the Henry Ford®

Elementary
Lesson Plans

Life Requirements

at the Ford Rouge Factory Tour

Grades 3-5 Lesson Plans

Contents

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Life Requirements | Teacher Guide

Glossary

Animals – living organisms that must eat food (plants or other animals) in order to survive.

Brownfield – a parcel of land that was used for industrial or commercial purposes and may have low levels of contamination.

Conclusion – a proposition that is reached after considering the evidence of an experiment or other research.

Consumer – an organism that must eat other organisms to get energy.

Control – the part of an experiment that does not contain the variable being tested; used to minimize the effect of other variables.

Ecosystem – a group of organisms that live close together and the environment in which they live.

Energy – the capacity to create or do work; all energy on Earth starts with the sun.

Environment – the living and nonliving things that act upon an organism or ecosystem.

Food – the source of energy for animals.

Habitat – the place or environment where a living thing is naturally and normally found.

Human needs – food for energy, water for hydration and shelter for protection.

Hypothesis – a proposed explanation for an observation.

Innovation – a new idea, method or device.

Interaction - action or influence between two or more organisms.

Native plants – plants that are indigenous or naturalized to a particular geographic area.

Nutrients - a substance found in soil and groundwater that contributes to the health of organisms growing there.

Plants – living organisms that can make their own food using energy from the sun.

Producer – an organism that uses energy from the sun to produce its own food.

Recycling – reusing materials and substances after their initial use.

Responsible manufacturing – manufacturing processes that attempt to produce goods while inflicting as little harm as possible on the environment.

Scavenger – an organism that feeds on refuse or carrion.

Shelter – something that covers or gives protection.

Soil – the upper layer of earth that may be dug or plowed; plants use soil to anchor their root systems.

Stewardship – the careful and responsible management of something entrusted to your care.

Sunlight – energy from the sun, the closest star to planet Earth.

Sustainability – a method of harvesting or using a resource so that the resource is not depleted or permanently damaged.

Temperature – a measure of how hot or cold a substance is.

Variable – the factor that is being tested in an experiment.

Water – necessary to survive for both plants and animals; found in the water cycle as evaporation, condensation, transpiration or precipitation.

Timeline

Ford Motor Company History and Green Initiatives

1903 Ford Motor Company is founded.

1908 Henry Ford introduces the Model T.

1913 Ford introduces a moving assembly line for auto production.

1915 Henry Ford purchases 2,000 acres of marshland along the Rouge River in Dearborn.

1917 Construction of the Rouge Plant begins.

1935 National Farm Chemurgic Council founded; dedicated to industrial use of renewable agricultural resources.

1997 Ford automotive plants first to achieve world environmental standard ISO 14001.

1997 Ford and the UAW sign Rouge Viability Agreement to revitalize the Rouge.

2000 Ford Rouge Center's new assembly plant is the centerpiece of the nation's largest industrial redevelopment project and features a living roof.

2003 Ford Motor Company Rouge Complex recognized with a Leadership in Energy and Environmental Design (LEED) Award.

Environmental Issues

1891 Forest Reserve Act passes Congress; sets aside over 17 million acres of forested land.

1892 1,000 Londoners die due to smog.

1933 Civilian Conservation Corps formed; 2,000 camps opened; trees planted, roads, fire towers, buildings and bridges constructed.

1955 The first international air pollution conference is held.

1957 Increasing CO2 buildup is one surprising conclusion of Scripps Oceanographic Institute scientists.

1970 Environmental Protection Agency (EPA) founded.

1980 Superfund legislation is passed by Congress directing the EPA to clean up abandoned toxic waste dumps.

1990s Strong national opinion polls favor environment over economic development.

2006 Documentary film An Inconvenient Truth opens, stimulating awareness of climate change issues.

2010 BP oil spill devastates ecosystem in Gulf of Mexico.

National and World Events

1906 Great San Francisco earthquake.

1909 First explorers reach the North Pole.

1914 World War I begins in Russia.

1929 U.S. stock market crashes, Great Depression begins.

1939 World War II begins.

1945 End of World War II and beginning of baby boom generation.

1969 Neil Armstrong sets foot on the moon.

2001 Terrorists hijack planes, crashing them in New York, Pennsylvania and Washington, D.C.

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Print Resources for Students

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Connections to National and Michigan Standards and Expectations

National Standards for Science Education

Life Science

Science and Technology

Science in Personal and Social Perspectives

History and Nature of Science

Michigan Grade Level Content Expectations

Science

L.OL.02.14—Life Requirements
Identify the needs of plants.

L.OL.03.41—Classification
Classify plants on the basis of observable characteristics (roots, leaves, stems and flowers).

E.ES.03.52—Human Impact
Describe helpful or harmful effects of humans on the environment (garbage, habitat destruction, land management, renewable and nonrenewable resources).

L.OL.04.15—Life Requirements
Determine that plants require air, water, light and sources of energy and building material for growth and repair.

L.OL.04.16—Life Requirements
Determine that animals require air, water and sources of energy and building material for growth and repair.

L.EC.04.11—Interactions
Identify organisms as part of a food chain or food web.

L.EC.04.21—Changed Environment Effects
Explain how environmental changes can produce a change in the food web.

L.EV.05.12—Species Adaptation and Survival
Describe the physical characteristics (traits) of organisms that help them survive in their environment.

Online Resources

Lesson 1: How Does Your Garden Grow?

– Students can solve online plant mysteries through "The Great Plant Escape" at http://urbanext.illinois.edu/gpe/.

– Students can learn more about the structure and function of soil through the online resources at "The Dirt on Soil", including an interactive "Soil Safari," which can be found at http://school.discoveryeducation.com/schooladventures/soil/.

– Practical information about planting a school garden, including step-by-step instructions, and the nutritional benefits of a school garden are online at http://aggie-horticulture.tamu.edu/kindergarden/Child/school/sgintro.htm.

