Sustainability: Environmental Management and Responsible Manufacturing at the Rouge

Grades 9-12

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Contents

Solar panels in front of the Ford Rouge Visitor Center

Glossary

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Carbon emissions – gases in an atmosphere that absorb and emit radiation within the thermal infrared range (heat); also called greenhouse gases.

Carbon offsets - a financial instrument aimed at a reduction in greenhouse gases. The money is used to support projects which support greenhouse gas reduction. Companies that cannot meet government emission rules can purchase carbon offsets.*

Ecological footprint – a measure of human demand on earth's resources.*

Economy – a system of interaction and exchange.

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

Emissions – amount of greenhouse gases given off by an object or process.

Energy efficiency - using less energy to provide the same level of energy service.*

Environment – the living and non-living things that act upon an organism.

Food – an energy source for living things.

Fuel economy – the distance traveled per unit of fuel used (MPG).*

Goods and services – economic output is divided into physical goods and intangible services.*

Housing – shelter for humans.

Innovation – a new idea, method, or device.

LEED certification – Leadership in Energy and Environmental Design certification is an internationally accepted green building certification.*

Natural resources – land or raw materials.

Personal choices – options chosen by an individual in everyday life.

Production – the creation of products through manufacturing.

Products – economic goods.

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

Services – the occupation of contributing to the welfare of others.

Social equity - fair access to livelihood, education, and resources.*

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

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

Transportation - means of conveyance or travel from one place to another.

Triple Bottom Line - an expanded spectrum of values and criteria for measuring organizational (and societal) success: economic, ecological and social.

Water efficiency - The accomplishment of a function, task, process, or result with the minimal amount of water feasible.*

* definition from Wikipedia
** definition from www.greenworks.tv

Timelines

Environmental Issues

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

1892 1,000 Londoners die because of 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 favoring 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.

Ford Motor Company 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 2000 acres of marshland along the Rouge River in Dearborn.

1917 Construction of the Rouge Plant begins.

1935 National Farm Chemurgic Council, 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 feature a living roof.

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

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, DC

Bibliography

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Hiaasen, Carl. *Hoot*. New York: Alfred A. Knopf, 2002.

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Thompson, Julian F. *Gypsyworld.* New York: H. Holt, 1992.

Challenging Reads:

Amick, Steve. *The Lake, The River, and the Other Lake*. New York : Pantheon, 2005.

Arthur, Lindsay G. *The Litigators*. Minneapolis, MN: Scarletta Press, 2005.

Barbour, Michael T. *The Kenai Catastrophe*. Sioux Falls, SD: Rebel Pub., 2002.

Sheffield, Charles (ed). *How to Save the World*. New York, NY: Tor, 1995.

Non-Fiction:

Carson, Rachel. *Silent Spring*. New York: First Mariner Books. 1962.

Glennon, Robert. *Unquenchable: America's Water Crisis and What To Do About It.* Washington, D.C.: Island Press. 2009.

McDonough, William and Michael Braungart. *Cradle to Cradle: Remaking the Way We Make Things*. New York: North Point Press. 2002.

Connections to National and Michigan Standards and Expectations

National Standards for Science Education

Earth and Space Science

Science and Technology

Science in Personal and Social Perspectives

History and Nature of Science

Michigan High School Content Expectations

Biology

L3.p4A—Human Impact on Ecosystems
Recognize that, and describe how, human beings are part of Earth's ecosystems. Note that human activities can deliberately or inadvertently alter the equilibrium in ecosystems. (prerequisite)

B3.4C—Changes in Ecosystems
Examine the negative impact of human activities.

B3.4x—Human Impact
Humans can have tremendous impact on the environment. Sometimes their impact is beneficial, and sometimes it is detrimental.

Earth Science

E2.4—Resources and Human Impacts on Earth Systems

E2.4A
Describe renewable and non-renewable sources of energy for human consumption (electricity, fuels), compare their effects on the environment, and include overall costs and benefits.

E2.4B
Explain how the impact of human activities on the environment (e.g. deforestation, air pollution, coral reef destruction) can be understood through the analysis of interactions between the four Earth systems.

E4.1C—Hydrogeology
Explain how water quality in both groundwater and surface water systems is impacted by land use decisions.

Online Resources

High School Unit

Lesson 1: Sustainability

- U.S. Department of Energy Alternative Fuels and Advanced Vehicles Data Center at www.afdc.energy.gov/afdc/
- EPA Green Vehicle Guide www.epa.gov/greenvehicles/Index.do
- The United Nations' Brundtland Commission Report of 1987 on sustainability http://www.un-documents.net/wced-ocf.htm
- General information on sustainability from the United States Environmental Protection Agency at http://www.epa.gov/sustainability/

Lesson 2: Choosing a Green Lifestyle

- Online ecological footprint calculator with avatar at Earth Day Network earthday.net/footprint2/flash.html
- Another great tool for calculating your footprint at Ecological Footprint: Center for Sustainable Economy at http://www.myfootprint.org/

Lesson 3: Understanding Green Design

- Information about LEED certification from the United States Green Building Council at www.usgbc.org
- The USGBC Green School Buildings website can be found at www.greenschoolbuildings.org/Homepage.aspx
- Useful tools for conducting energy audits for homes or schools can be found at www.energysavers.gov or www.energystar.gov
- "Generation G" web video about the LEED certified Sidwell School in Washington D.C. at www.greenschoolbuildings.org/resources/vid_gen_g.aspx

Lesson 4: Ford Motor Company—An Innovator in Responsible Manufacturing

- More information about the living roof at the Ford Rouge Factory at http://www.greenroofs.org/index.php/grhccommittees/290?task=view
- Ford Motor Company's website "Greener Miles", with information about environmental innovation, at http://www.ford.com/innovation/environmentally-friendly

Sustainability: Environmental Management and Responsible Manufacturing at the Ford Rouge

Unit Plan Overview—High School

Overarching Question: How do personal and business decisions affect environmental sustainability?

Key Concepts

Carbon emissions
Carbon offsets
Ecological footprint
Economy
Emissions
Energy efficiency
Environment
Food
Fuel economy
Goods and services
Housing
Innovation
LEED certification
Natural resources
Personal choices
Production
Products
Responsible manufacturing
Services
Social Equity
Stewardship
Sustainability
Transportation
Triple Bottom Line
Water efficiency

Lessons and Main Ideas

Lesson 1
Principles of Sustainability

- Sustainability is a concept that describes using our resources in a responsible manner to ensure that these resources will be plentiful for future generations.
- Sustainability is usually described in terms of three components—environment, economy and society.

Lesson 2
Choosing a Green Lifestyle

- An ecological footprint is a representation of the impact of an individual's decisions on the planet's resources. It seeks to quantify carbon emissions and water usage by looking at choices in transportation, housing, energy usage, food, and goods and services.
- People can reduce their ecological footprint by decreasing resource consumption.
- Businesses, like the Ford Rouge Plant, can reduce their ecological footprint by decreasing waste in the manufacturing process, and by lessening the environmental impact of their production facilities.

