# **Energy Resources Introduction**



The *MEECS Energy Resources Unit* will help students become aware of some of the energy and resource challenges our society faces and some of the possible solutions to those challenges. The unit is designed for grades 7-9 and can support schools' existing science and social studies curricula. Many lessons and activities can be adapted for other grades as well as for non-formal education programs.

Topics addressed in the unit include energy consumption and use; electricity generation; the economic, environmental, and social advantages and disadvantages of renewable and non-renewable energy resources; energy conservation and energy efficiency; pollution prevention; ecological footprint; stewardship; and sustainability.

The energy and product choices that Michigan residents make, now and in the future, will have global environmental, economic, and social impacts for us as individuals and for our communities, the State of Michigan, and our country. How can Michigan residents, businesses, and industry continue to meet their needs without compromising the ability of future generations to meet their needs? In order to ensure a sustainable future, Michigan residents must have the knowledge and skills necessary to make informed data-based decisions about the environmental, energy, and natural resource challenges that all residents of Earth face.

Some of the energy and resource challenges that we face as a state and as a country are increasing consumption and competition for the limited energy and resources available, dependence on other countries for our energy resources, economic loss, depletion of non-renewable energy resources, increasing energy-related pollution, global warming, climate change, and ecosystem disruption. Students will be encouraged to explore possible solutions to these challenges including diversifying Michigan's energy portfolio by using more renewable energy sources, increasing energy and resource conservation and efficiency through improved design and incorporating pollution prevention strategies (reduce, reuse, recycle), using data to make environmentally friendly purchasing decisions, and more.

The unit was designed using the following "Enduring Understandings":

Upon completion of the unit students will understand that:

- 1. (Awareness) All people use renewable and non-renewable energy resources to meet their basic needs and to improve their material standard of living.
- 2. (Awareness) Current Michigan residents use more energy resources per capita than did past generations.
- 3. (Concern) Energy and product choices have direct and indirect economic, social, and environmental consequences that affect everyone.
- 4. (Knowledge) To make renewable and non-renewable energy sources available for human use, the energy resource *usually* has to be processed, transported, and transformed, which also requires energy and creates pollution.
- 5. (Knowledge/problem solving) Energy conservation and energy efficiency save money, reduce energy consumption, and prevent pollution of Michigan's air, water, and land.
- 6. (Knowledge/connections) Pollution prevention strategies (reduce, reuse, and recycle) can help conserve energy and resources and protect Michigan's environment.
- 7. (Stewardship/decision making) People can use a variety of tools including data collection and analysis to make informed decisions about their energy and product choices and personal actions.
- 8. (Sustainability/stewardship) A sustainable future depends on informed personal choices and actions, the efficient use and conservation of energy and resources, the use of renewable energy sources whenever possible, and the development of new environmentally friendly technologies and government policies.

The future of Michigan's environment, economy, and natural resources depends on the decisions that will be made by *today's* youth as *tomorrow's* decision-makers. The *MEECS Energy Resources Unit* will help Michigan students gain the knowledge and skills they need to become stewards of Michigan's environment and to help keep the Great Lakes State GREAT!