Lesson 2: Nature in Balance

– For information about endangered species, students can visit the World Wildlife Fund website at www.worldwildlife.org/species/specieslist.html or the National Wildlife Federation's Adoption Center website at www.shopnwf.org/Adoption-Center/index.cat?&sSource=94117&kw=.

– To illustrate the connection between plants and animals within an ecosystem, students can act out a pollination activity found at http://entweb.clemson.edu/K12/classroom/pollgame.pdf.

Lesson 3: We All Play a Part

– Information about LEED certification from the United States Green Building Council is at www.usgbc.org.

– The USGBC Green School Buildings website can be found at www.greenschoolbuildings.org/Homepage.aspx.

– More information about the green roof at the Dearborn Truck Plant at http://www.greenroofs.org/index.php/grhccommittees/290?task=view.

– Ford Motor Company's website "Greener Miles," with information about environmental innovation, is at http://corporate.ford.com/innovation/environment/greener-miles/greener-driving-457p.

– To help young students learn about ways to improve the environment through their actions both at home and at school, play the "Energy Elf" game at http://www.eere.energy.gov/kids/games/EERE.html.

– Students may wish to calculate their ecological footprint online. One that allows them to create an avatar that simulates their choices can be found at http://files.earthday.net/footprint/flash.html. Another useful online tool can be found at http://myfootprint.org.

– "Generation G" web video about the LEED-certified Sidwell School in Washington D.C., is at www.greenschoolbuildings.org/resources/vid_gen_g.aspx.

Life Requirements | Unit Plan

Unit Plan Overview Elementary

Overarching Question: What do plants and animals need to survive, and how do humans impact the environment?

Key Concepts

Brownfield
Conclusion
Consumer
Control
Ecosystem
Energy
Environment
Experiment
Food
Habitat
Human needs
Hypothesis
Innovation
Native plant
Nutrients
Plant
Producer
Recycling
Scavenger
Shelter
Soil
Stewardship
Sunlight
Sustainability
Temperature
Variable
Water

Lessons and Main Ideas

Lesson 1 | How Does Your Garden Grow?
- Learn about the conditions needed for plants to grow.
- Learn about native plants and why they are important.
- Learn about the orchard and native plants at the Ford Rouge Complex.

Lesson 2 | Nature in Balance
- Learn about the interaction of animals with plants (habitat).
- Learn about the beehives, birds and mammals at the Ford Rouge Complex

Lesson 3 | We All Play a Part
- Learn how William Clay Ford Jr. and William McDonough worked to rebuild the Ford Rouge Complex.
- Learn how brownfield sites can be improved for the benefits of plants and animals.
- Learn how you can make a difference to our environment.

Duration

7 class periods (45-60 minutes each)
- Lesson Plans—5 class periods
- Unit Project—2 class periods for in-class work, plus 1 day for presentations (optional)

Field Trips

- Ford Rouge Factory Tour (FRFT)
- Local nature center or zoo

Assessment

- Performance assessments included with each lesson plan.
- Culminating projects (see Supplemental Resources)
- Review/Assessment Questions (see Supplemental Resources)

Digitized Artifacts

From the collections of **The Henry Ford** — PowerPoint slide show What Lives at the Rouge?

Lesson 1 | How Does Your Garden Grow?

– Living roof at FRFT ID# THF50020 (first picture slide in PowerPoint slide show "What Lives at the Rouge?")

Materials

– Computer with access to Internet; digital projector and screen (preferred) or printed handouts of digitized artifacts.
– Sign: What do plants and animals need to survive, and how do humans impact the environment?
– Student Activity Sheet 1: Eco-Detective—Plant Life
– Answer Key 1
– One or two pots of sedum
– Various materials for student-designed experiments: containers (yogurt cups, pots, coffee cans, etc.), seeds and plant cuttings, potting soil, sand, liquid plant fertilizer, thermometers, rulers.
– PowerPoint slide show "What Lives at the Rouge?" (engagement activity)
– Access to computer lab or laptops
– Student Activity Sheet 2: Eco-Detective—Animal Life
– Answer Key 2
– Poster materials: computer paper, construction paper, scissors, glue, crayons, markers and/or colored pencils
– Access to computer labs or laptops
– Student Activity Sheet 3: Eco-Detective—Human Impact
– Answer Key 3

Lesson 1 | How Does Your Garden Grow?

Main Ideas

– Learn about the conditions needed for plants to grow.
– Learn about native plants and why they are important.
– Learn about the living roof and native plants at the Ford Rouge Complex.

Key Concepts

Conclusion	Native plant	Sunlight
Control	Nutrients	Temperature
Ecosystem	Plant	Variable
Experiment	Soil	Water
Hypothesis		

Digitized Artifacts from the collections of **The Henry Ford** – PowerPoint slide show "What Lives at the Rouge?"

Lesson 1 | How Does Your Garden Grow?
– Living Roof at FRFT ID# THF50020 from PowerPoint slide show "What Lives at the Rouge?"

Materials

– Computer with access to Internet; digital projector and screen (preferred) or printed handouts of digital images.
– Sign: What do plants and animals need to survive, and how do humans impact the environment?
– Student Activity Sheet 1: Eco-Detective—Plant Life
– Answer Key 1
– One or two pots of sedum
– Various materials for student-designed experiments: containers (yogurt cups, pots, coffee cans, etc.), seeds and plant cuttings, potting soil, sand, liquid plant fertilizer, thermometers, rulers.

Duration 2 class periods (45-50 minutes) plus additional class time for data collection.

Instructional Sequence

1 Engage

One to two days prior to starting this lesson, purchase one or two 4" pots of sedum. You can buy sedum at most local nurseries or large retail stores with a garden center. It is also called stonecrop and often sold with several varieties in the same pot.