Lesson 3
Understanding Green Design

- Green architects, such as William McDonough and Toshiko Mori, strive to design buildings that achieve their intended purpose without impacting the environment in a negative manner.
- The Ford Rouge Factory Tour, designed by McDonough, exemplifies the ideals of green design and innovation by serving as a model for other businesses here and abroad.
- The Ford Rouge Factory Tour highlights changes to the Rouge Plant that make it more sustainable.
- LEED certification is granted by the United States Green Building Council to businesses, schools and homes which follow principles of sustainability.

Lesson 4
Ford Motor Company—An Innovator in Responsible Manufacturing

- Responsible manufacturing describes the process by which businesses and industry create environmentally friendly products in a manner which do not harm its workers or the surrounding environment.
- William Clay Ford Jr.'s vision for Ford Motor Company is to deliver excellent products and services while making the world a better place.
- Individuals can show their support for responsible manufacturing by purchasing products and services from businesses that have sustainable environmental practices.

Duration

- Lesson Plans—5 class periods or blocks (60-75 minutes) plus additional time for Lesson 4 RAFT project presentations (optional)
- Unit Project—1-3 days depending on project chosen

Field Trips

- Ford Rouge Factory Tour
- Other local green architecture

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 *Sustainability: Environmental Management and Responsible Manufacturing* ("**PP**" numbers below correspond to slide numbers on the Sustainability PowerPoint)

Lesson 1
Principles of Sustainability

- Henry Ford wearing a suit made from soybeans on his 78th birthday, Tecumseh, Michigan, July 1941; ID# THF23180 **PP3**

Lesson 2
Choosing a Green Lifestyle

- Bus to Ford Rouge Factory Tour, September 2004; ID# THF16324 **PP5**

Lesson 3
Understanding Green Design

- Power Point—"The 21st Century at the Ford Rouge Factory: Environmental Innovations" at http://www.thehenryford.org/rouge/eduResources/environment3.ppt

Lesson 4
Ford Motor Company—An Innovator in Responsible Manufacturing

- 1928 Ford Model A on Assembly Line; ID# THF23871 **PP7**
- F150 Assembly Line at FRFT; ID#THF16016 **PP8**
- Aerial view of FMC Rouge Plant; ID #THF23881 **PP9**
- Coke quenching tower; ID #THF24018 **PP10**
- Living Roof at FRFT; ID# THF50020 **PP11**
- View from Visitors' Center roof at FRFT **PP12**

Materials

- Computer with access to Internet; digital projector and screen (preferred) or printed handouts of digital images.
- Sign: How do personal and business decisions affect environmental sustainability?
- Student Activity Sheet #1A: Searching for Green
- Student Activity Sheet #1B: The Greenest Mile
- Answer Key #1B
- Student Activity Sheet #2: "Are You Stepping Lightly?"
- Answer Key #2
- OnInnovation.com interview clips

- PowerPoint Slide Show *The 21st Century Ford Rouge Factory: Environmental Innovations* at http://www.thehenryford.org/rouge/eduResources/environment3.ppt
- PowerPoint Slide Show *Sustainability: Environmental Management and Responsible Manufacturing* at
- Student Activity Sheet #3: "Building Green—Innovation in Action"
- Answer Key #3A
- Student Activity Sheet #4: "Green Goods—Responsible Manufacturing in Our World"
- Answer Key #4
- Extension activities
- Culminating projects
- Student Activity Sheet #5: Review/Assessment Questions
- Answer Key #5

How do personal and business decisions affect environmental sustainability?

Sustainability: Environmental Management and Responsible Manufacturing at the Ford Rouge

Lesson 1 Principles of Sustainability

Main Ideas

- Sustainability is a concept that describes using our resources in a responsible manner to ensure that these resources will be plentiful for future generations.
- Sustainability is usually described in terms of three components—environment, economy and social equity.

Key Concepts

Sustainability
Triple Bottom Line
Environment
Social Equity
Economy
Products
Services

Digitized Artifacts from the Collections of The Henry Ford-- From the Collections of The Henry Ford –PowerPoint Slide Show *Sustainability: Environmental Management and Responsible Manufacturing* ("PP" numbers below correspond to slide numbers on the Sustainability PowerPoint)

Lesson 1
Principles of Sustainability

- Henry Ford wearing a suit made from soybeans on his 78th birthday, Tecumseh, Michigan, July 1941; ID# THF 23180 **PP3**

Materials

- Computer with access to Internet; digital projector and screen (preferred) or printed handouts of digital images.
- Sign: How do personal and business decisions affect environmental sustainability?
- Student Activity Sheet #1A: Searching for Green
- Student Activity Sheet #1B: The Greenest Mile
- Answer Key #1B

Duration 1 class period or block (60-75 minutes)

Instructional Sequence

1 Engage

- A couple of days prior to starting this lesson give students a copy of Student Activity Sheet #1A: "Searching for Green", as homework. Each student will be required to go to a local "big box" chain retail store (the kind that sells both groceries and household items) and search for products that they feel are environmentally friendly, or "green".
- If students are unable to drive or walk to the store, they can search the store's website online to look for products.
- Once completed, they should bring this activity sheet to class to share and discuss.
- Ask the students what green products they discovered on their visit to the store/website.
- Record student answers on the classroom white board, or type and project as the answers are given—sample products might include organic produce, organic cotton t-shirts, non-toxic cleaning products, etc.
- The following discussion questions can be answered out loud as a class or in small groups.

  Discussion Questions:

  - How did you determine which products were green?
    Answers may include: packaging claims, commercials, and prior knowledge about organic products.

  - What are some characteristics of green products?
    Answers may include: organic or locally grown, recycled materials or content, reduced packaging, fair trade, energy efficient, water efficient, biodegradable and non-toxic.

  - Which category was the easiest in which to find green products? The most difficult? Why do you think that is?
    Answers will vary.

  - Which green products have you purchased in the past? Were you satisfied with these products?
    Answers will vary. This would be a good point to discuss/debate differences in green product cost and perceived quality. Some students may feel that purchasing green products is the right thing to do and worth any extra cost. Other students may feel that these products aren't worth the cost. (Another interesting question to debate—do some people buy green as a status symbol?)

  - Which green products would you consider buying in the future?
    Answers will vary. This activity may have exposed students to some green products that they weren't aware of before. Students may not be aware that there are tax incentives for purchasing some green appliances and automobiles.

2 **Explore—**Automobile Sustainability Comparison

In this activity, students will learn about the triple bottom line (also known as the "3 E's") of sustainability. They will be responsible for applying this information to an analysis of automobiles to gauge sustainability and to generate discussion about responsible vehicle purchase and ownership.

Procedure:

- Post the sign "How do personal and business decisions affect environmental sustainability?" in the front of your classroom. Inform the students that during the course of this lesson and unit on sustainability, they should keep that question in mind. They will be asked to reflect upon that question at the end of the unit.
- Divide the class into groups, so that there are three to four students per group. Ideally, there should be six to eight groups per class, so adjust group size as needed.
- Hand out Student Activity Sheet #1B: "The Greenest Mile" (1 activity sheet per group).
- Read the background information aloud, and clear up any student misconceptions or vocabulary questions.
- Give groups five to ten minutes to brainstorm criteria for the pre-activity discussion questions, and record their answers. You may wish to give them an example for each category.
  Environment—availability of raw materials
  Social Equity—market access (product is available to all socioeconomic groups)
  Economy—made in the USA
- After each group has identified their triple bottom line criteria, the teacher should assign a category of vehicle to each group. Each group will choose a make and model in that category to research online. Before the groups begin their computer research, the teacher may want to check for understanding to make sure there are no student questions about the data table.
- Classroom data should be collected on an overhead transparency or data projector, so that as groups finish their individual research they share that data with the class.
- Once students have the classroom data, they can spend ten to fifteen minutes answering the post-activity discussion questions.