# **Energy Resources Overview**

Essential Questions	Core Lesson						
How do we use energy in Michigan? How and why has our energy consumption changed? How does Michigan's energy use compare to the energy use of the United States?	1. Energy Use in Michigan—Then and Now–Students learn how energy consumption has changed over the past 100 years, why it has changed, and the impact it has had. Students brainstorm and categorize uses of energy, take part in an optional consumption simulation, interpret graphs about energy use, take surveys, and engage in small group and classroom discussions about energy comparisons.						
2 What is the difference between renewable and non- renewable energy resources? Which energy resources does Michigan use? Where does Michigan get its energy resources and how are they transported?	2. Michigan's Energy Resource Mix–Students use pictures, graphs, and a map to identify the kinds of energy we use in Michigan, differentiate between renewable and non-renewable energy resources, and identify the sources of Michigan's energy resources.						
How are energy resources transformed into the electricity we use in our homes, schools and businesses? Which energy resources are used to generate electricity in Michigan, the United States and the world?	<b>3. Generating Michigan's Electricity</b> –Students build a model turbine to observe how different energy resources can be used to turn a turbine, inquire how the interaction between a wire and a magnet generates electricity, and investigate the different mix of energy resources used to generate electricity in Michigan, the United States, and the world.						
What are the economic, social, and environmental advantages and disadvantages of using coal, petroleum, natural gas, and uranium (nuclear fission) to produce electricity? What are the environmental impacts of my family's electricity use?	4. Non-renewable Energy Choices and Impacts—The advantages and disadvantages of different kinds of non-renewable energy sources are the focus of this lesson. Students match different kinds of energy resources with their advantages and disadvantages, and then discuss whether these advantages and disadvantages are economic, ecological, or social. As an extension students identify the environmental impacts of their family's electricity usage using EPA's <i>Power Profiler</i> web site.						
5 What are the characteristics of our renewable energy resources? Which renewable energy resources have the greatest potential in Michigan? What are the economic, social, and environmental advantages and disadvantages of wind, solar, hydroelectric, biomass, and geothermal energy resources? How do the advantages and disadvantages of non-renewable and renewable resources compare?	<b>5. Renewable Energy and Michigan</b> –The focus of this lesson is learning about the advantages and disadvantages of different kinds of renewable energy resources and their potential use in Michigan. Students read about different renewable resources, watch a teacher demonstration, and match different kinds of energy sources with the advantages and disadvantages of each. Students then compare the advantages and disadvantages of renewable and non-renewable resources and use the comparisons to write a letter to their state legislators.						
What are the benefits of energy conservation and energy efficiency? What data and tools can you use to help you make better decisions about your energy and resource use and your personal actions?	6. Energy Conservation and Efficiency: Leaks and Lights–Energy conservation and energy efficiency are the focus of this lesson. Students learn how basic energy conservation and energy efficiency choices can save their family money, reduce energy consumption, and prevent energy-related pollution. Students learn how to identify and fix air leaks, compare incandescent and compact fluorescent light bulbs, and list ways they can conserve energy and increase energy efficiency in their daily lives.						
What are the economic, social, and environmental consequences of your product choices? What tools and data can consumers use to help make better decisions about energy and resource use and personal actions?	7. Using a Product's Life Cycle–The lesson introduces the concept of a product life cycle and how it can be used as tool for the consumer to make more environmentally friendly product choices. The lesson uses the life cycle of a CD or DVD as an example to investigate the life cycle of an everyday product and examine options for reusing, recycling, or disposing of the item after its useful life. Students are introduced to pollution prevention strategies (the three Rs), how consumers can use them, and how the strategies can be incorporated at different stages of a product's life cycle to make a product more economically and environmentally sustainable.						
8 What is my ecological footprint? What choices can I make or actions can I take that will reduce my energy and resource consumption and impact on the environment?	8. Leaving Smaller Footprints–This lesson develops the concept of an ecological footprint. Students use data and tools to assess the impacts of their energy and resource consumption. They examine their results and assess their impacts on the environment. Students discuss and compare their impacts and try to identify actions to reduce their footprints.						