The day of the lesson:
– Show students (either project on a data projector, or print out and pass around) a picture of the living roof at the Dearborn Truck Plant.
– Ask students if they have any idea what is planted on the roof. (Many students will think grass.)
– What do they think about the different colors that they see? (Some students may think that the reddish-brown-patches are dead plants, but they are really just a reddish variety of sedum.)
– Ask students if they have any idea they are why people would cover a roof with plants. (Older students may be able to make some hypotheses about cleaning the air or storm water. Some may think the purpose is to make the roof "pretty.")
– Show students the pots of sedum that you purchased, and allow them to observe and touch the plants.
– Tell students that the plants in the pots are the same as the ones on the living roof at the Dearborn Truck Plant. The living roof has many beneficial purposes that will be further explored in Lesson 3: We All Play a Part.

2 Explore

In this activity, students will be learning more about the life requirements of plants and how those variables can be manipulated to see how they affect the plant's health and growth rate. This information will build upon prior knowledge (enhanced through previous classroom experiences) about plant structure and function. This activity can be modified based upon the grade and skill level of your students.

Procedure:

– Group students into pairs (preferable) or groups of three. Hand out copies of Student Activity Sheet 1: Eco-Detective—Plant Life. Read the directions out loud as a class.

– **Part I—Plant Structure Review** is a context-setting activity to recap previous classwork involving plant structure and function. Draw or project a diagram of a plant on the board (simple line drawing works best) for students to copy onto their activity sheet. Make sure that the picture shown to the students has all five parts listed on their sheet—leaves, roots, stem, flower, fruit. Give students five to 10 minutes to draw, label and discuss with their partner the function of each plant part. Ask students to share their ideas for the function of each plant part. (Roots absorb water and nutrients from the soil. Stems transport water and food throughout the plant. Leaves are the site of food production through photosynthesis. Flowers are the site of reproduction/seed production. The fruit is the part of the plant that contains and nourishes the seeds.) You may want to bring in some actual examples of some plants for the students to pass around, such as some large weeds that you have pulled to reveal the root structure.

Picture book recommendations:
– *Tops and Bottoms* by Janet Stevens
– *A Fruit Is a Suitcase for Seeds* by Jean Richards

– In **Part II—Laying the Groundwork** students will be working in their group to learn about the seven life requirements for plants, and to make predictions about their effect on plant growth. It may be helpful to do the first requirement - Sunlight as a class, so that students have something to model their predictions on (see answer key). After students have had approximately 10 minutes to complete the predictions, the correct answers should be read out loud for students to copy down. Students who made a correct prediction should simply draw a check mark in the "Actual" box instead of rewriting their answer.

Discussion Questions:

– Which life requirement(s) was/were the easiest to predict the effect on plant growth?
Answers will vary.

– Which life requirement(s) was/were the most difficult to predict the effect on plant growth?
Answers will vary.

– Do all plants need the same amount of each life requirement as others?
No, they do not. The amount of sunlight, water and temperature are life requirements that vary significantly from one plant species to another.

– Can you give a specific example of a type of plant that requires more or less of a life requirement than another plant?
Answers will vary. Example: A cactus is a plant that requires less water than some other types of plants.

Continued...

– In **Part III—Designing an Investigation**, students will have an opportunity to choose a life requirement from Part II, and then design and conduct an experiment to see how varying that factor affects the growth of plants. Depending on the grade and skill level of your students, this activity can be modified to accommodate student needs. A class full of younger students, for example, may all do the same life requirement and will need teacher assistance in designing the experimental procedure. Students should have access to a wide variety of fast-growing seeds (such as peas and beans), as well as sprouted plants and/or cuttings. Students can also bring in plants that are growing outside their home (with parent permission, of course!) Groups should discuss which type of plant will be best for their experiment. Students should determine how/when they will measure their plants and should practice taking measurements before the actual experiment. If conducting an experiment where there is more than one plant per pot ("room to grow" life requirement), students should be aware of the concept of finding an average. Younger students especially may need help calculating this value.

– The student-designed experiments may take one to two weeks to conduct, depending on the length of data collection. Students should be allowed five to 10 minutes of class time on data collection days to measure their plants and record their data. At the end of the experiment, students should complete the student activity sheet by formulating their conclusion and making note of any changes that they would make for future experimentation.

– Post-activity reflection: Show students the PowerPoint slide show "What Lives at the Rouge?" that includes pictures taken at the Ford Rouge Factory of the various native plants (wetlands, orchard, meadow species, etc.). Share with students that native plants are those which have lived in a particular area for a very long time (hundreds of years or more) and are adapted to living in certain conditions (ecosystem).

Discussion Questions:

– Were there any results from your experiment that surprised you?
Answers will vary.

– What was the purpose of using the same species of plant in all of your experimental pots?
By using the same species of plant, you are more certain that the differences in plant growth are caused by the factor being tested.

– How could you change the experiment using different types of plants?
Answers will vary. Example: You could design an experiment with plants that prefer different amounts of water (such as succulents and wetland plants) to compare plant growth under different conditions.

– In terms of life requirements, what is the advantage of planting native plant species in a garden or other landscape versus planting non-native plants?
Native plants are accustomed to growing in a certain area, so they will be easier (and cheaper) to grow in the conditions (water and sunlight) of that area.

– Now that you know more about the life requirements of plants, why do you think sedum was chosen for the roof of the truck assembly plant at the Ford Rouge Factory instead of regular lawn (turf) grass?
Turf grass requires a lot of water and nutrients to grow, which would be difficult and expensive to accomplish on a roof. Sedum on the other hand, does not require much water, loves full sun and can grow in very shallow soil — ideal conditions on a roof!

Continued...

3 Explain

Plants require seven factors in order to grow and thrive—sunlight, water, temperature, nutrients, air, room to grow and time. Different species of plants require varying amounts of these seven factors. Succulents such as sedum, which was chosen for the green roof at the Ford Rouge Factory, require little water and full sunlight, and they can thrive in shallow soils due to limited root growth. Native plants, such as those planted in the orchard and around the Dearborn Truck Plant, grow best in the natural conditions of a particular area with very little help from humans.

4 Extend

– Students can apply their newfound plant detective skills to solve online mysteries through "The Great Plant Escape" at http://urbanext.illinois.edu/gpe/.