3 **Explain**

After students have finished the assignment, share the picture of Henry Ford wearing his suit made of soybeans. Ask the students if they know who is in the picture, and once identified, ask them what they think was the level of environmental awareness in the time of Henry Ford (early to mid-1900s.) Ask them to share their answers to the post-activity questions #4-6 to generate a discussion about contemporary environmental views.

4 **Extend**

- Students can generate a comparison of fuel efficiency and alternative fuels by accessing the U.S. Department of Energy Alternative Fuels and Advanced Vehicles Data Center at www.afdc.energy.gov/afdc/

- Students individually or in groups can create a poster or video presentation about a vehicle or manufacturer that they feel is the most sustainable. Additional research about company initiatives and policy can be found on manufacturers' websites.
- Students can expand this comparison to include public transportation, by considering the triple bottom line of traveling by bus, subway, train or airplane.

5 Evaluate

Student responses to Post-Activity Discussion Questions serve as the evaluation for this lesson. If desired, extension projects can be assigned to further assessment.

Searching for Green

Name _____

Visit a "big box" chain retail store, or utilize the store's website, and identify products in each category listed that you feel are environmentally-friendly, or "green." List the products in the spaces below and then answer the following questions.

Produce:

_____

_____

_____

_____

Meat and Dairy:

_____

_____

_____

Other packaged grocery items:

_____

_____

_____

_____

_____

Paper products:

_____

_____

_____

_____

Cleaning products:

_____

_____

_____

_____

Health and beauty products:

_____

_____

_____

Clothing/shoes:

_____

_____

_____

Appliances and electronics:

_____

_____

_____

Other:

_____

_____

The Greenest Mile

Names:

Background Information: Sustainability is a concept that has been defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Bruntland Report, 1987.) While different groups have their own slightly different definitions, the overall concept of protecting resources for the future is generally a common thread. These resources can be divided into three basic categories, which are sometimes referred to as the "3 E's" of sustainability—**E**nvironment, social **E**quity and **E**conomics. These three strands are also sometimes referred to as the "triple bottom line" of sustainability.

In this activity you will be working in groups to identify criteria for making sustainable choices about automobiles. You will be responsible for gathering research for one type of automobile, which you will then share with the other groups in class. Once all vehicle data is collected and shared, you will answer some post-activity discussion questions with your small group.

Pre-Activity Discussion Questions:

1. What are three **environmental** criteria that could be considered when choosing a new automobile for purchase?
   - _____
   - _____
   - _____

2. What are three **social equity** criteria that could be considered when choosing a new automobile for purchase?
   - _____
   - _____
   - _____

3. What are three **economic** criteria that could be considered when choosing a new automobile for purchase?
   - _____
   - _____
   - _____

Activity: Your group will be assigned one category of automobile from the choices in the data table below. Within that category, you may pick the vehicle of your choice. Use the manufacturer's website, along with the EPA Green Vehicle Guide (www.epa.gov/greenvehicles/Index.do) to obtain the information required for your group's chosen vehicle. You will be sharing this information with the rest of your class to complete the table. *Please put a star/asterisk above the vehicle column that your group researched.*

Vehicle Data Report

	Full-sized truck	Large SUV	Hybrid (fuel) SUV	Mid-size car	Mid-size hybrid car	Compact car	Compact hybrid car	Other
Make and model								
Engine								
Fuel type								
Trans-mission								
Drive								
Air Pollution Score								
Fuel economy (mpg)								
Greenhouse Gas Score								
Cost								
Number of passengers								
Evidence of eco-friendly materials?								

Post-Activity Discussion Questions:

1. According to the research done in class, which vehicle best fit your criteria for **environmental** sustainability? Why?

   _____

   _____

   _____

2. Which vehicle best fit your criteria for **social equity** sustainability? What additional information would you like to gather to help you make this decision?

   _____

   _____

   _____

3. Which vehicle best fit your criteria for **economic** sustainability? What additional information would you like to gather to help you make this decision?

   _____

   _____

   _____

4. Should the government require automobile manufacturers to meet certain environmental standards, even if it raises vehicle price or availability? Why or why not?

   _____

   _____

   _____

5. Should the government mandate what kind of car you can drive? Why or why not?

   _____

   _____

   _____

6. What responsibilities do consumers have when making a new vehicle purchase?

   _____

   _____

The Greenest Mile

Names: **Answer Key #1B**

Pre-Activity Discussion Questions:

What are three **environmental** criteria that could be considered when choosing a new automobile for purchase?
Answers will vary. Example: How many miles per gallon does the vehicle get?

What are three **social equity** criteria that could be considered when choosing a new automobile for purchase?
Answers will vary. Example: How are the workers treated at the auto factory?

What are three **economic** criteria that could be considered when choosing a new automobile for purchase?
Answers will vary. Example: How much does the vehicle cost?

Vehicle Data Report

	Full-sized truck	Large SUV	Hybrid (fuel) SUV	Mid-size car	Mid-size hybrid car	Compact car	Compact hybrid car	Other
Make and model	Example: Ford F-150							
Engine	4.6 L 8 cyl							
Fuel type	gasoline							
Trans-mission	Automatic							
Drive	2WD							
Air Pollution Score	7							
Fuel economy(mpg)	15/19							
Greenhouse Gas Score	3							
Cost	$21,820-46,500							
Number of passengers	3-6							
Evidence of eco-friendly materials?	yes							

Sustainability: Environmental Management and Responsible Manufacturing at the Ford Rouge

Lesson 2 Choosing a Green Lifestyle

Main Ideas

- An ecological footprint is a representation of the impact of an individual's decisions on the planet's resources. It seeks to quantify carbon emissions and water usage by looking at choices in transportation, housing, energy usage, food, and goods and services.
- People can reduce their ecological footprint by decreasing resource consumption.
- Businesses, like the Ford Rouge Plant, can reduce their ecological footprint by decreasing waste in the manufacturing process, and by lessening the environmental impact of their production facilities.

Key Concepts

Carbon emissions
Ecological footprint
Food
Goods and services
Housing
Stewardship
Transportation

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Lesson 2
Choosing a Green Lifestyle

- Bus to Ford Rouge Factory Tour, September 2004; ID# THF16324 **PP5**

Materials

- Computers with access to Internet; digital projector and screen (preferred) or printed handouts of digital images
- Sign: How do personal and business decisions affect environmental sustainability?
- Student Activity Sheet #2: "Are You Stepping Lightly?"
- Answer Key 2

Duration 1 class period or block (60-75 minutes)

Instructional Sequence

1. Engage

- Project or write one of the following quotes on the board (or find a quote of your choosing):

- "We must all strive to be good ancestors." --Bill Nader

- "We did not weave the web of life; we are merely a strand in it. Whatever we do to the web, we do to ourselves." --Chief Seattle

- "The human race is challenged more than ever before to demonstrate our mastery, not over nature but of ourselves." --Rachel Carson

  - Ask students to reflect on the quote for a moment, and then write a sentence or two in their science notebook on what they feel the quote is trying to say.
  - Give students a chance to share their thoughts with the class, and encourage discussion about what it means to protect the resources that we have on Earth.
  - Share with the students that another word for the protection and restoration of our resources is "stewardship". (You may wish to share with them some antonyms of stewardship—destruction, degradation, depletion.) The authors above are encouraging us to become good stewards of the environment.