Enhancements/Extensions
<ul> <li>1- Students research energy sources used to complete everyday tasks during different time periods in Michigan history.</li> <li>- Meter Monitor activity from Get Smart About Energy, located on the MEECS Energy Resources CD</li> <li>- The Lighting Audit activity from Get Smart About Energy, located on the MEECS Energy Resources CD</li> <li>- What's a Watt activity from Get Smart About Energy, located on the MEECS Energy Resources CD</li> <li>- What's a Watt activity from Get Smart About Energy, located on the MEECS Energy Resources CD</li> <li>- Analyze 2001 Household Energy Consumption Data on the MEECS Energy Resources CD</li> </ul>
<ul> <li>2- Natural Gas PowerPoint presentation on the MEECS Energy Resources CD</li> <li>- Home Energy Use—MTU Tech Alive Web Module</li> </ul>
<ul> <li>3- Students compare the energy portfolios and energy consumption of different nations to Michigan and the United States using sources from the References and Additional Resources sections.</li> <li>- Students examine global electricity using NASA's "Night Lights" poster.</li> </ul>
<ul> <li>4- Oil, Gas and Coal in Your Lifetime—MTU Tech Alive Web Module</li> <li>Students explore EPA's Global Warming Kids Page.</li> <li>Students take online virtual tours of a coal mine, coal-fired power plant, and a nuclear power plant</li> <li>Students use the EPA's eGrid database to find the emissions profile, generation resource mix, and plant characteristic data for their utility's nearest power plant</li> <li>Students conduct online research to answer: Should directional drilling for oil and natural gas be allowed in the Great Lakes?</li> <li>Students learn about the history of oil using the "Oil Age Poster"</li> </ul>
<ul> <li>5- Students design an experiment to test if they can complete an everyday task using renewable energy source.</li> <li>Students take online tours of hydroelectric and geothermal plants</li> <li><i>My Decisions Impact Michigan, the United States and the World</i>—MTU Tech Alive Web Module</li> <li>Students research how Michigan homes and businesses are using renewable energy using the resources provided</li> <li>Students use Michigan <i>Biomass Curriculum Project</i> activities on the MEECS Energy Resources CD to learn about biomass</li> <li>Students watch the "Great Lakes, Great Wind" video online to learn more about wind power.</li> </ul>
<ul> <li>6- Project Learning Tree's <i>In the Driver's Seat</i> activity on the MEECS Energy Resources CD</li> <li>Students take the <i>Energy Savers Virtual Home Tour</i> on the Energy Savers CD.</li> <li>Students take the online <i>Lighting Quiz: Change a Light and Change the World</i>.</li> <li><i>Energy Power Plants: Using Bicycles for Transportation</i> lesson from Get Smart About Energy, located on the MEECS Energy Resources CD</li> <li>Students make smart energy choices and play fun energy games at the US DOE <i>Energy Hog</i> web site.</li> <li>Students read about <i>Michigan Renewable Energy and Efficiency Success Stories</i> at the Urban Options web site</li> </ul>
<ul> <li>7- Students plan an eco-friendly lunch.</li> <li>- Life Cycle Analysis of Paper and Plastic Bags—MTU Tech Alive Web Module</li> <li>- Where Does Our Garbage Go?—MTU Tech Alive Web Module</li> <li>- Students play EPA's online Recycle City game</li> <li>- A Collection of Solid Waste Resources CD</li> <li>- Life Cycle of a Sport Shoe activity on the MEECS Energy Resources CD</li> </ul>
<ul> <li>8- Students calculate the average ecological footprint of the class and compare it to the size of their home's property</li> <li>Green Teacher's <i>Measuring Your School's Ecological Footprint</i></li> <li>Sustainability—MTU Tech Alive Web Module</li> <li>Students play the Union of Concerned Scientists online <i>Great Green Web Game</i></li> <li>Students read the <i>Sustainability Fact Sheets</i> provided with this unit</li> <li>Students develop an environmental stewardship program</li> </ul>

# **Michigan Grade Level Content Expectations**

#### Grade 6-7 Science:

- Generate scientific questions based on observations, investigations and research. S.IP.06.11, S.IP.07.11
- Identify patterns in data. S.IP.06.16, S.IP.07.16
- Analyze information from data tables and graphs to answer scientific questions. **S.IA.06.11**, **S.IA.07.11**

#### Social Studies:

- Explain that communities are affected positively or negatively by changes in technology. 6 G2.2.2, 7 G2.2.2
- Understand the scientific method of inquiry to investigate social scientific and historical problems. P2.1
- Read and interpret data in tables and graph. P2.2
- Explain the changes over the past 50 years in the use, distribution, and importance of natural resources on human life, settlement, and interactions by describing and evaluating. WHG CG2