– Students can learn more about the structure and function of soil through the online resources at "The Dirt on Soil," including an interactive "Soil Safari," which can be found at http://school.discoveryeducation.com/schooladventures/soil/.

– Planting a school garden is a great application of the ideas covered in this lesson. Practical information, including step-by-step instructions, and the nutritional benefits of a school garden, are online at http://aggie-horticulture.tamu.edu/kindergarden/Child/school/sgintro.htm. This site also presents information about developing an indoor "growing science center" that would be a nice resource for students who wish to further explore plant concepts in a hands-on manner.

5 Evaluate

Student responses to activity sheet and discussion questions, as well as the student-designed experiment serve as assessment to this lesson.

Eco-Detective—Plant Life

Name .....

Directions: In this activity, you will be learning about the life requirements that plants need in order to grow. You will use this knowledge to design an experiment (using the scientific method) to investigate the effect of manipulating one of these factors on the growth rate of a plant.

Part I—Plant Structure Review: Before we can investigate the life requirements of plants, it would be helpful to review the structure and function of the different plant parts. In the space below, draw and label the diagram of a plant that your teacher has drawn (or is projecting) on the board. Your diagram should have the leaves, stem, roots, flower and fruit correctly labeled. Think about the purpose of each part, and be prepared to share that information with the class.

1. Purpose of roots: .....
2. Purpose of leaves: .....
3. Purpose of stem: .....
4. Purpose of flower: .....
5. Purpose of fruit: .....

Part II—Laying the Groundwork: In this part of the activity, you will learn the seven requirements that plants need in order to grow. You will be working with a partner to make predictions about why plants need those seven factors. You will then check your predictions against the correct explanations given by your teacher.

Requirement	Why it's important—Prediction	Why it's important—Actual
Sunlight		
Water		
Temperature		
Nutrients		
Air		
Room to grow		
Time*		

* Do not select this requirement for Part III.

Part III—Designing an Investigation: In this part of the activity, you and your partner will select one of the life requirements from the table in Part II to test experimentally. You will be investigating the effect of varying (changing) life requirements on the growth rate of the plant. Your experiment will have at least four containers of seeds or plants that fit the following general pattern:

Pot A—control pot; plant receives normal growing conditions
Pot B—negative variable; plant is denied the life requirement
Pot C—positive variable; plant receives increasing amount of life requirement
Pot D—positive variable; plant receives increasing amount of life requirement

Use the steps of the scientific method below to conduct an experiment to test your chosen requirement. You and your partner will have to design a specific experimental procedure (quantity of variable, what type of plant to use, whether to use seeds or sprouted plants, which days to measure your plants, how to measure your plants, etc.)

1. **Problem:** How does varying the amount of _____ affect the growth rate of
(chosen life requirement)
_____ plants?
(type of plant)

2. **Hypothesis:** .....

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3. **Experiment** (briefly describe your procedure): .....

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4. **Results:** Record your measurements in the data table below. Once all data have been collected, construct a graph of your data on a separate sheet of paper.

Day	Pot A	Pot B	Pot C	Pot D

5. **Conclusion:** Based on your data, what can you determine about the effect of your chosen life requirement on plant growth?

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6. **Further experimentation:** How would you change this experiment if you were to do it over?

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Eco-Detective—Plant Life

Name Answer Key

Part I—Plant Structure Review

1. Purpose of roots: Absorb water and nutrients from the soil, anchor plant to the soil
2. Purpose of leaves: Site of food production through photosynthesis
3. Purpose of stem: Transport water and food throughout the plant
4. Purpose of flower: Site of reproduction/seed production
5. Purpose of fruit: Contains and nourishes the seed(s)

Part II—Laying the Groundwork

Sunlight: Plants need sunlight for photosynthesis.
Water: Water is a solvent that moves nutrients and food throughout the plant. Water also cools the plant through evaporation.
Temperature: Different plants have different optimal temperatures for their metabolism.
Nutrients: Plants need nutrients to help make food through photosynthesis.
Air: Plants need the carbon dioxide in air for photosynthesis, and they need the oxygen in air for respiration.
Room to grow: Different plants require different amounts of space between seedlings so that their roots and leaves do not become crowded.
Time: Some plants require more time to grow than other plants. Plants flower and bear fruit at certain times of the year.

7. Part III—Designing an Investigation

Plants without water will wither. Plants without sunlight will grow, but the green will fade to yellow and white, as photosynthesis cannot take place. Plants can also be deprived of carbon dioxide, one leaf at a time. Cover the bottom of the leaf with petroleum jelly, which closes off the stoma (gas exchange mechanism). After a few days, that leaf will be visibly different (brown, withered) than the other leaves.

Lesson 2 | Nature in Balance

Main Ideas

– Learn about the interaction of animals with plants (habitat).
– Learn about the beehives, birds and mammals at the Ford Rouge Complex.

Key Concepts

Consumer	Habitat	Scavenger
Ecosystem	Producer	Shelter
Food		

Materials

– Computer with access to Internet; digital projector and screen (preferred) or printed handouts of digital images.
– Sign: What do plants and animals need to survive, and how do humans impact the environment?
– PowerPoint slide show "What Lives at the Ford Rouge Complex?" (engagement activity)
– Access to computer lab or laptops
– Student Activity Sheet 2: Eco-Detective—Animal Life
– Answer Key 2
– Poster materials: computer paper, construction paper, scissors, glue, crayons, markers and/or colored pencils

Duration 2 class periods (45-50 minutes)

Instructional Sequence

1 Engage

– Ask students to think about what constitutes a life requirement.
– What life requirements do they think they need?
– Ask students to share something that they think is a life requirement for them. Do the other students agree that each item is a necessity for life? Direct students' thinking to the difference between a need (air, food, water, shelter) and a want (cell phone, game system, TV, computer).
– Tell them that animals have needs similar to humans. Show students the PowerPoint slide show "What Lives at the Ford Rouge Complex?"
– After viewing the PowerPoint slide show, ask students to think about the life requirements of the animals that they see.
– Share with students that all of the animals that they saw in the slide show (plus some others not pictured) have returned to the Ford Rouge Complex since environmental innovations such as an orchard, a wetlands and a living roof were implemented in 2004.