2. **Explore—**Calculating Your Ecological Footprint

In this activity, students will analyze their personal choices to better understand their individual impact on the Earth. After calculating their ecological footprint, they will create and implement a plan for minimizing their footprint.

Procedure:

- Ask the students if they have heard of the term ecological footprint. If so, how would they define what an ecological footprint is, or what does it indicate. Some students may have heard of a carbon footprint, and reassure them that it is a similar concept, but an ecological footprint includes a greater scope of impact than just carbon emissions. It includes depletion of natural resources such as water, consumption of food resources, and the raw materials that go into goods and services.
- Hand out Student Activity Sheet #2A: "Are You Stepping Lightly?"—one copy to each student. Encourage students to answer the questions as honestly as possible.
- After each student has finished the quiz, they should tabulate their score and find the size of their ecological footprint.
- Students should quietly finish the post-activity discussion questions. Students can discuss how they felt about the activity if they are comfortable sharing their results.

- You may wish to tell the students that Earth has enough biologically productive land for each person to have 4.5 acres. Unfortunately, the average American leads a lifestyle that consumes approximately 24 acres per person.

  Additional Discussion Questions:

  - When considering your ecological footprint are there any decisions that may not be as clear-cut as they seem?
    Answers will vary. Example: Driving an SUV may seem like a bad ecological choice, but if a person drives with additional occupants (such as carpooling), it is less polluting than driving 4 or 5 smaller cars.

  - How does the concept of an ecological footprint pertain to industry?
    Businesses, just like people, can decrease resource consumption and reduce the amount of waste that they generate. Specific practices such as reducing packaging, recycling, reducing water use, and creating products with recyclable materials are all ways that a company can decrease the size of its footprint.

3. Explain

Students should not be made to feel uncomfortable about their ecological footprint quiz answer choices. Explain to them that the point of the activity was for them to analyze their choices and attitude about environmental stewardship. If students realize that their footprint is very large, the best course of action is to develop a plan that involves making more environmentally-responsible choices, and then doing their best to stick to the plan. Many students do not realize that they have control over many of these decisions, and the rest are things they should think about as they become adults and make decisions about their own family and living situation.

4. Extend

- Students may wish to take an online ecological footprint quiz that includes more parameters. One that may be of particular interest allows students to create an avatar that simulates the choices they make. It can be found at: earthday.net/footprint2/flash.html
- Another useful online tool can be found at myfootprint.org. After students complete the comprehensive quiz, they can investigate steps to reduce their impact.
- Show students the picture of the shuttle bus going to the Ford Rouge Factory Tour (ID# THF16324) and the picture of recycling. Ask the students how these pictures represent a company trying to lower its ecological footprint. What things can students do at school to reduce their ecological footprint. (Example: more students can ride the bus so that individual cars don't have to drive to school; one bus pollutes less than 40 cars.)
- Students may wish to create an online or print campaign to convince their peers to lower their ecological footprint.

5. Evaluate

Student responses on the post-activity discussion questions serve as the assessment for this lesson. Extension activities may also be used for evaluation purposes.

Wetlands and swales outside the Ford Rouge Visitor Center

the Henry Ford

Are You Stepping Lightly?

Name:

Directions: Read each question below and circle the letter of the answer choice that most accurately reflects the personal decisions that you make. When you are finished, use the scoring rubric at the end to tally your points, and then find your score in the legend to check the size of your ecological footprint.

1. **How large is your home?**
   A. small—one bedroom apartment or house
   B. medium—two to three bedrooms
   C. large—four or more bedrooms

2. **Where is your home located?**
   A. city
   B. rural/country
   C. suburb

3. **How much of your home is made or furnished with environmentally friendly materials (including recycled content, second-hand furnishings, sustainably grown materials, etc.)?**
   A. quite a bit
   B. some
   C. not much or none

4. **Do you have any of the following in your house: energy saving appliances, low-flow showers and toilets, power strips, solar panels, CFL bulbs, storm doors and windows, insulating drapes or blinds?**
   A. almost all items on list
   B. a couple of them
   C. none of them

5. **What type of vehicle does your family own? Circle all that apply**
   A. hybrid or compact
   B. midsize car, small SUV or minivan
   C. large SUV, truck or van

6. **What is your transportation style?**
   A. very little driving—I try to walk most places or ride a bike
   B. moderate driving—I try to avoid frequent long drives
   C. heavy driving—I go where I want, when I want

7. **How much have you flown in the past year?**
   A. not at all
   B. less than 10 hours of flight time
   C. more than 10 hours of flight time

8. **Does your family have a fruit or vegetable garden?**
   A. yes
   B. no

9. **Where does your family get most of its groceries?**
   A. grow or produce our own food, or farmers' market
   B. try to buy in-state grown/made goods from a grocery store
   C. supermarket goods from all over the country

10. **Your diet is considered**
    A. vegan or vegetarian
    B. omnivore (red meat 1-3 times per week)
    C. big-time carnivore (red meat almost every day of the week)

11. **How often do you shop for clothing and personal electronics?**
    A. only when absolutely necessary—worn out
    B. several times per month—when I feel like I might like something new
    C. weekly—I've got to have the latest fashions/fads

12. **When I buy clothing or paper products I look for organic fabrics or recycled content**
    A. all of the time
    B. some of the time
    C. never

13. **My family recycles paper, plastics, glass, batteries and electronics.**
    A. all of these items
    B. one or two of these items
    C. none of these items

14. **How many bags of trash would you estimate your family puts out each week?**
    A. one or two bags
    B. 3-4 bags
    C. 5 or more bags

15. **How many people live in your house?**
    A. three or fewer
    B. four or five
    C. six or more

****

Scoring:

_____ A's x 1 point = _____

_____ B's x 2 points = _____

_____ C's x 3 points = _____

Total points = _____

Less than 18 points: Congratulations! Your ecological footprint is minimal, and you are living within your share of Earth's resources.

Between 19 and 25 points: Good news is you are trying to keep your impact within an acceptable range; bad news is you are still living outside your means in terms of Earth's resources. You're leaving a medium size footprint.

More than 26 points: Ouch! Your footprint is smashing quite a bit of our lovely Earth. Much could be done to reduce your impact.

Choosing a Green Lifestyle Post-Activity Discussion Questions:

1. Were there any quiz items that surprised you? Any that you were embarrassed to answer?

2. Which quiz items do you feel are beyond your control and why?

3. Of the items that are within your control, list two or three and describe your improvement plan. Be specific about how you'd like to lower your score/footprint on these items.

