Lesson 9: Draft Busters

Energy Knowledge in Action

Overview

Students identify sources of unwanted heat transfer within their school and homes and make suggestions as to how these types of transfers can be slowed. Students further investigate how buildings are heated.

Teacher Background

Every autumn Maine people are faced with the prospect of heating their homes for another winter. How do Mainers heat their homes? Are there options for keeping homes in Maine warm? What are the environmental effects of home heating actions, including conservation?

As we know, heat moves from warm to cool. This has been a key concept throughout this unit. But how do we prevent warmer air from inside our homes, schools, and businesses from moving to the colder outdoors? Since heat transfers occur naturally we can't totally prevent them but there are actions we can take to slow the rate of unwanted heat transfers within our homes. One note of caution has to do with the common usage of the word "loss" when discussing heat. Very often people will refer to heat "loss" or the notion that heat is "escaping" when discussing weatherizing. Keep in mind that heat is never "lost." When discussing heat conservation and heat transfers with students, use the terms "moves or transfers"; this will help to reinforce the notion of heat transfers rather than the common misconception that heat is "lost." Heat moves and can be transferred somewhere else but it is never "lost." Avoid using the terms "loss/lost."

In Lesson 8 students explored a few of the common resources Maine people use for heating buildings. Where these resources come from, including the ideas that resources are limited in supply and their use has effects on the Earth, are critical concepts that will aid students in understanding the need for conservation. Conservation is a powerful action that everyone can take to reduce the energy used to heat their homes and schools. Linking conservation to a minimal impact on the environment saving natural resources, and saving money are important ideas for students to understand before they move toward ownership of and action toward conservation.

Understanding the difference between renewable and nonrenewable resources, including the idea that there is finite supply of resources such as oil and coal, often changes how people view and use resources. The following analogy may help. If a family has 1 week's worth of food in the refrigerator but 2 more weeks until pay day/shopping day, the need for conservation is usually crystal clear. But if it is believed that food will continuously refill the refrigerator no matter how much is eaten or how fast it's eaten then the idea of conservation will be foreign. Applying this type of understanding to nonrenewable resources may be helpful for students to understand the idea of finite resources and the need for conservation.

People conserve for a variety of reasons, with cost and environmental concerns usually topping the list. As students begin to link their actions with the use of natural resources they are often ask, "What can I do to make a difference?" With that in mind, there are several no or low cost actions that will help students make sense of that question. A few actions, such as adding insulation, weather stripping and caulking, using curtains and shades, using draft socks, closing doors to unused rooms, and planting deciduous trees on the south side of a home and coniferous trees on the windward side of a home, are a few methods people use to slow unwanted heat transfers.

Other actions may not slow heat transfers per se but will aid in conservation. Lowering the thermostat and putting on a sweater or some other layer of clothing are no cost first steps Mainers can take to conserve energy. Every degree the thermostat is turned down saves 5-10% on heating costs as well as reducing the release of major greenhouse gases. Using a programmable thermostat is a great way to lower the home's temperature when the family is sleeping and/or away from home. Developing simple habits, such as having slippers and a sweater by the door can encourage their use and thus lessen the immediate need to turn up the thermostat when returning home from school or work.

How often do we think about maintaining the furnace or boiler? Having a dirty furnace air filter reduces the required airflow and uses more fuel by making the blower work harder. Cleaning the air filter at least once a year will reduce the wear on the furnace and the amount of fuel used. A clean filter and fuel injector tune up can help save as much as 5% in heating costs as well as reducing greenhouse gases. By combining the actions of cleaning the furnace filter and injector yearly along with turning down the thermostat, a person can save a substantial amount of money and reduce the amount of greenhouse gases that are released into the environment.

A local Maine resource that may be useful when discussing actions to conserve heat energy with students is through WSCH 6 Project Heat: Tips on Winterizing Your Home http://www.wcsh6.com/life/community/project_heat/story.aspx?storyid=95533&catid=225

Key Ideas

- There are a number of simple ways to slow unwanted transfer(s) of heat.
- It is everyone's responsibility to use energy efficiently or wisely. Conservation of heat is linked to our use of natural resources, which impacts our environment, economy, and national security.

Lesson Goals

Students will:

- identify and describe steps that can be taken to conserve energy and the reasons for doing so.
- produce media that will interest, convince, and persuade an audience to take action in conserving energy used for heating.

Vocabulary

conservation: reduction of wasteful or excessive use (consumption) of energy resources.

conserve: to avoid wasteful use of energy resources.

energy efficiency: using less energy to perform the same function.