#### Grade 6-7 Science:

- Identify patterns in data. S.IP.06.16, S.IP.07.16
- Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities S.RS.06.15, S.RS.07.15

### HS Earth Science:

- Identify differences in the origin and use of renewable (e.g., solar, wind, water, biomass and nonrenewable (e.g., fossil fuels, nuclear [U-235]) sources of energy. **E2.2B**
- Describe renewable and nonrenewable sources of energy for human consumption (electricity, fuels), compare their effects on the environment, and include overall costs and benefits. **E2.4A**

# Social Studies:

- Identify and explain factors that contribute to conflict and cooperation between and among cultural groups (e.g., natural resources, power, culture, wealth) 6 G4.4.1, 7 G4.4.1
- Read and interpret data in tables and graphs. **P2.2**

#### Grade 6-7 Science:

- Use tools and equipment appropriate to scientific investigations S.IP.06.13, S.IP.07.13
- Analyze information from data tables and graphs to answer scientific questions. S.IA.06.11, S.IA.07.11
- Draw conclusions from sets of data from multiple trials of a scientific investigation to draw conclusions. S.IA.06.14, S.IA.07.14
- Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities. S.RS.06.15, S.RS.07.15

# HS Earth Science:

- Conduct scientific investigations using appropriate tools and techniques. E1.1C
- Describe a reason for a given conclusion using evidence from an investigation. E.1.1E
- Predict what would happen if variables, methods, or timing were changed. E1.1F

#### Social Studies:

• Read and interpret data in tables and graphs P2.2

#### Grade 6-7 Science:

- Generate scientific questions based on observations, investigations, and research. S.IP.06.11, S.IP.07.11
- Evaluate the strengths and weaknesses of claims, arguments, and data. S.RS.06.11, S.RS.07.11
- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere, (car exhaust, industrial emissions, acid rain, and natural sources), and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**
- Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance in ecosystems. **L.EC.06.41**

# HS Earth Science:

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

#### Social Studies:

- Explain that communities are affected positively or negatively by changes in technology. 6-G2.2.2, 7-G2.2.2
- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere. 6-G5.1.1, 7-G5.1.1
- Know how to find and organize information from a variety of sources; analyze, interpret, support interpretations with evidence, critically evaluate, and present the information orally and in writing; report investigation results effectively. **P2.3**



#### Grade 6-7 Science:

- Generate scientific questions based on observations, investigations, and research. S.IP.06.11, S.IP.07.11
- Communicate and defend findings of observations and investigations. S.IA.06.13, S.IA.07.13
- Evaluate the strengths and weaknesses of claims, arguments, and data. S.RS.06.11, S.RS.07.11

# HS Earth Science:

- Describe a reason for a given conclusion using evidence from and investigation. E1.1E
- Analyze how science and society interact from a historical, political, economic, or social perspective. E1.2k
- Identify differences in the origin and use of renewable (e.g., solar, wind, water, biomass) and nonrenewable (e.g., fossil fuels, nuclear [U-235[) sources of energy. **E2.2B**
- Describe renewable and nonrenewable sources of energy for human consumption (electricity, fuels), compare their effects on the environment, and include overall costs and benefits. **E2.4A**

## <u>Social Studies:</u>

- Clearly state an issue as a question of public policy, trace the origins of the issue, analyze various perspectives, and generate and evaluate alternate resolutions. 6 P3.1.1, 7 G5.1.1, 8 G5.1.1
- Contemporary Investigations conduct research on contemporary global topics and issues, compose persuasive essays, and develop a plan for action. 6 G6.1.1, 7 G6.1.1
- Identify, research, analyze, discuss, and defend a position on a national public policy issue. 6 P3.1.1, 7 P3.1.1, 8 P3.1.1
- Engage in activities intended to contribute to solving a national or international problem. 6 P4.2.2, 7 P4.2.2, 8 P4.2.2