4. How is the size of your ecological footprint related to the concept of stewardship that was discussed in class?

Post-Activity Discussion Questions
Name: **Answer Key**

Post-Activity Discussion Questions:

5. Were there any quiz items that surprised you? Any that you were embarrassed to answer?
   Answers will vary. Students may be surprised that the food they eat impacts their ecological footprint. They may be embarrassed by the amount of trash their family produces, or by the lack of recycling.

6. Which quiz items do you feel are beyond your control and why?

   Answers will vary. Students have little control over the size of the house they live in, the types of cars their parents drive, or the size of their family. These are all things for them to think about for making choices about their future.

7. Of the items that are within your control, list two or three and describe your improvement plan. Be specific about how you'd like to lower your score/footprint on these items.

   Answers will vary. Students may select an item such as where they get their food, and make a commitment to shopping at a local farmers market or growing food in a backyard garden.

8. How is the size of your ecological footprint related to the concept of stewardship that was discussed in class?

   Being a good steward of the environment means making choices that don't deplete more than our share of natural resources. Driving a vehicle that gets low miles per gallon uses a greater amount of gasoline than one that gets better fuel efficiency. Another way we can be good stewards is by limiting the amount of waste that we create by reducing our consumption and reusing or recycling the waste we do generate. A person who practices stewardship will have a smaller ecological footprint.

Sustainability: Environmental Management and Responsible Manufacturing at the Ford Rouge

Lesson 3 Understanding Green Design

Main Ideas

- Green architects, such as William McDonough and Toshiko Mori, strive to design buildings that achieve their intended purpose without impacting the environment in a negative manner.
- The Dearborn Truck Plant, designed by McDonough, exemplifies the ideals of green design and innovation by serving as a model for other businesses here and abroad.
- The Ford Rouge Factory Tour highlights changes to the Dearborn Truck Plant that make it more sustainable.
- LEED certification is granted by the United States Green Building Council to businesses, schools and homes which follow principles of sustainability.

Key Concepts

LEED certification
Energy efficiency
Water efficiency
Green Architecture
Innovation

Materials

- Computers with access to Internet; digital projector and screen (preferred) or printed handouts of digital images
- Sign: How do personal and business decisions affect environmental sustainability?
- OnInnovation.com interview clips
- PowerPoint Slide Show *The 21st Century Ford Rouge Factory: Environmental Innovations* at http://www.thehenryford.org/rouge/eduResources/environment3.ppt
- Student Activity Sheet #3: "Building Green—Innovation in Action"
- Answer Key for Student Activity Sheet #3

Duration 1 class period or block (60-75 minutes)

Instructional Sequence

6. Engage

- Using a classroom computer projector, or printed images, show students some pictures of "green" buildings. Some great pictures can be found at flickr.com/groups/sustainablebuilding/, or you can do an image search in the browser of your choice.
- Ask students to identify some common elements in the pictures, or they can share how they feel when they look at the structures. Students may wish to share some differences that they see between the green buildings in the pictures and more traditional structures such as the school building they are sitting in. Additionally, you may wish to show students how green innovation can be implemented at school in 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.

7. Explore

In this activity, students will be utilizing select OnInnovation.com video clips and digitized artifacts from The Henry Ford to better understand the philosophy and process of green design. The architects featured are William McDonough, co-author of the book *Cradle to Cradle* and designer of the Dearborn Truck Plant in Dearborn, MI, and Toshiko Mori, Harvard professor and renowned green designer.

- If your students have access to a computer lab with headphones, you may want to have them watch the video clips in this fashion, either individually or in groups of two, so that they can replay clips as needed. If that is not an option, you can watch the clips as a class using a computer projector. Hand out Student Activity Sheet #3A: Building Green—Innovation in Action. When students have completed the video questions, they should look through the PowerPoint Slide Show titled *21st Century Ford Rouge Factory: Environmental Innovations* found at http://www.thehenryford.org/rouge/eduResources/environment3.ppt and answer the corresponding questions. Upon completion of the student activity sheet, students may be asked to share their thoughts on green design with the class.

  Additional Discussion Questions

  - McDonough mentions the criteria for environmental safety as "when we would be willing to let our children play there". How is this better or worse than quantifiable measurements?"
    Qualitative measurements, such as visual assessments ("it looks better") or perceived safety ("it's safe enough for my kids to play here") are the types of "evidence" that many citizens respond to emotionally. Scientifically, hard data (quantifiable) is

needed to actually prove that remediation was achieved. So, both types of measurements serve important functions.

- Were you surprised to learn that the living roof was going to cost less than half of a traditional roof? Are there other green products or processes that represent a significant cost savings?
  Answers will vary. Examples: Many businesses find that recycling saves money, since the tipping fees charged by their waste hauler decrease when the dumpsters don't need to be emptied as frequently. Another example would be the money saved when a person replaces incandescent light bulbs with CFLs—a savings when the cost of electricity is factored in.

- When McDonough discusses changing the way people think, he refers to the colleague who answers a challenge with "What's wrong with that?" Compare that scenario to the peer pressure that young people face.
  Many people resist the process of change—it is comfortable to continue the status quo, and sometimes it is a matter of not understanding or agreeing with the reason for change. When a teen social group exerts peer pressure, it is usually a case where an individual teen is trying to "go against" or change the group norm—the rest of the group is resistant and resorts to emotional ploys to hamper the change.

8. Explain

Green designers like McDonough and Mori seek to create multi-functional buildings, while protecting natural resources such as soil, water and air. Conditions that affect the building occupants, such as natural light and comfortable temperature are optimized without compromising energy efficiency. Increased costs associated with green design and construction are usually offset by energy savings. Students, like the rest of the public, may have misconceptions about the costs and benefits of green buildings.

9. Extend

a. Students can research and conduct an energy audit of their home or school. Useful tools can be found at www.energysavers.gov or www.energystar.gov
b. Students can visit the U.S. Green Building Council's website at www.usgbc.org to learn more about LEED certification. Interested students may research and develop a presentation to the school board about LEED certification for their school building. The USGBC Green School Buildings website can be found at www.greenschoolbuildings.org/Homepage.aspx
c. Students can go on a field trip to the Ford Rouge Factory Tour or other green buildings in their area to see these environmental innovations in action.

10. Evaluate

Student responses to the student activity discussion questions serve as the assessment for this lesson. Extension activities may also be used for evaluation purposes.

Building Green—Innovation in Action

Name:

Directions: Watch the selected interview video clips from two innovative green architects, and answer the questions below. In the second part of the activity, you will be answering questions about environmental innovation at the Ford Rouge Factory as seen in a power point slideshow.

Part I—OnInnovation.com Video Clips

1. **William McDonough: Clip #15 "The Rouge Plant" (length 5:48)**

A. What was the guiding principle of the Rouge Plant redevelopment?

_____

B. How did William Clay Ford Jr. and McDonough define the goal for quality soil?

_____

C. By installing features such as the living roof, porous pavement, wetlands and swales, how much money did Ford save over installing a traditional storm water treatment facility?

