Download the Ohio Department of Natural Resources “Renewable or Not” activity and complete with your class. Students will learn how to identify and define renewable and nonrenewable resources, through demonstrations and a provided worksheet. Students will discover why sustainable use of natural resources is important. http://forestry.ohiodnr.gov/portals/forestry/pdfs/plt/activity/14_renewableornot.pdf

Air Pollution

Earth and Space Science (ESS)

Topic: Cycles and Patterns of Earth and the Moon

Ohio Science Standard, pp. 212-213: *The atmosphere has different properties and contains a mixture of gases. “This study must include greenhouse gases (including water vapor), ozone (in the atmosphere and at Earth’s surface), and natural events/human activities can change the properties of the atmosphere. Contemporary issues and technological advances should be included within this concept. Real-time scientific data pertaining to air quality and properties of air must be incorporated into the study of atmospheric properties and air quality.”*

- Plan and implement an investigation to collect and test ground levels of ozone or carbon monoxide in a local area. Compare results to statewide data. Determine the existing factors that contribute to these levels. Explain and defend the investigation and the results to an audience.
- Using ozone data from the stratospheric level, generate a graph that illustrates the changes in the ozone over a specific period of years.
- Complete the “Urban Trees” lesson plan and video from Nature Works Everywhere to teach students about the air-scrubbing ability of trees. Complete the optional plan for protecting and promoting trees in the Columbus community. [Branch Out Columbus](#) is a local program that may be available for collaboration <https://www.natureworkseverywhere.org/resources/urban-trees/>
- Lead an “Idle-Free” project to discourage people from idling their cars unnecessarily in an effort to help improve air quality around schools. **See Appendix F.**

Biofuels

Life Science (LS)

Topic: Cycles of Matter and Flow of energy

Ohio Science Standard, pp. 218-219: *“Matter is transferred continuously between one organism to another and between organisms and their physical environments. New discoveries, technology, and research must be used to connect the concept of energy transfer and transformation within the ecosystem and between ecosystems. For example, the use of biomass as an alternative energy source for the local area can focus of different types of biomass, competition between human food crops and biomass crops, and biomass vs. other types of alternatives to fossil-fuels energy.”*

- Ethanol, a plant product, is used in place of fossil fuels. Evaluate the pros and cons of using biomass products such as ethanol vs. traditional fossil fuels. Include in the evaluation anticipated real-world effects for production and usage of biomass products vs. traditional fossil fuels.
- Visit a facility that produces ethanol or biodiesel or invite a professional in the field. Ask them about the process and advancements in technology. Compare biofuels to traditional fossil fuels and other renewable energies. **See Appendix G.**
- Download and complete the Department of Energy’s “Cell Wall Recipe: A Lesson on Biofuels.” This lesson teaches student about the conversion of biomass to ethanol and about the DNA composition of plant cell walls that makes them ideal for energy use. You should also discuss how biofuels can help society and the environment, and some potential downfalls of biofuels <http://www.greeneducationfoundation.org/institute/lesson-clearinghouse/97-Cell-Wall-Recipe-A-Lesson-on-Biofuels.html>

Biomes

Life Science (LS)

Topic: Cycles of Matter and Flow of energy

Ohio Science Standard, p. 220: *“Biomes are defined by abiotic components of the environment – topography, soil types, precipitation, solar radiation and temperature...An ecosystem is composed of linked and fluctuating interactions between biotic and abiotic factors.” Environmental factors and finite resources hold populations of organisms in check.*

- Download the Ohio Department of Natural Resources “Field, Forest, and Stream” activity and complete with your class. This activity is designed to teach students how nonliving elements influence living elements within an ecosystem through a team activity and lesson. http://forestry.ohiodnr.gov/portals/forestry/pdfs/plt/activity/48_FieldForestandStream.pdf

Climate

Life Science (LS)

Topic: Cycles of Matter and Flow of energy

Ohio Science Standard, pp. 220-221: *“Compare the different biomes found on Earth and their climate zones and ecosystems within climate zones.”*