2 Explore

In this activity students will be learning more about the life requirements of animals, and how animals interact with other animals and plants in an ecosystem. Students will choose an animal for further study, research that animal's characteristics and habitat, and then apply that knowledge to a creative project.

Procedure:

– Hand out copies of Student Activity Sheet 2: Eco-Detective—Animal Life and read the directions out loud as a class. Give students five to 10 minutes to work on **Part I—Vocabulary Matching.** (It would be best for students to use pencil so that they may correct any incorrect answers.) When all students are finished with this part, go over the correct answers with the class. Ask students if they have any questions about the vocabulary in Part I.

– In **Part II—Animal Investigations**, students will need access to a computer. If an entire lab is not available, students may work in pairs on this part of the activity. They should visit one or both websites listed in the directions and choose an endangered or threatened animal for further study. Encourage them to use multiple websites to gather information to complete the animal survey on page 2 of the activity sheet. The end of Part II would be a good place to stop for Day 1, so that students may think at home about the imaginary animal they will create in Part III on Day 2.

Discussion Questions:

– What are the life requirements of an animal?
Animals require air, food, water and shelter.

– Is your animal endangered or threatened because one of its needs is not being met? If so, which one, and how is it not being met?
Answers will vary. Example: Marine turtles are endangered because their need for shelter is not being met. Humans invade beaches where they lay their eggs, and fishing nets injure and kill maturing turtles before they can reproduce.

– What adaptations does your animal have to help it survive in its ecosystem?
Answers will vary. Example: An arctic fox has white fur to camouflage it against the snow. This helps it to hunt without being detected, as well as avoid predators.

– Where does your animal fit in the food chain/web within its ecosystem?
Answers will vary. Example: The vaquita, or gulf porpoise, feeds on small fish and squid. It is preyed upon by sharks and killer whales.

– **Part III—Create Your Own.** At the beginning of class on Day 2, students should have access to plain computer paper, construction paper, scissors and crayons, markers or colored pencils. They will be using these materials to create a small poster of an imaginary animal within the ecosystem of their chosen animal from Part II. Students will probably need the entire class period to complete their drawing, as well as create the biographical information for their imaginary animal. These posters can be displayed around the classroom, and/or students may present them to the class.

3 Explain

Animals require four basic things to survive—air, food, water and shelter. Animals are adapted, both physically and behaviorally, to meet their needs within the ecosystem in which they live. Humans can have both positive and negative effects on animals in terms of their survival. Environmental innovations at the Ford Rouge Factory, such as adding wetlands and an orchard, have helped bring back animals to the site.

4 Extend

– To further illustrate the connection between plants and animals within an ecosystem, students can act out a pollination activity found at http://entweb.clemson.edu/K12/classroom/pollgame.pdf. This extension connects to what is being done at the Ford Rouge Complex orchard with the addition of beehives.

– Interested students can design a school fund-raising campaign to "adopt" an endangered species through the National Wildlife Federation. This campaign could include creation of a brochure or bulletin board for educating other students.

5 Evaluate

Student responses to activity sheet and discussion questions, as well as the imaginary animal poster, serve as assessment to this lesson.

Eco-Detective—Animal Life

Name .....

Directions: In this activity, you will be learning more about the needs of animals. You will have the opportunity to select an animal for further study, and then you will apply the knowledge that you gain to create an imaginary animal that would coexist in the ecosystem with the animal you selected.

Part I—Vocabulary Matching: Match the ecology term on the left with the best matching definition on the right.

1. ..... ecosystem	**A.** a consumer that primarily eats plants
2. ..... adaptation	**B.** a feature that helps a plant or animal to survive
3. ..... producer	**C.** an organism that breaks down dead or decaying organisms
4. ..... consumer	**D.** animals that feed on dead animals that they did not kill
5. ..... scavenger	**E.** a consumer that primarily eats other animals
6. ..... decomposer	**F.** organisms that make their own food
7. ..... herbivore	**G.** above a producer on a food chain/web
8. ..... carnivore	**H.** a consumer that eats both plants and animals
9. ..... omnivore	**I.** a community of living organisms and the nonliving factors with which they interact
10. ..... food chain/web	**J.** series of events created when one organism consumes another to survive

Part II—Animal Investigations: In this activity, you will be choosing an animal to research. You may choose an endangered species from the choices on the World Wildlife Fund website (www.worldwildlife.org/species/specieslist.html) or from the National Wildlife Federation's Adoption Center website (www.shopnwf.org/Adoption-Center/index.cat?&sSource=94117&kw=.). These websites should be considered a starting point for gathering information. You will need to search for and visit other sites to look for additional information about your chosen animal.

Animal: .....

Geographic range (Where is it found in the world?) .....

.....

Ecosystem (example: desert): .....

What does the animal look like? .....

.....

What does it eat? .....

.....

What, if anything, preys on it? .....

What time of day is it active? .....

What adaptations help this animal to survive in its ecosystem? .....

.....

.....

How are this animal's life requirements met in this ecosystem? .....

.....

What other animals live with this animal in this ecosystem?.....

.....

Part III—Create Your Own! On a separate sheet of paper create a drawing of an imaginary animal that would co-exist with the animal you selected in Part II. (This animal should live in the same ecosystem.) On your paper, you should include the name of your animal, as well as information about its size, what/how it eats and any animals that prey upon it. You may include any additional information that you desire.

Eco-Detective—Animal Life

Name Answer Key

Directions: In this activity, you will be learning more about the needs of animals. You will have the opportunity to select an animal for further study, and then you will apply the knowledge that you gain to create an imaginary animal that would coexist in the ecosystem with the animal you selected.

Part I—Vocabulary Matching: Match the ecology term on the left with the best matching definition on the right.