### Grade 6-7 Science:

- Generate scientific questions based on observations, investigations, and research. S.IP.06.11, S.IP.07.11
- Use tools and equipment appropriate to scientific investigations S.IP.06.13, S.IP.07.13
- Construct charts and graphs from data and observations. S.IP.06.15, S.IP.07.15
- Analyze information from data tables and graphs to answer scientific questions. S.IA.06.11, S.IA.07.11
- Draw conclusions from sets of data from multiple trials of a scientific investigation to draw conclusions. S.IA.06.14, S.IA.07.14
- Evaluate the strengths and weaknesses of claims, arguments, and data. S.RS.06.11, S.RS.07.11

# HS Earth Science:

- Conduct scientific investigations using appropriate tools and techniques. E1.1C
- Analyze how science and society interact from a historical, political, economic, or social perspective. E1.2k HS Physics:
- Compare the energy used in one day by common household appliances (e.g., refrigerator, lamps, hair dryer, toaster, televisions, music players.) **P4.10i**

#### Social Studies:

• Engage in activities intended to contribute to solving a national or international problem. 6 – P4.2.2, 7 – P4.2.2, 8 – P4.2.2

# Grade 6-7 Science:

- Describe the effect humans and other organisms have on the balance of the natural world. S.RS.06.17, S.RS.07.17
- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere, (car exhaust, industrial emissions, acid rain, and natural sources), and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**

#### HS Earth Science:

- Critique solutions to problems, given criteria and scientific constraints. E1.2f
- Identify scientific tradeoffs in design decisions and choose among alternative solutions (e.g., best management practices, resource quantity and quality trade-offs). E1.2g
- Describe the life cycle of a product, including the resources, production, packaging, transportation, disposal, and pollution. **E2.4d**

# Social Studies:

- Engage in activities intended to contribute to solving a national or international problem. 6 P4.2.2, 7 P4.2.2, 8 P4.2.2
- Describe the environmental effects of human action on the atmosphere, biosphere lithosphere and hydrosphere. 6-G5.1.1, 7-G5.1.1

# Grade 6-7 Science:

- Generate scientific questions based on observations, investigations, and research. S.IP.06.11, S.IP.07.11
- Use tools and equipment appropriate to scientific investigations S.IP.06.13, .IP.07.13
- Analyze information from data tables and graphs to answer scientific questions. S.IA.06.11, S.IA.07.11
- Describe the effect humans and other organisms have on the balance of the natural world. S.RS.06.18, S.RS.07.18

# HS Earth Science:

- Identify and critique arguments about personal or scientific issues based on scientific evidence. E1.2B
- Analyze how science and society interact from a historical, political, economic, or social perspective. E1.2k
- Examine the negative impact of human activities. B3.4C

# Social Studies:

- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere. 6-G5.1.1, 7-G5.1.1
- Engage in activities intended to contribute to solving a national or international problem. 6 P4.2.2, 7 P4.2.2, 8 P4.2.2



# **Energy Resources Master Materials List**

(\*on MEECS Energy Resources CD)

Lesson 1. Energy Use in Michigan—Then and Now										
<ul> <li>Reproducible Materials per class </li> <li>Michigan and United States Total Energy Consumption by Sector, 2009 (transparency master) </li> <li>Residential Energy Use Based on National Averages (transparency master) </li> <li>U.S. Estimated Total Energy Consumption, 1900-2010 and Michigan Estimated Total Energy Consumption, 1960-2010 (transparency master) </li> <li>Michigan Population, 1900-2010 and Michigan Estimated Total Energy Consumption, 1960-2010 (transparency master) </li> <li>Michigan Population, 1960-2010 (transparency master)</li> <li>per student Note to Parents (home activity) </li> <li>Survey of Past and Present Energy Use (home activity) </li> <li>Global Petroleum Discovery and Use (optional student activity)</li> <li>My Environmental Diary (home activity)</li> </ul>	Materials in MEECS kit         per class         • MEECS Energy Resources CD (teacher resources)         • *Get Smart About Energy (extension)         To be supplied by teacher         per class         • calculator         • overhead projector         • stopwatch or watch with second hand         • clear flat plastic tub (1 or 3)         • dried peas (2 large bags)         per student         • clear cup or beaker									