- Monitor the local environment (e.g., stream, river, construction site) for the impact Ohio’s wetland mitigation plans have on water quality (e.g., oxygen levels, pH, phosphorus levels, and nitrogen levels) and how the plans will impact living organisms (e.g., algae, diatoms, mussels, insect larvae).
 - Research a state or federally listed endangered species and examine environmental conditions that may contribute to that organism’s classification. Determine if any conservation efforts have been employed and document whether or not any efforts have been successful. Use evidence to support responses.
- Q To fulfill this standard, design your own lesson using the suggested activities or use our resources below to teach these lessons. A lesson plan and video about reforestation and its impact on climate and the carbon cycle. <https://www.natureworkseverywhere.org/resources/reforestation-impact-on-climate/>
- Q Research the various environmental causes of bee population decline, and the role that bees play in the ecosystem. <https://www.natureworkseverywhere.org/resources/discover-culprit-declining-bee-populations/>

Conservation of Natural Resources

Social Studies: U.S. Studies from 1492 to 1877: Exploration through Reconstruction

Topic: Geography— Human Systems

Ohio Social Studies Standard, p. 26: *“The availability of natural resources contributed to the geographic and economic expansion of the United States, sometimes resulting in unintended environmental consequences.”*

- 🕒 Download the Ohio Department of Natural Resources “400-acre Wood” activity and complete with your class. Students will work as teams to make complex land management decisions involving trade-offs between profit and natural resources. “Students will understand that any land-use decision has a number of consequences for people, wildlife, and plants. http://forestry.ohiodnr.gov/portals/forestry/pdfs/plt/activity/50_400acrewood.pdf

Climate Change

Science: Earth Systems

Ohio Science Standard, p. 308: *“The focus for this topic is on the connections and interactions between Earth’s spheres (the hydrosphere, atmosphere, biosphere and lithosphere). Both natural and human-made interactions must be studied. This includes an understanding of causes and effects of climate, global climate.”*

- Choose a specific location in the United States. Research and analyze the patterns of climate change throughout the geologic record, historic data (human records) and present-day data for the location. Be able to explain the interpretation and analysis of the data. Create a graphical representation of the pattern and discuss with the class.
- Plan and implement an investigation to explore bio-magnification or bioaccumulation within a specific Ohio ecosystem (existing public case studies can be used, such as a local Brownfields case – see resource listed below). Document the steps and process to collect or research, evaluate or test and analyze the data. Research should include the possible impact to humans. Present the process and results to the class verbally or in writing.
- Plan and implement a population study of a specific area (over a period of time) or critique/analyze an existing population study. Document changes in weather, food availability and any change to the population. Prepare a scientific analysis and conclusion (in writing) for the study.

Deforestation and Climate

Science: Global Environmental Problems and Issues

Ohio Science Standard, p. 314: *“Technology can be used for comparative studies to share local data internationally so that specific, quantifiable data can be compared and used in understanding the impact of some of the environmental problems that exist on a global scale. Researching and investigating environmental factors on a global level contributes to the depth of understanding by applying the environmental science concepts to problem solving and design.”*

- Investigate and/or research (using quantifiable data and evidence) the relationship between deforestation and changing weather or, in some cases, climate, at a specific location (like the Amazon region of South America). Analyze the data and draw a conclusion based upon the analysis. Discuss the conclusion with the class.

Glaciers and Climate

Science: Glacial Geology


Ohio Science Standard, p. 328: “[Understand] the cryosphere and the relationship of the analysis of ice cores in understanding changes in climate over thousands of years.”