1. I ecosystem	**A.** a consumer that primarily eats plants
2. B adaptation	**B.** a feature that helps a plant or animal to survive
3. F producer	**C.** an organism that breaks down dead or decaying organisms
4. G consumer	**D.** animals that feed on dead animals that they did not kill
5. D scavenger	**E.** a consumer that primarily eats other animals
6. C decomposer	**F.** organisms that make their own food
7. A herbivore	**G.** above a producer on a food chain/web
8. E carnivore	**H.** a consumer that eats both plants and animals
9. H omnivore	**I.** a community of living organisms and the nonliving factors with which they interact
10. J food chain/web	**J.** series of events created when one organism consumes another to survive

Part II—Animal Investigations
Answers will vary.

Part III—Create Your Own!
Answers will vary.

Lesson 3 | We All Play a Part

Main Ideas

– Learn how William Clay Ford Jr. and William McDonough worked to rebuild the Ford Rouge plant.
– Learn how brownfield sites can be improved for the benefit of plants and animals.
– Learn how you can make a difference to our environment.

Key Concepts

Brownfield	Human needs	Stewardship
Energy	Innovation	Sustainability
Environment	Recycling	

Materials

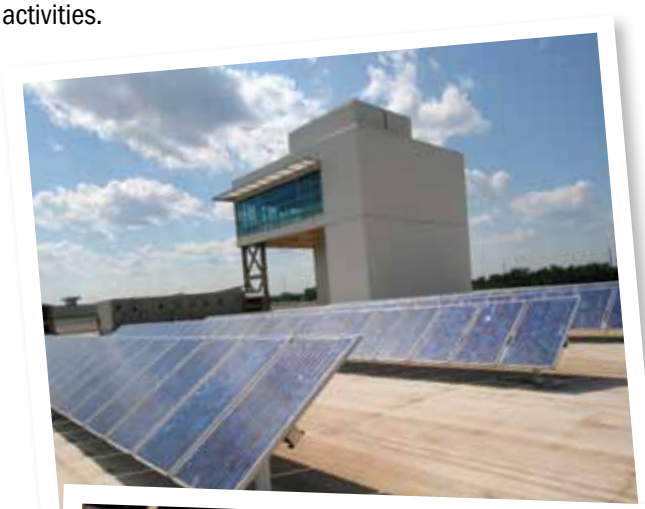
– Computer with access to Internet; digital projector and screen (preferred) or printed handouts of digital images.
– Sign: What do plants and animals need to survive, and how do humans impact the environment?
– Access to computer lab or laptops
– PowerPoint slide show: 21st Century Ford Rouge Factory: Environmental Innovations
– OnInnovation.com Life Requirements Elementary School
– Student Activity Sheet 3: Eco-Detective—Human Impact
– Answer Key 3

Duration 2 class periods (45-50 minutes)
– Optional—additional time for students to present artwork or video

Instructional Sequence

1 Engage

– Display the poster "What do plants and animals need to survive, and how do humans impact the environment?"
– Read the question out loud to the class.
– Ask students to close their eyes and to visualize what they think of when they hear you repeat that question.
– Tell them that they will have five minutes to either draw a picture or write a description of what they saw in their mind when they thought about that question.
– Ask students to share their drawings or descriptions with the class. Some students may draw/describe scenes with a positive human impact, while others may gravitate toward depicting a more negative human impact.
– Ask students to think about and share ways that the negative impacts can be fixed or improved.
– Share with them that many citizens and businesses are implementing innovative ways to fix or improve ecosystems that have been damaged through human activities.



2 Explore

In this activity, students will be learning more about the innovative changes that were made to the Ford Rouge Complex in Dearborn, Michigan. Students will watch a PowerPoint that illustrates these environmentally conscious changes, as well as some OnInnovation.com video clips from an interview with Ford Rouge architect William McDonough. The culminating project of this lesson will be the creation of a student video or podcast that serves as an appeal to take action.

Procedure:

– Hand out copies of Student Activity Sheet 3: Eco-Detective—Human Impact. Read the background information out loud as a class. Ask students if they have any questions about the background material.

– Using a classroom computer and video projector, or a classroom set of computers with headphones (for listening to the interviews), show students the slide show titled 21st Century Ford Rouge Factory: Environmental Innovations found at www.thehenryford.org/rouge/teachers.aspx and have them answer the corresponding questions in **Part I—Changes at the Rouge** of the Student Activity Sheet.

Discussion Questions:

– How have environmental attitudes changed since the early 20th century?
In the early 20th century, people did not know as much about the harmful effects of filling in wetlands and building factories. In current times, we know more about the effects of pollution and habitat destruction.

– Do you think that Henry Ford would have been able to build the Rouge where he did, in current times?
In current times, Henry Ford would not be able to build his factory on such a large wetland. Wetlands are protected much better now than they were 100 years ago.

– How did changes made at the Rouge by William Clay Ford Jr. and William McDonough provide life requirements for plants and animals?
Ford and McDonough created better management of storm water and space for the new plants that were added to the site. By creating a wetlands, an orchard with native plants, and a green roof, they provided shelter, food and cleaner water and air for the animals.

– How can their model of environmental innovation inspire you at home and at school?
Answers will vary. Example: The work of Ford and McDonough inspires me to plant a garden at my house, and clean up litter on my school grounds.

– After the students have finished the slide show questions, show them the selected clips from the William McDonough interview from www.OnInnovation.com. Students should answer the corresponding questions from **Part II—Interview with an Innovator** on the Student Activity Sheet.

– Upon completion of the student activity sheet, students should choose one facet of environmental innovation at the Ford Rouge Complex (examples: solar panels, green roof, native landscaping, recycling, water conservation, wildlife habitat creation) for further research. They should use Internet and/or print resources to investigate how that innovation works and how it can be used in a home or school. A good resource to show the students how green innovation can be implemented at school is the web video "Generation G" about LEED certification at the new middle school at Sidwell Friends School in Washington, D.C. This can be found by navigating through the U.S. Green Building Council's website (www.usgbc.org) to www.greenschoolbuildings.org/resources/vid_gen_g.aspx. This nine-minute video can give students a sense of purpose and empowerment in shaping environmental decisions and policy. Your students' culminating project will be a short video or artistic poster showcasing the environmental innovation, its environmental benefits and information for their fellow students about how they can take action to help

the environment.