Lesson 2. Michigan's Energy Resource Mix								
<ul> <li>Reproducible Materials per class <ul> <li>Renewable and Non-renewable Energy Resources Used in Michigan (transparency master)</li> <li>Renewable and Non-renewable Energy Resources Used in Michigan (answer key)</li> <li>Michigan and U.S. Consumption of Energy Resources, 2001 (transparency master)</li> <li>U.S. Energy Consumption by Source, 1635-2000 (transparency</li> </ul></li></ul>	Materials in MEECS kit         per class       •         •       MEECS Energy Resources CD (teacher resources)         •       *Natural Gas PowerPoint (optional)         •       Michigan Energy Resources Unit Poster         •       Electricity Generation map         per small group       Nichigan Energy Resources Unit Poster							
<ul> <li>Benergy Consumption by Source, 1055-2000 (transparency master)</li> <li>Heating Use, Transportation Use, Electricity Use (transparency masters)</li> </ul>	<ul> <li>To be supplied by teacher per class</li> <li>computer and computer projector (optional for Description)</li> </ul>							
<ul> <li><i>Renewable and Non-renewable Energy Resources Used in</i> <i>Michigan</i> (student activity)</li> <li><i>Michigan and U.S. Consumption of Energy Resources, 2001</i> (student resource)</li> </ul>	<ul> <li>overhead projector</li> </ul>							

Lesson 3. Generating Michigan's Electricity							
Lesson 3. Generating Michigan's Electricity per class • Investigating the Generation of Electricity (answer key) • Resource Mix, 2008 (transparency master) • Investigating the Generation of Electricity (student activity) • Resource Mix, 2008 (student resource)	Materials in MEECS kit         per class         • MEECS Energy Resources CD (teacher resources)         *Electricity Generation PowerPoint (optional)         *How Does Electricity Get to Our Homes?         PowerPoint (optional)         • Electrical Generation poster         • NASA - Night Lights poster (extension)         To be supplied by the teacher         per class         • nail         • hammer         • pop can         • 3-4 self-adhesive plastic index tabs         • plastic drinking straw         • plastic coffee stirrer straw or wooden skewer         • water         • ring stand or tripod         • Bunsen burner or gas grill         • ignition device         • oven mitts         • safety glasses         • wire gauze         • wire cutters, wire strippers (one for teacher or one per group), scissors         • overhead projector         • computer and computer projector (optional for PowerPoint)         per small group         • 3-4 self-adhesive plastic index tabs         • plastic drinking straw         • scissors         • plastic drinking straw         • scissors         • plastic bottle or beaker         • water						
	<i>per student</i> • safety glasses						

Lesson 4. Non-Renewable Energy Choices and Impacts									
<ul> <li>Reproducible materials per class <ul> <li>*Air Pollutants (optional student/teacher resource)</li> <li>Observing Non-renewable Energy Resources (answer key)</li> <li>Non-renewable Energy Resources Summary Chart <ul> <li>(answer key)</li> </ul> </li> <li>per small group</li> <li>Michigan Non-renewable Energy Resources Cards <ul> <li>(student resource)</li> </ul> </li> </ul></li></ul>	Materials in MEECS kit         per class         • MEECS Energy Resources CD (teacher resources)         • The Oil Age Poster (extension)         per small group         • Non-renewable Energy Resources Summary Charta and Card Sets (student activity)         To be supplied by the teacher								
<ul> <li>per student</li> <li>*Air Pollutants (optional student/teacher resource)</li> <li>Observing Non-renewable Energy Resources (student activity)</li> <li>Impacts of Local Resource Mix (student activity)</li> <li>My Electricity Profile (extension student activity)</li> </ul>	<ul> <li><i>per class</i></li> <li>bromothymol blue solution (dilute) (small dropper bottle)</li> <li>beakers (3)</li> <li>Bunsen burner, fume hood (recommended)</li> <li>goggles</li> <li>ignition device, kerosene lamp, lump of coal, tongs</li> <li>local electric utility bill</li> <li><i>per student</i></li> <li>electric utility bills (optional)</li> <li>goggles</li> </ul>								