- Take a field trip to an area of Ohio that has visible glacial features. (Check the Ohio Department of Natural Resources, state parks and/or metro parks that have access to view glacial features throughout the state. Compare the area to maps or satellite data or visit a scientific center that studies glaciers or glacial formation (e.g., the Byrd Polar Research Center) to see glacial core data and learn about glaciers from experts (what kind of data is collected and how it is analyzed). Document observations in a scientific journal or paper (including graphics where appropriate).
- Research the glacial history of a specific location using data from the rock record, contemporary field data (research conducted and published by scientists) and/ or glacial features that can be documented (maps, virtual/aerial documentation, remote sensing data). Relate the history to contemporary evidence of changing climate. Present or discuss findings with the class. **See Appendix H.**

Ohio’s Environment

Science: Earth’s Resources

Ohio Science Standard, pp. 311-312: “This topic explores the availability of Earth’s resources, extraction of the resources, contamination problems, remediation techniques and storage/disposal of resources or by-products. Conservation, protection and sustainability of Earth’s resources also are included.”

- Choose a specific environmental problem, such as the effect of herbicides in water (e.g., Atrazine), an invasive species (e.g., purple loosestrife or the Asian carp) or carbon monoxide in the atmosphere, and research the history, the scientific data before and after relevant laws were passed, and how this problem is being addressed in other countries/globally
 - Take a field trip to visit the water treatment facility or watch the drilling of a water well. Document observations, including information about how water is treated prior to and after use, specific issues that may impact the source, the location of the original water source, specific tests conducted (materials and methods needed to test and how the tests are conducted, results of the tests), and the steps taken to monitor the water at the source and throughout the process (including from the facility/well into the residence). Discuss with the class.
 - Using real-time data, research the most severe environmental problems (and the root causes for the problems) that face the local community, Ohio, the United States or the world. Present evidence (quantitative data) and conclusions orally, through a poster session or in written form (scientific research paper)
-  A potential resource to fulfill this learning standard is the NOAA’s lesson plan on harmful algal blooms.

Ohio's Learning Standards | High School

Ecosystem Services

Social Studies: Sustainability

Ohio Social Studies Standard, p. 39: *“An increasingly global society is faced with the interdependency of ecological, social and economic systems. The functioning of these systems determines the sustainability of natural and human communities at local, regional, national and global levels.”*

- 🕒 This lesson plan from the Green Education Foundation shows the change in human habitation and environmental impacts over the course of time. Advancements in science, technology, and society have given up greater agency over the Earth and its systems. <http://www.greeneducationfoundation.org/institute/lesson-clearinghouse/42-how-have-human-impacts-changed-over-time.html>

Cost and Benefits of Using Resources

Social Studies: Environment and Society

Ohio Social Studies Standard, p. 40: *“Humans adapt to and modify the environment and shape the landscape through their interaction with the land. This has both positive and negative effects on the environment.”* Content Statement 6: *There are costs and benefits of using renewable, nonrenewable, and flow resources.*

- Follow this lesson plan from the Green Education Foundation. This lesson explores and compares the carbon footprints of gasoline, ethanol, and electricity by leading students through a life-cycle assessment for each fuel type. From this analysis, students find evidence for which fuel is the most environmentally sustainable. <http://www.greeneducationfoundation.org/institute/lesson-clearinghouse/563-analyzing-fuel-carbon-footprints-gasoline-ethanol-and-electricity.html>

Globalization and Resource Scarcity

Social Studies: *Globalization*

Ohio Social Studies Standard, p. 35: *“Changes in the global economy present new challenges. Environmental concerns, impacted by population growth and heightened by **international** competition for the world’s energy supplies, have resulted in a new environmental consciousness and a movement for the sustainability of the world’s resources”*

- Follow this lesson plan from National Geographic to teach students about conserving fresh water resources. This source provides a number of activities based on interactive computational models. <https://www.nationalgeographic.org/lesson/will-there-be-enough-fresh-water/>
- Use PBS materials to run a fishing simulation with your class. This project helps demonstrate the social, environmental, and economic impacts of overfishing, and teaches the concept of the “tragedy of the commons” as it applies to global fishing practices today. <https://www-tc.pbs.org/emptyoceans/educators/activities/docs/Activity-Fishing.pdf>