3 Explain

Environmental innovations such as the living roof and solar panels at the Dearborn Truck Plant demonstrate the positive interaction that humans can have with nature. Students should feel empowered to make a difference through their personal decisions, as well as by educating others to adopt environmentally friendly practices and policies.

4 Extend

– To help young students learn about ways to improve the environment through their actions both at home and at school, play the "Energy Elf" game at http://www.eere.energy.gov/kids/games/EERE.html.

– Students interested in learning more about their ecological/carbon footprint can take the quiz at http://zerofootprintkids.com/kids_home.aspx.

– Students can apply their concern for the environment by researching whether their school has an environmental mission statement or environmental policies concerning the construction of new school buildings. A team of students might push for the adoption of an environmental mission statement or policies and make a presentation to the administration and school board.

5 Evaluate

Student responses to activity sheet and discussion questions, as well as the quality of the video or podcast as the culminating project, serve as the assessment for this lesson.

Eco-Detective—Human Impact

Name .....

Background Information: In the previous lessons, you've learned about the life requirements of plants and animals. These requirements include such factors as clean air and water and adequate shelter. When ecosystems are contaminated or damaged by building homes or factories, these factors are reduced or eliminated, and plant and animal communities suffer. As people learn more about the environment, they are better equipped to make positive changes in their homes, businesses and schools.

In this activity, you will learn how a business like the Ford Motor Company is making positive changes at one of its factories to repair a damaged ecosystem. Environmental innovations at the Ford Rouge Complex are bringing back the plants and animals that used to live there, as well as conserving energy and filtering storm water. This case study will serve as an example of what people can do in their homes, businesses and schools to benefit the environment. You will finish this activity with the development of a video or artistic poster that encourages your classmates to take action to improve the environment.

Part I—Changes at the Ford Rouge Complex: Watch the PowerPoint slide show "The 21st Century Ford Rouge Factory: Environmental Innovations" at www.thehenryford.org/rouge/teachers.aspx and answer the following questions.

1. Innovations at the Ford Rouge Complex involve ways of better managing the ..... ,

..... , ... and ..... .

2. The living roof at the Ford Rouge Complex covers ..... acres.

3. What are the four layers of the living roof composed of? .....

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4. Besides the living roof, what are some other innovations at the Ford Rouge Complex for managing water? .....

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5. Describe one way that natural light and air are being managed at the Ford Rouge Complex? .....

.....

Part II—Interview with an Innovator: In this section, you will watch two video clips from OnInnovation (http://oninnovation.com) interviews with leading green designers to learn more about environmental innovation. In the first clip, architect William McDonough talks about the green roof that he designed at the Dearborn Truck Plant. In the second clip, designer Toshiko Mori shares her thoughts about how young people can shape the future.

1. William McDonough: Clip #17 "The Green Roof" (length 3:51)


William McDonough

A. The green roof at the Ford Rouge Complex is composed of what plant?

.....

B. List four of the benefits of the living roof at the Ford Rouge Complex:

....

....

C. What surprised McDonough about the living roof project? .....

.....

2. Toshiko Mori: Clip #29 "Advice to Kids" (length 1:41)


Toshiko Mori

A. Mori advises youth to not "do things they'll feel sorry for."
In terms of the environment, what do you think she means by this?

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.....

B. Mori describes the youth of today as being interested in sharing, innovating, collaborating and being civic-minded. Pick one of those traits, and describe how a kid could use that to help solve an environmental problem.

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Part III—Take Action! Choose one facet of environmental innovation at the Ford Rouge Complex (examples: solar panels, living roof, native landscaping, recycling, water conservation, wildlife habitat creation) for further research. Use Internet and/or print resources to investigate how that innovation works and how it can be used in a home or school. Create a short video or artistic poster describing the innovation and its environmental benefits and including information for your fellow students about how they can take action to help the environment.

Eco-Detective—Human Impact

Name Answer Key

Part I—Changes at the Ford Rouge Complex: Watch the PowerPoint slide show "The 21st Century Ford Rouge Factory: Environmental Innovations" at www.thehenryford.org/rouge/teachers.aspx and answer the following questions.

1. Innovations at the Ford Rouge Complex involve ways of better managing the water , soil , daylight and fresh air .

2. The living roof at the Ford Rouge Complex covers 10.4 acres.

3. What are the four layers of the living roof composed of? The top layer of the green roof is composed of crushed shale, sand, peat, compost and dolomite. The next layer is made of an absorbent fleece. The third layer is a porous drainage layer, and the final layer is a plastic membrane that prevents water from leaking onto the roof.

4. Besides the living roof, what are some other innovations at the Ford Rouge Complex for managing water? Porous pavement, swales and wetlands

5. Describe one way that daylight and air are being managed at the Ford Rouge Complex? Examples: air replacement and cooling, large glass monitors (windows) and energy-efficient glass.

Part II—Interview with an Innovator: In this section, you will watch two video clips from OnInnovation (http://oninnovation.com) interviews with leading green designers to learn more about environmental innovation. In the first clip, architect William McDonough talks about the green roof that he designed at the Dearborn Truck Plant. In the second clip, designer Toshiko Mori shares her thoughts about how young people can shape the future.

1. William McDonough: Clip #17 "The Green Roof" (length 3:51)

A. The green roof at the Ford Rouge Complex is composed of what plant? sedum

B. List four of the benefits of the living roof at the Ford Rouge Complex (four from the following):

makes oxygen

creates habitat

accrues solar energy

absorbs particulates

cools the building in summer and warms it in winter

shunts the wind load

C. What surprised McDonough about the living roof project? Birds nested within 5 days, and how light the roof was (only seven pounds per square inch.)

2. Toshiko Mori: Clip #29 "Advice to Kids" (length 1:41)

A. Mori advises youth to not "do things they'll feel sorry for." In terms of the environment, what do you think she means by this?