Lesson 5. Renewable Energy and Michigan	
<ul> <li>Reproducible materials per class <ul> <li>Observing Renewable Energy Resources (answer key)</li> <li>Renewable Energy Resources Summary Chart (answer key)</li> <li>Michigan's Renewable Energy Potential (teacher resource)</li> <li>Comparing Renewable and Non-renewable Energy Resources (answer key)</li> <li>Energy and the Role of Government in Michigan (transparency master)</li> </ul></li></ul>	<ul> <li>Materials in MEECS kit per class</li> <li>MEECS Energy Resources CD (teacher resources),</li> <li>per small group</li> <li>Renewable Energy Resources Summary Chart and Card Sets (student activity)</li> <li>Completed Non-renewable Energy Resources Sum- mary Chart and Card Sets (student activity from Lesson 4)</li> </ul>
<ul> <li><i>Per small group</i></li> <li><i>Michigan Renewable Energy Cards</i> (student resource)</li> <li><i>per student</i></li> <li><i>Observing Renewable Energy Resources</i> (student activity)</li> <li><i>Michigan's Renewable Energy Potential</i> (student resource)</li> <li><i>Comparing Renewable and Non-renewable Energy Resources</i> (student activity)</li> <li><i>Energy and the Role of Government in Michigan</i> (student resource)</li> </ul>	<ul> <li>To be supplied by the teacher per class</li> <li>model turbine from Lesson 3</li> <li>goggles</li> <li>beaker, glass, plastic basin or sink, water</li> <li>scissors, thermometer, tongs, wooden matches</li> <li>bromothymol blue solution (dilute) (small dropper bottle)</li> <li>overhead projector</li> </ul> <i>per student</i> <ul> <li>goggles</li> </ul>

# Lesson 6. Energy Conservation and Efficiency: Leaks and Lights

#### **Reproducible materials**

per class

- *Energy Star* (transparency master)
- Sources of Air Leaks in the Home (transparency master)
- *How to Caulk* (teacher resource)
- Incandescent vs. Compact Fluorescent Light Bulbs (transparency master)
- Incandescent vs. Compact Fluorescent Light Bulbs Advantages and Disadvantages (transparency master)
- An Enlightening Investigation (answer key)

## per student

- *Energy Use of Some Typical Home Appliances* (student resource)
- *Ways to Conserve Energy and Increase Energy Efficiency* (student activity)
- Identifying and Fixing Air Leaks (home activity)
- An Enlightening Investigation (student activity)

#### Materials in MEECS kit

per class

- MEECS Energy Resources CD (teacher resources)
- Get Smart About Energy CD (extension)
- Energy Savers CD (extension)

# To be supplied by the teacher

- per class
- pencil
- tissue paper or box of facial tissues
- tape
- scissors
- caulk tube(s)
- caulking gun
- cardboard
- plastic spoons
- rags
- overhead projector
- utility knife
- light meter or calculator light probe (optional)
- linear tape measure or yardstick (optional)

#### per small group

- calculators
- compact fluorescent light bulb
- incandescent light bulb
- standard light sockets, desk, or table lamps (2 per group)
- thermometers or calculator temperature probes (2 per group)

#### per student

- pencil
- tissue paper or facial tissues
- scissors
- tape
- rubber gloves
- goggles
- graph paper