Urbanization and the Environment

Social Studies: *Human Settlement*

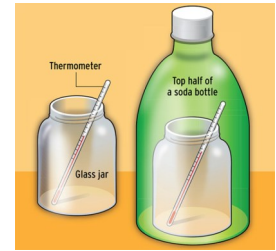
Ohio Social Studies Standard, p. 41: *“Urbanization provides opportunities and challenges for physical and human systems in cities and their surrounding regions.”*

- Complete this Nature Works Everywhere lesson plan and video on urban runoff. This activity teaches students about the problem of runoff pollution and has them develop a storm water management plan for their school grounds. <https://www.natureworkseverywhere.org/resources/urban-runoff/>
- Complete this Nature Works Everywhere lesson plan and video on Sustainable Cities. This activity focuses on introducing sustainability into the design of urban areas. Have student complete the activity to plan, design, and propose an urban design project that incorporates nature-based solutions. <https://www.natureworkseverywhere.org/resources/sustainable-cities/>

Appendix A | the Greenhouse Effect

Materials:

- Tall plastic soda bottle
- Glass jar small enough to fit inside the bottle
- Scissors
- Thermometer



Instructions:

1. Use the scissors to cut the bottom off the plastic bottle. Remove the label, but leave the top on.
2. Stand the thermometer inside a jar, place it in a sunny spot, and check the temperature in an hour.
3. Put the bottle over the jar and leave it for another hour. Check its temperature, and compare with the earlier temperature.

Conclusion:

The second temperature is considerably warmer than the first. That's because the solar energy passing into the bottle has been turned into heat that can't escape. The earth's atmosphere serves a similar function as the bottle — it allows the sun's energy to pass through, and then keeps it from escaping into space.

<https://boyslife.org/hobbies-projects/funstuff/2859/weather-experiments/>

Appendix B | Bird Feeder

Materials :

- Pinecones, preferably open
- String
- Peanut butter
- Oatmeal or cornmeal
- Birdseed mix from the store (you can make it high energy by adding some extra sunflower seeds or chopped nuts)
- Plate or pie tin



Instructions:

1. Tie a string around the pinecone.
2. Mix ½ cup peanut butter/suet/shortening with ½ cup oats/cornmeal.
3. Use a spoon (or fingers!) to spread the mixture onto the pinecone. Make sure to get the mixture into the open areas of the pinecone. It's easier if the mixture is warm.
4. Place birdseed in pie tin. Roll and press seed onto pinecone until well covered.\
5. Hang your pinecone feeder in a tree just outside you window. Try to place it away from the tree trunk so it's more difficult for squirrels to get to it.

<http://www.mykidsadventures.com/pinecone-bird-feeder/>

Appendix C | Bird Bath

Materials:

- 1 14" terracotta pot
- 12" terracotta pot
- 10" terracotta pot
- 16" terracotta saucer
- Liquid Nails adhesive
- Assorted Paints- Patio or weather resistant paint is best
- 1 can of Valspar Clear Sealer Instructions:

Instructions:

1. Stack pots from largest to smallest upside down and take a pencil to mark a line around the pot it is sitting on. This is so you can save some time by not painting the entire pot since only a portion of it will be showing (with the exception of the smallest pot).
2. After you have marked your line paint your base color a little above the line you drew to make sure you do not have terracotta showing.
3. Add your design under the pencil line!
4. Once the paint is dry, spray several coats of Valspar Interior/Exterior clear sealer.
5. Once the sealer is dry, use the Liquid Nails to glue each of the pots together. Adhere the saucer to the bottom of the smallest pot.
Once the glue is dry, fill the saucer with water.

<http://my-creativit.blogspot.com/2012/06/diy-terracotta-birdbath.html>



Appendix D | Vermiculture

This project is suggested in the Ohio Learning Standards to fulfill the Grade 2: Life Science (LS) requirement.. At the end of the project nutrient-rich soil can be added to a school garden. Have students save their lunch compost (minus acidic foods like orange peels and onions) to add to the classroom vermiculture project.