_____

D. According to McDonough, this project required massive amounts of what four traits?

_____

2. William McDonough: Clip #17 "The Living roof" (length 3:51)

A. The living roof at the Ford Rouge is composed of what plant? _____

B. List at least six benefits of the living roof at the Ford Rouge:

_____ _____

_____ _____

_____ _____

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

_____

_____

D. What expression did he use to describe the living roof? _____

3. Toshiko Mori: Clip #24 "Building for Energy Efficiency" (length 3:37)

A. What does Mori say about LEED certification? _____

_____

B. What are some of the features of her design of the Great Lakes Visitor Center in Buffalo, New York? _____

_____

_____

_____

_____

4. Toshiko Mori: Clip #27 "Studying Bldg. Environments at Syracuse" (length 3:11)

A. What is the name of the building featured in this clip? _____

_____

B. What are some of the purposes of this building? _____

_____

_____

_____

C. What are they testing on the living roof? _____

_____

5. Toshiko Mori: Clip #28 "A Living Laboratory of Energy Efficiency" (length 4:03)

A. When the bio-fuel testing is one hundred percent active, how much electrical use would it support? _____

B. What other testing is taking place in the building? _____

_____

_____

_____

Part II—*The 21st Century Ford Rouge Factory: Environmental Innovations* PowerPoint

1. Before the Ford Rouge Factory was built, how would you describe the land at the site?

   _____

2. After 80 years of operation, how had the site and attitudes changed?

   _____

   _____

3. Innovations at the Rouge involve ways of better managing the _____, _____, _____ and _____.
4. The living roof at the Rouge covers _____ acres.
5. What are the four layers of the living roof composed of? _____

   _____

   _____

   _____

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

   _____

7. How are scientists cleaning up the soil at the Rouge? _____

   _____

8. Describe one way that daylight and air are being managed at the Rouge? _____

   _____

9. **Analysis Question**—How could innovations like those seen at the Ford Rouge Factory be implemented at your home or school? _____

   _____

   _____

   _____

   _____

   _____

   _____

   _____

   _____

Building Green—Innovation in Action

Name: **Answer Key**

Part I—OnInnovation.com Video Clips

1. **William McDonough: Clip #15 "The Rouge Plant" (length 5:48)**

E. What was the guiding principle of the Rouge Plant redevelopment? **The guiding principle was to build a "quality workplace".**

F. How did William Clay Ford Jr. and McDonough define the goal for quality soil? **The goal was for "children to be able to play in the dirt" and be safe.**

G. By installing features such as the living roof, porous pavement, wetlands and swales, how much money did Ford save over installing a traditional storm water treatment facility?
They saved somewhere between 17-35 million dollars.

H. According to McDonough, this project required massive amounts of what four traits?
The traits this project required were hope, creativity, teamwork and leadership.

2. William McDonough: Clip #17 "The Living roof" (length 3:51)

A. The living roof at the Ford Rouge is composed of what plant? **Sedum**

B. List at least six benefits of the living roof at the Ford Rouge:
Benefits include: makes oxygen, creates habitat, accrues solar energy, absorbs particulates, cools the building in summer, warms the building in winter, and shunts the wind load.

E. What surprised McDonough about the living roof project? **He was surprised that birds started nesting within 5 days, and by how light the roof was (only seven pounds per square foot.)**

F. What expression did he use to describe the living roof? **Ballast with weeds**

6. **Toshiko Mori: Clip #24 "Building for Energy Efficiency" (length 3:37)**
   - **A.** What does Mori say about LEED certification? **She explains that it means the building is "certified for environmental sustainability and energy efficiency".**
   - **B.** What are some of the features of her design of the Great Lakes Visitor Center in Buffalo, New York? **Features include: triple glazing glass (insulating), no duct work for heat (displacement ventilation), and the angle of the ceiling causes natural light to bounce down to work space (no artificial light needed April to November during the day.)**

7. **Toshiko Mori: Clip #27 "Studying Bldg. Environments at Syracuse" (length 3:11)**

   A. What is the name of the building featured in this clip? **It is the Center of Excellence for Energy and Environmental Systems.**

   B. What are some of the purposes of this building? **Purposes include: a lab testing environmental quality (especially air quality), reclamation of a contaminated site, classrooms, solar panel testing, living roof.**

   C. What are they testing on the living roof? **They are testing to see which species grow best on the roof, and the drainage of the roof.**

8. **Toshiko Mori: Clip #28 "A Living Laboratory of Energy Efficiency" (length 4:03)**
   - **A.** When the bio-fuel testing is one hundred percent active, how much electrical use would it support? **It would support 99% of the electrical use.**
   - **B.** What other testing is taking place in the building? **Elevator testing and air quality metrics are also being tested in this building.**

Part II—"The 21st Century Ford Rouge Factory: Environmental Innovations" Power Point

10. Before the Ford Rouge Factory was built, how would you describe the land at the site? **It was approximately 2,000 acres of undeveloped wetlands.**
11. After 80 years of operation, how had the site and attitudes changed? **After 80 years of manufacturing (including waste disposal), the site had become contaminated. Attitudes had changed as people began to understand the environmental impact of these actions.**
12. Innovations at the Rouge involve ways of better managing the **water, soil, daylight and fresh air.**
13. The living roof at the Rouge covers **10.4** acres.
14. What are the four layers of the living roof composed of? **The top layer of the living 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 on to the roof below.**
15. Besides the living roof, what are some other innovations at the Rouge for managing water? **Porous pavement, wetlands and swales**
16. How are scientists cleaning up the soil at the Rouge? **Phytoremediation is the process by which plants and trees are planted to clean up the soil with their root systems.**
17. Describe one way that daylight and air are being managed at the Rouge? **Examples: air replacement and cooling, large glass monitors (windows) and energy efficient glass.**
18. **Analysis Question**—How could innovations like those seen at the Ford Rouge Factory be implemented at your home or school? **Answers will vary. Example: Instead of planting a living roof on your home or school, students could plant a rain garden to filter storm water runoff before it flows into a storm drain or nearby water body. Replacing impervious pavement or turf grass with native plants is another way to manage surface runoff at home or school.**

Sustainability: Environmental Management and Responsible Manufacturing at the Ford Rouge

Lesson 4 Ford Motor Company—An Innovator in Responsible Manufacturing

Main Ideas

- Responsible manufacturing describes the process by which business and industry create environmentally friendly products in a manner which do not harm its workers or the surrounding environment.
- William Clay Ford Jr.'s vision for Ford Motor Company is to deliver excellent products and services while making the world a better place.
- Individuals can show their support for responsible manufacturing by purchasing products and services from businesses that have sustainable environmental practices.

Key Concepts

Innovation
Responsible Manufacturing
Emissions
Fuel Economy
Natural Resources
Production

Digitized Artifacts from the Collection of The Henry Ford From the Collections of The Henry Ford –PowerPoint Slide Show *Sustainability: Environmental Management and Responsible Manufacturing* ("PP" numbers below correspond to slide numbers on the Sustainability PowerPoint)

- 1928 Ford Model A on Assembly Line; ID# THF23871 **PP7**
- F150 Assembly Line at FRFT; ID#16016 **PP8**
- Aerial view of FMC Rouge Plant; ID# THF23881 **PP9**
- Coke quenching tower; ID# THF24018 **PP10**
- Living Roof at FRFT; ID# THF50020 **PP11**
- View from Roof of Visitor Center **PP12**

Materials

- Computers with access to Internet; digital projector and screen (preferred) or printed handouts of digital images
- Sign: How do personal and business decisions affect environmental sustainability?