Lesson 7. Using a Product's Life Cycle	
Reproducible materials	Materials in MEECS kit
per class	MEECS Energy Resources CD (teacher resources)
Life Cycle Assessment (transparency master)	EPA Solid Waste Resources (2003 edition) CD
Pollution Prevention (transparency master)	(extension)
• <i>The Life Cycle of a CD or DVD</i> (answer key)	
	per class
per student	• EPA's <i>Life Cycle of a CD or DVD</i> (poster: large size)
• * <i>Product Life Cycle Stages Cards</i> (optional activity)	
Self-Assessment: Student Product Choice and Use	per small group
(student activity)	• EPA's <i>Life Cycle of a CD or DVD</i> (poster: small size)
• <i>The Life Cycle of a CD or DVD</i> (student activity)	
	To be supplied by the teacher
	per class
	6 home-grown or locally grown apples
	• jar of applesauce
	individual serving size packs of applesauce
	overhead projector
	per small group
	• CD (1 per group)
	per student
	large sheet of paper
	• markers

Lesson 8. Leaving Smaller Footprints	
<ul> <li>Reproducible materials per class</li> <li>Ecological Footprint (transparency master)</li> <li>per student <ul> <li>What is Your Ecological Footprint? (student activity)</li> <li>Five Actions I Could Take to Reduce My Ecological Footprint (student activity)</li> <li>Students' completed My Environmental Diary (assigned in Lesson 1)</li> </ul> </li> </ul>	<ul> <li>Materials in MEECS kit per class</li> <li>MEECS Energy Resources CD (teacher resources)</li> <li>Sustainability Fact Sheets (extension)</li> </ul> To be supplied by the teacher per class <ul> <li>cutting board</li> <li>knife</li> <li>large apple</li> <li>overhead projector</li> </ul> per student <ul> <li>computer with Internet access</li> </ul>

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higan Grade Level Content Expectations (Continued) relation for Energy Resources Unit ddresses/Supports	<b>E1.2f</b> Critique solutions to problems, given criteria and scientific constraints.	<b>E1.2g</b> Identify scientific tradeoffs in design decisions and choose among alternative solutions (e.g., best management practices, resource quantity and quality trade-offs).	<b>E2.4d</b> Describe the life cycle of a product, including the resources, production, packaging, transportation, disposal, and pollution.	E1.2B Identify and critique arguments about personal or scientific issues based on scientific evidence.	<b>B3.4C</b> Examine the negative impact of human activities.	<b>P4.10i</b> Compare the energy used in one day by common household appliances (e.g., refrigerator, lamps, hair dryer, toaster, televisions, music players.)	6 - G2.2.2, 7 - G2.2.2 Explain that communities are affected positively or negatively by changes in technology.	P2.1 Understand the scientific method of inquiry to investigate social scientific and historical problems.	<b>P2.2</b> Read and interpret data in tables and graph.	<b>WHG CG2</b> Explain the changes over the past 50 years in the use, distribution, and importance of natural resources on human life, settlement, and interactions by describing and evaluating.	6 - G4.4.1, 7 - G4.4.1 Identify and explain factors that contribute to conflict and cooperation between and among cultural groups (e.g., natural resources, power, culture, wealth)	<b>6-G2.2.2</b> , $7 - $ <b>G2.2.2</b> Explain that communities are affected positively or negatively by changes in technology.	6 - G5.1.1, 7 - G5.1.1 Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere.	<b>P2.3</b> Know how to find and organize information from a variety of sources; analyze, interpret, support interpretations with evidence, critically evaluate, and present the information orally and in writing; report investigation results effectively.	6 - P3.1.1, $7 - G5.1.1$ , $8 - G5.1.1$ Clearly state an issue as a question of public policy, trace the origins of the issue, analyze various perspectives, and generate and evaluate alternate resolutions.	6 - G6.1.1, 7 - G6.1.1 Contemporary Investigations – conduct research on contemporary global topics and issues, compose persuasive essays, and develop a plan for action.	<b>6 – P3.1.1</b> , <b>7 – P3.1.1</b> , <b>8 – P3.1.1</b> Identify, research, analyze, discuss, and defend a position on a national public policy issue.	6 - P4.2.2, 7 - P4.2.2, 8 - P4.2.2 Engage in activities intended to contribute to solving a national or international problem.
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