Materials

- **1lb Worms:** *Eisenia fetida* worms are sold by the pound at many gardening centers or bait shops. You don't need a lot to start a home worm bin. They reproduce like crazy and regulate their number based on the amount of food available.
- **Two opaque plastic storage bins with snap on lids:** These should be at least 12" deep.
- **A drill**
- **A small flowerpot or brick**
- **Some old newspapers and food waste.**

Instructions

1. **Mark out holes on one of the bins.** Using a pencil, mark out a series of holes around all four sides of the top of the bin. Mark out about 20 holes in the bottom of the bin. Leave the other bin blank. Take one of the lids and mark out enough holes so that the bin will get some air exchange. We made our whole pattern for the lid in the shape of a worm.
2. **Drill out the holes.** For the lid and sides we used a 3/32" drill bit. For the bottom holes, we used a larger 3/16" bit.
3. **Stack your bins.** Put a brick or flowerpot in the undrilled bin and stack the drilled bin on top. This allows some space for the liquid to drain out of the top bin into the bottom one.
4. **Prepare the bedding.** Elliot says that the bedding materials are like "browns" in garden compost. Shredded newspapers work great, as does torn up corrugated cardboard. A few dried leaves work too. Just avoid anything with glossy color printing or leaves with a lot of volatile oil or strong scent. Once your bedding is in place, wet it down until it's the consistency of a wet sponge. It should be moist, but fluffy.
5. **Lay out some worm food.** Table scraps are the best. Just don't add any oil or animal products like bone, meat or fat, or any dairy like butter or yoghurt. Citrus is okay, and Elliot says that the blue mold that naturally occurs on citrus peels is actually good and it inoculates your bin with beneficial substances that help your worms do their work. Just go moderately with acidic substances like citrus and coffee grounds. "Diversity is the key," she explains.
6. **Add the wigglers.** Once your bin is all set, bury a small amount of food scraps and let your worms loose on it. Worms naturally go for the dark, so they'll bury themselves in your table scraps. Don't worry, they usually can't find their way out of the bin and escape. They don't want that anyway, and neither do you.

Appendix D | Vermiculture

- 7. Tuck them in.** To avoid fruit fly infestation, and worm escapees, take a few sheets of wet newspaper and lay them flat on top of your bedding. Then take a few more wet sheets and roll them up. Tuck them around the corners to form a seal so that everything stays in place and your worms are protected.
- 8. Put them to work.** Don't expect much in the first few weeks. They are getting over the trauma of a new home. Once they're up to it, though, they can consume up to their own weight in food a day. So, if you put in roughly 1 pound of worms, try putting in just about a pound of scraps a day. Don't worry if you put in too much or too little, just make sure you add a variety of food scraps, so that the little guys will have something to munch on. You can feed them every few days, or as infrequently as once every two weeks. Just make sure you replace the food that is disappearing. You'll see that some foods break down quickly (like ripe fruit) and others take forever (like root veggies and cabbage). To avoid bad smells, bury your food scraps underneath some bedding and vary the location of the food throughout the box.
- 9. Harvest your worm compost.** Once the worms have done their work, you will see vermicompost in the bin. It is dark brown and looks like coffee grounds. To get some, without using fancy machinery, lure the worms to another area of the bin with fresh food. In a few days most of the worms will be working the new area, so you can carefully scoop out the finished compost. It's okay if you have a few worms hanging on. Just make sure you leave most of them in the bin to keep working. You can also detach the top bin and pour out the "juice" that accumulates in the bottom bin. This stuff is like a high-energy drink for your plants. Dilute it or aerate it and feed your houseplants. And thank your employees.

See next page for step-by-step picture instructions!