Answers will vary. Example: People shouldn't throw things away that they could recycle because it will create lots of trash that future generations will have to deal with.

B. Mori describes the youth of today as being interested in sharing, innovating, collaborating and being civic-minded. Pick one of those traits, and describe how a kid could use that to help solve an environmental problem.

Answers will vary. Example: By sharing ideas with other kids their age, students can find answers to environmental problems around the world, like how to get people to push for renewable energy.

Part III—Take Action! Choose one facet of environmental innovation at the Ford Rouge Complex (examples: solar panels, living roof, native landscaping, recycling, water conservation, wildlife habitat creation) for further research. Use Internet and/or print resources to investigate how that innovation works and how it can be used in a home or school. Create a short video or artistic poster describing the innovation and its environmental benefits and including information for your fellow students about how they can take action to help the environment.
Answers/project will vary.

What do plants and animals need to survive, and how do humans impact the environment?

These projects are designed as opportunities for students to demonstrate their learning and their response to the overarching question for this unit, "What do plants and animals need, and how do humans impact the environment?" Consider introducing these projects at the beginning of the unit so that students can gather information along the way.

Choose the project option or options that best fit your class's needs:

Online Individual Project
Media Campaign

Select a topic from one of the unit's three lesson plans for further study. Use online resources to learn more about the issue, and develop a plan for a persuasive media campaign. Inspire your fellow students to make a change that leads to a positive impact on our environment. This campaign should include multiple, diverse products, such as a brochure, bumper sticker or billboard, newspaper article/editorial, podcast and/or video PSA.

Off-Line Individual Project
Survey

Design a survey to assess your fellow students' attitudes about the environment. Conduct your survey during academic downtime such as in the cafeteria at lunch or in the school foyer before or after school. If you would like to survey adults as well, another good forum for administering your survey would be at a school sports event or parent-teacher conferences. Survey questions should be written in either a "yes or no" or "strongly agree—agree—neutral/no opinion—disagree—strongly disagree" format. Sample survey questions:

– A reusable lunch container is better than using brown paper bags.

– Homework should be banned to save paper.

– Kids who live within a mile of the school should be required to walk/bike.

– The school should implement uniforms for students so they can avoid buying unnecessary clothes.

Off-Line Group Project
Design a Board Game

Reuse an old game board to design a new, improved version of the game from an environmental standpoint. Games such as Candy Land or Monopoly, with a "path" to follow and "draw-a-card" format are good choices to modify. Students should be encouraged to decorate the board, design new game pieces, and rewrite the cards and instructions. Once each group is finished with their new board game, groups can trade and play each other's games.

LIfe Requirements

Name .....

1. What are the seven life requirements or conditions that plants need to grow? .....

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2. Why was sedum chosen for the green roof at the Ford Rouge Factory? .....

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3. What are the advantages of planting native plants instead of plant species from other ecosystems or climates?

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4. What are the life requirements of animals? .....

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5. Identify and describe the three main types of diets that animals may have. .....

.....

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6. How has adding more plants and trees at the Ford Rouge Factory resulted in an increase in animals? .....

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7. In what other ways have the environmental innovations at the Ford Rouge Factory benefited the environment? .....

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8. How can you adapt and apply the ideas implemented at the Ford Rouge Factory into actions that you can implement at home and at school? .....

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LIfe Requirements

Name Answer Key

1. What are the seven life requirements or conditions that plants need to grow? Plants require sunlight, water, temperature, nutrients, air, room to grow and time.

2. Why was sedum chosen for the green roof at the Ford Rouge Factory? Sedum is a succulent, which means it can survive on limited water, which is an advantage on the roof during periods of time when it doesn't rain. Sedum is also low-growing—moving out rather than up, so it does not need to be mowed. Another reason that sedum is a great choice for a green roof is the fact that it has a shallow root system and can grow in a thin layer of almost any well-draining substrate (crushed shale on the factory roof), which decreases the weight of the roof.

3. What are the advantages of planting native plants instead of plant species from other ecosystems or climates? Native plants are specially adapted to the conditions of their native ecosystem. This means that they are suited for the temperature, rainfall and daylight of that particular region, unlike plants which are brought in from other climate zones. They are also able to coexist with other plants and insects within their native ecosystem, without becoming invasive or being susceptible to disease.

4. What are the life requirements of animals? Animals require food, water, fresh air and shelter.

5. Identify and describe the three main types of diets that animals may have. Animals are usually classified as herbivores (plant eaters), carnivores (meat eaters) or omnivores (diet of plants and animals).

6. How has adding more plants and trees at the Ford Rouge Factory resulted in an increase in animals? By adding more plants and trees to the Rouge, Ford has created a variety of habitats for various insects, birds, reptiles, amphibians and mammals. For example, the green roof has become a nesting area for a variety of birds, and the wetlands are home to frogs, birds and insects.

7. In what other ways have the environmental innovations at the Ford Rouge Factory benefitted the environment? In addition to the green roof, the Ford Rouge Factory has installed porous pavement in one of the large parking lots that filters storm water and moves it toward the swales and wetland. This slows storm water down so that it doesn't overwhelm the river and cause flooding. All of these innovations work to clean impurities and sediment from the storm water as well. The Ford Rouge Factory Visitors Center also has solar panels (which provide electricity and warm the water in the building), a cistern (which holds collected rainwater for use in the building), large windows for increased natural lighting (which lowers energy usage), and improved heating and cooling (which are more efficient).

8. How can you adapt and apply the ideas implemented at the Ford Rouge Factory into actions that you can implement at home and at school? Some of the practices that could be implemented at home include recycling, decreased water usage (low-flow toilets and showerheads) and energy conservation (turning lights off, opening curtains during the day and closing them at night). Students could plant a garden at school or at home using native plants, which reduces water usage compared with traditional landscaping. Planting a rain garden near a storm drain or drainage ditch helps prevent polluted runoff from reaching the nearest river or lake.