- Student Activity Sheet #4: "Green Goods—Responsible Manufacturing in Our World"
- Answer Key #4

Duration 2 class periods or blocks (60-75 minutes)
Plus one additional day for presenting (optional)

Instructional Sequence

11. Engage

- Write or project the following quote on the board:

  "A good company delivers excellent products and services. A great company does all that and strives to make the world a better place."

  (William Clay Ford Jr.)

  - Ask students to answer the following two questions in their science notebooks after reading the quote:

1. Do you agree or disagree with the premise of the quote, that it is a responsibility of business and industry to "make the world a better place?" Support your view.
2. Do you as a consumer feel that you have a duty to support sustainable businesses with your purchases, even if those products and services are more expensive as a result of responsible manufacturing? Support your view.

- As a method of surveying the class, give each student two small sticky-notes to cast their "votes" as to whether they agree or disagree with the above questions.
- On the board (or on poster board prepared in advance), write out each question with an area below labeled "agree" and "disagree."
- Ask students to come up to the board and place their sticky-notes in the area below each question that corresponds to their viewpoint.
- Once all sticky-notes are placed, ask a couple students from each response group to share their view-point and supporting opinion with the class.
- After discussion, allow students to move their sticky-note to the other column if the discussion persuaded them to change their mind.

Additional Discussion Question:

- Ford's view is that businesses have the responsibility of making the world a better place. Is this the same thing as not making it a worse place? If not, how do they differ?
  Not "making the world a worse place" implies that the business would not be creating any environmental damage or unsustainable resource depletion, but it would not be going out of its way to improve the Earth either. Ford's position is to encourage business leaders to take a proactive approach to sustainability and resource management.

12. Explore

In this activity, students will be doing some Internet research to learn about responsible manufacturing and corporate sustainability initiatives. With the knowledge they gain, they will be doing a RAFT (Role, Audience, Format, Topic) project to demonstrate their comprehension of the material. Students will need to be in a computer lab where they should work one or two students per computer.

Procedure:

- Hand out copies of Student Activity Sheet #4: "Green Goods—Responsible Manufacturing and Our World" and read the background information together as a class.
- Project or hand out images of the Ford Rouge Complex and assembly line from the PowerPoint Slide Show *Sustainability: Environmental Management and Responsible Manufacturing* for students to make a comparison of the site and assembly line before and after responsible manufacturing initiatives were implemented.
- Students should then begin their Internet research on the Ford Motor Company (Part I) and a company of their choice (Part II).
- When research questions have been completed, students may choose their RAFT activity (Part III) and begin working on that.
- It is suggested that students have at least one full class period to conduct their research, and all or part of a class period to work on the RAFT activity. Additional time can be given if needed to work on projects or present them to the class.

13. Explain

Environmental innovations like those implemented at the Ford Rouge Complex are creating a resource for other corporations who wish to operate in a sustainable manner. It is a consumer responsibility to create a marketplace for products made through responsible manufacturing.

14. Extend

a. Students can have a debate about the roles of consumers, manufacturers and government in promoting responsible manufacturing.
b. Students can do Internet research and debate the concept of "eco-labels", which identify consumer goods that are manufactured in an environmentally responsible manner. This process is not currently used in the United States, but it is gaining popularity.

15. Evaluate

Student responses to the student activity discussion questions and completion of the RAFT project serve as the assessment for this lesson.

Name:

Green Goods—Responsible Manufacturing in Our World

Background Information: *Responsible manufacturing* describes the process by which businesses and industry create environmentally friendly products in a manner which do not harm its workers or the surrounding environment. Many large companies, such as those in food and beverage manufacturing, have responded to public pressure and new government regulations by reducing and reformulating packaging, and implementing recycling programs. Additionally, many companies, such as those in apparel or home furnishings manufacturing, have begun to take a closer look at the environmental- and social equity-sustainability of their source materials.

American automotive manufacturer Ford Motor Company has taken this process a step further by implementing innovative changes at the Ford Rouge Complex to not only produce a product with a greater amount of sustainable materials, but to remediate an industrial site that had become contaminated by decades of steel production. The Ford Rouge Factory Tour, which showcases the world's largest living roof, living lab tour through wetlands and an orchard, a LEED certified visitor center, and an ergonomically-designed truck assembly line, allows the public to see firsthand how an industry leader tackles the issue of responsible manufacturing.

In this activity, you will research sustainability practices at Ford and other top companies, with the purpose of creating a product that highlights the importance of responsible manufacturing to a global audience.

Part I—Ford Motor Company and the Ford Rouge Factory Tour

Your teacher will display digitized artifacts (photos) from the collection of The Henry Ford that highlight the changes made to the Ford Rouge Plant. In addition, you will obtain information from Ford Motor Company's sustainability report which can be found at www.ford.com/about-ford/company-information/corporate-sustainability, or you can access articles about Ford's environmental program Greener Miles at www.ford.com/innovation/environmentally-friendly. Answer the following questions as you conduct your research.

1. Describe what conditions were like historically at the Rouge and on the assembly line.

   _____

   _____

   _____

   _____

2. How have innovations at the Rouge changed the site and the assembly line in the last decade?

3. According to Ford Motor Company's sustainability report and other articles on Ford's Greener Miles website, what are some environmental innovations that are being implemented in the automobile manufacturing process?

4. How can Ford Motor Company continue to be a role model to other companies both here and abroad?

Part II—Responsible Manufacturing at _____

Select a large corporation that you are interested in (maybe you love their soft drink or food, or you wear their shoes or clothing), and search online for their environmental accomplishments and practices. These can usually be found by doing a search for "Company Name Sustainability Report" or "Company Name Environmental Sustainability Report." In addition to the sustainability report, many companies highlight their environmental practices on their main homepage for consumers to access.

1. What company did you select, and what products do they manufacture?

   _____

   _____

   _____

2. According to their sustainability report and other website information, what environmental accomplishments and practices are taking place at this company?

   _____

   _____

   _____

   _____

   _____

   _____

   _____

   _____

   _____

3. Does this company have any marketing tools to get the word out about its environmental practices? If so, what are they?

   _____

   _____

   _____

4. How is this company serving as a role model to other companies both here and abroad?

   _____

   _____

   _____

   _____

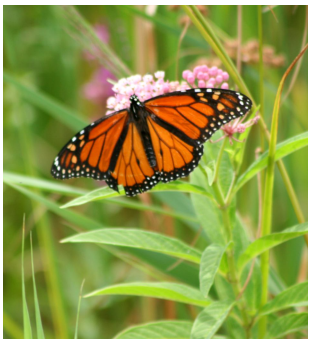
   _____

Part III—RAFT Project

In this part of the activity, you will select a "role, audience, format, topic" project choice from those listed below. If you have an idea for a RAFT project that is not on the list, talk to your teacher for project permission. Use the information gathered in parts I and II of this activity to demonstrate your comprehension of responsible manufacturing.