Appendix D | Vermiculture

Step 1:



Step 1:



Step 2:



Step 3:



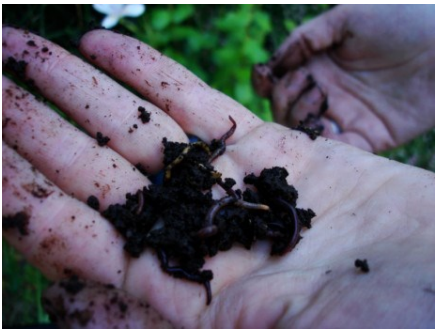
Step 4:



Step 5:



Step :6



Step 7:



Appendix E | Environmental Law/Gov't Contacts

SUSTAINABLE COLUMBUS

<https://www.columbus.gov/getgreen/>

<https://www.columbus.gov/GreenSpot/>

Alana Shockey

Assistant Director, Sustainability

Phone: (614) 645-7157

ARShockey@columbus.gov

David R. Celebrezze

GreenSpot Coordinator

Phone: (614) 645-6703

DRCelebrezze@columbus.gov

ENVIRONMENTAL LAW AND POLICY

CENTER – COLUMBUS OFFICE

<http://elpc.org/states/ohio/>

<http://elpc.org/staff/madeline-fleisher/>

MCMAHON DEGULIS LLP

[http://www.mdllp.net/practice-areas/
environmental/](http://www.mdllp.net/practice-areas/environmental/)

<http://www.mdllp.net/people/>

OHIO ENVIRONMENTAL PROTECTION AGENCY

<http://www.epa.state.oh.us/oea/>

[#135377996-environmental-education-
resources](http://www.epa.state.oh.us/oea/#135377996-environmental-education-resources)

OHIO ENVIRONMENTAL COUNCIL

<https://theoec.org/>

<https://theoec.org/contact-us/>



Appendix F | Anti-Idling

- 1) Students conduct surveys on school property to observe idling (who idles, frequency, number of vehicle, age of driver, time idling, etc.).
- 2) Students research for information on tailpipe pollution and develop and estimate types and total of pollutants produced based from observed findings.
- 3) Students research and discuss potential health impacts related to vehicle pollution observed from idling survey.
- 4) Present findings (to school administration, school board, parent-teacher organization, etc.).
- 5) Students request an idle-free policy.
- 6) “Idle-Free” signage is obtained from Columbus Public Health/Mid-Ohio Regional Planning Commission and displayed at school.
- 7) “Idle-Free” pledge sheets are circulated to students for parent signature.
- 8) Optional: follow-up student idling survey to gauge impact.

Information, Videos, Infographics, Pledge:

<http://iturnitoff.com/school.html#/pass-it-on-school>

Step-by-Step:

<https://acespace.org/action/projects/idle-free>

Survey Example:

<https://docs.google.com/file/d/0B98LM7BCCoZ7a1V5LVZHbl9uc28/edit>

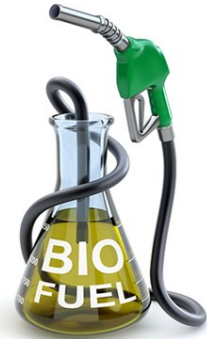


Appendix G | Bio-Fuels

General Information:

<https://www.cleanfuelsohio.org/biodiesel>

<https://www.afdc.energy.gov/fuels/biodiesel.html>



Ohio anaerobic bio-digesters:

<http://quasareg.com/New/>

<https://renergy.com/>

Ohio Biodiesel:

<http://www.benchmarkbio.com/>

Appendix H | Glaciers

Resources/History:

http://www.ohiohistorycentral.org/w/Shaping_the_Land

<https://geosurvey.ohiodnr.gov/portals/geosurvey/PDFs/Education/el07.pdf>

Lesson Plan:

<http://beyondpenguins.ehe.osu.edu/issue/icebergs-and-glaciers/hands-on-lessons-and-activities-about-glaciers>

Map → :

<https://geosurvey.ohiodnr.gov/portals/geosurvey/PDFs/Glacial/glacial.pdf>