RAFT Project Choices

Role	Audience	Format	Topic
Current employee	Employee of the future	Letter for time capsule	Explaining environmental innovations at the company and why they were implemented
Salesperson	Green Consumer	Sales pitch	Explain why they should buy your product
Politician	Voters	Campaign Speech	Explain what environmental policies you would support or develop
American teenager	Friend in another country	Youtube video	Explain your favorite green product, and why it's so green
Environmentally-aware singer	Radio listeners	song	Explain how they can care about the Earth by supporting green companies



Name: **Teacher Key**

Green Goods—Responsible Manufacturing in Our World

Part I—Ford Motor Company and the Ford Rouge Factory Tour

Your teacher will display digitized artifacts (photos) from the collection of The Henry Ford that highlight the changes made to the Ford Rouge Plant. In addition, you will obtain information from Ford Motor Company's sustainability report which can be found at www.ford.com/about-ford/company-information/corporate-sustainability, or you can access articles about Ford's environmental program Greener Miles at www.ford.com/innovation/environmentally-friendly. Answer the following questions as you conduct your research.

1. Describe what conditions were like historically at the Rouge and on the assembly line?

The Ford Rouge Factory resembled most factories of its era—noisy, smoky, and bustling with activity. Trains and ships made daily visits to drop off raw materials for automobile production. The workers on the assembly line were compensated well, but faced many dangers along with the physically demanding labor.

2. How have innovations at the Rouge changed the site and the assembly line in the last decade?

In the last ten years, many innovations have been implemented at the Rouge which improved the health and safety of the workers, along with the restoration of key areas of the damaged ecosystem. Workers on the assembly line now face fewer physical demands with the implementation of skids which raise the vehicle to a comfortable height for the worker. Robots also assist with more arduous tasks such as windshield installation. Environmentally, the Rouge is becoming greener with the implementation of a living roof, porous pavement, and wetlands and swales which slow and filter storm water runoff.

3. According to Ford Motor Company's sustainability report and other articles on Ford's Greener Miles website, what are some environmental innovations that are being implemented in the automobile manufacturing process?

- **Global manufacturing at Ford reduced water consumption by 25%.**

- **Ford scientists have engineered a patent-pending process for using soy oil to make rubber car parts.**
- **Ford reduced carbon emissions in its 2009 fleet by 12%.**
- **Ford delivered on its 2006 pledge to double the fleet of flexible fuel vehicles by 2010.**

4. How can Ford Motor Company continue to be a role model to other companies both here and abroad?

Answers will vary. Example: Ford can serve as a role model to other companies by showing that following principles of sustainability not only benefits the environment, but it helps the bottom line economically as well. When other businesses see that customers will buy products made with sustainable materials, it encourages them to use those types of materials.

Sustainability: Environmental Management and Responsible Manufacturing at the Ford Rouge

Culminating Projects

These projects are designed as opportunities for students to demonstrate their learning and their response to the overarching question for this unit, "How do personal and business decisions affect environmental sustainability?" 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 four 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, society, and/or economy. This campaign should include multiple, diverse products, such as a brochure, bumper sticker or billboard, newspaper article/editorial, podcast, and/or video PSA

Offline Individual Project
Survey

Design a survey to assess your fellow students' attitudes about the environment and sustainability. 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:

- Consumers should make every effort to purchase green products.
- Stores should charge customers a small fee for using paper or plastic bags.
- The government should provide tax incentives to businesses that implement green initiatives.
- Consumption of red meat should be taxed.

Offline Group Project
Debate

Select some famous quotes about the environment that have opposing messages, such as:

"The human race is challenged more than ever to demonstrate our mastery, not over nature but of ourselves." --Rachel Carson

"The proper goal of communism is the domination of nature by technology and the domination of technology by planning, so that raw materials of nature will yield to mankind all that it needs and more besides." --Leon Trotsky

Allow students time to gather background information about the issue, and then facilitate a small-group debate over the topic.

Suggestions:

- Have students work in groups of 4 or 6, with 2-3 students on each side of the issue. Small-group debate is easier to manage than a whole-class debate.
- You may wish to assign an independent moderator to each group to keep track of time.
- Before groups are chosen/assigned, you can ask students to take a side on the issue. Use this information to assign groups—for added interest, assign groups to a position counter to their initial belief.

Cross-curricular component—as an American or World History class project, students may be interested in using environmental quotes by famous leaders to draw a parallel between popular beliefs and historical/environmental events.

Name:

Sustainability
Review/Assessment Questions

1. What are the three components of sustainability? _____
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2. How do consumer choices affect the sustainability of our natural resources? _____
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   _____
   _____

3. What does an ecological footprint indicate? _____
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   _____
   _____

4. Is it possible to have a large ecological footprint, and be considered a good steward of the environment? _____
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   _____

5. How are innovators, such as William McDonough and Toshiko Mori, changing the purpose and function of architecture? _____
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6. How are businesses such as Ford Motor Company using responsible manufacturing to create a sustainable product and work environment? _____

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7. How can the environmental innovations at the Ford Rouge Complex serve as a model for other businesses in the United States and abroad? _____

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Name:

Sustainability
Review/Assessment Questions

1. What are the three components of sustainability? **The three components of sustainability are the environment, social equity, and the economy. These are also known as the "triple bottom line."**

2. How do consumer choices affect the sustainability of our natural resources? **By selecting products that have "green" characteristics, consumers minimize their impact on natural resource depletion, habitat destruction and unsafe work practices. These products are typically organic or locally grown, made of recyclable materials, have reduced packaging, utilize fair trade practices, are energy and water efficient, biodegradable and/or non-toxic.**

3. What does an ecological footprint indicate? **An ecological footprint indicates the level of impact that a person's choices have on the environment. It seeks to quantify carbon emissions and water usage by looking at choices in transportation, housing, energy usage, food, and goods and services. The larger a person's ecological footprint is, the more that person is "stepping" on the Earth by utilizing more than the one person's biologically productive space.**

4. Is it possible to have a large ecological footprint, and be considered a good steward of the environment? **Stewardship is another word for the practice of protecting and restoring our natural resources, so a person with a large ecological footprint is not exhibiting good environmental stewardship.**

5. How are innovators, such as William McDonough and Toshiko Mori, changing the purpose and function of architecture? **Innovators such as McDonough and Mori are dedicated to creating buildings which achieve their intended purpose without impacting the**

environment in a negative manner. In fact, many of their buildings actually improve the land, air and water around them. An example would be the Center of Excellence for Energy and Environmental Systems in Syracuse designed by Mori—this building has multiple functions, such as classroom and laboratory space, as well as features, such as a living roof, which improve air quality and other environmental parameters.

6. How are businesses such as Ford Motor Company using responsible manufacturing to create a sustainable product and work environment? **Ford is using responsible manufacturing to deliver products with a greater amount of sustainable materials in a work environment that is healthy and safe for employees. Innovations at the Ford Rouge Factory include the world's largest living roof, natural lighting and an ergonomic assembly line, to name a few.**

7. How can the environmental innovations at the Ford Rouge Complex serve as a model for other businesses in the United States and abroad? **Ford serves as a role model by showing that environmental innovations, such as the living roof, can actually save a company money over traditional practices. Other companies will also emulate their practices if they can demonstrate that consumers are eager to buy vehicles that are more environmentally-friendly, even if the sticker price is slightly higher.**