Preparation

- Consult with the custodian to determine how the school is heated and consider inviting the custodian to speak to students about how the school is heated.
- Determine where and how students will initially explore drafts in the school. Consider assigning students to different areas of the school building and/or limit exploration to common spaces or their classrooms. Alert staff to upcoming exploration.
- Preview websites that students will be using to find out more about how they can prevent unwanted heat transfers in schools and their homes.
- Determine what form students' culminating media action project will take, how this will be managed, how their project will be shared, and with what audience. A description of the project is found in step 7. Modify if necessary Student Handout 9.3: Draft Busters Media Guidelines and Rubric so that it aligns with the assigned final project.

Materials

Item	Quantity
Scientist's Notebook	1 per student
Computers with internet access	1 per student or pair of students
1 piece of toilet or tissue paper (12 cm X 5 cm or 5" X 2") (unwanted VCR tape can be substituted)	1 per student pair
1 pencil	1 per student pair
Clear tape	Enough for the class
Scissors	1 per student
Student Handout 9.1: Draft Busters School Detection Recording Sheet Student Handout 9.2: Draft Busters Home Detection Recording Sheet Student Handout 9.3: Draft Busters Media Guidelines and Rubric	1 per student
Digital camera	1 per class minimally

Time Required: 3 sessions

Connection to *Maine Learning Results: Parameters for Essential Instruction (MLR)*, *National Science Education Standards (NSES)*, and *Benchmarks for Science Literacy (BSL)*

- Identify personal choices that can either positively or negatively impact society including population, ecosystem sustainability, personal health, and environmental quality. MLR C3(6-8) b
- Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature. NSES B(5-8) 8
- Different ways of obtaining, transforming, and distributing energy have different environmental consequences. BSL 8C/M2
- Some resources are not renewable or renew very slowly. Fuels already accumulated in the earth, for instance, will become more difficult to obtain as the most readily available resources run out. How long the resources will last, however, is difficult to predict. The ultimate limit may be the prohibitive cost of obtaining them. BSL 8C/M10** (SFAA)

- By burning fuels, people are releasing large amounts of pollution and carbon dioxide into the atmosphere and transforming chemical energy into thermal energy which spreads throughout the environment. Benchmarks 8C/M11**
- Summarize and apply information presented. MLR-ELA E1(6-8)b
- Select appropriate media, relevant to audience and purpose that support oral, written, and visual communication. MLR-ELA E2(6-8)e
- Explain the role of media in forming opinions. MLR-ELA F1(6-8)b

Teaching The Lesson

Engage

1 Introduce the lesson using the following scenario:

Because of the high cost of fuel this past year there have been a lot of programs on the news recently about people needing to reduce their energy bills. The news reporters said they are going to create short news segments related to heating issues in upcoming broadcasts. That gave me an idea for a special community service project for our class; to put together some informational materials as an outreach project for our community.

2 Brainstorm sources of unwanted heat transfers.

Ask students to brainstorm where unwanted heat transfers might be occurring in their homes or in the school. Students will most likely suggest places such as windows, doorways, cracks between windows and doors, attic, cellar windows, vents for stoves and dryers, etc.

Segue into asking students to brainstorm a list of things that they know can help slow unwanted heat transfers. As students offer suggestions, create a master list on the chalkboard, whiteboard, or chart paper. Students will most likely recognize that homes are insulated and may suggest actions such as keeping doors and windows closed and properly sealed, sealing windows with plastic in the winter, keeping windows covered with insulated window treatments, adding hay bales or bags of leaves around the perimeter of their homes, and the like. The purpose of this initial brainstorm is to see what students already know about minimizing unwanted energy transfers as opposed to giving them a comprehensive list of tips and suggestions– these will be further researched and generated by students. Summarize students' list by noting that all of these suggested strategies have one thing in common – they are done to slow heat transfer by sealing up leaks or eliminating drafts. Save this list for the second part of the lesson.

Throughout this lesson, as students look at preventing unwanted heat transfers, revisit the types of heat transfer and have students identify what types of heat transfer are being prevented by the changes suggested.

Explore

3 Introduce Draft Detectors.

Ask students: *What is a draft? How are drafts related to unwanted heat transfers? In a draft, where is the heat or warm air coming from and where is it moving to?* As students describe drafts and their connection to heat transfers, pay close attention to the words students use to describe the direction of transfer and in what terms. Students may revert back to earlier, inaccurate notions about heat. Discuss with students the connection between unwanted heat transfers and conserving energy.

Ask students what conserving energy means and why it is important to use energy as efficiently as we can. Help students relate minimizing heat transfers to using less energy for heating our homes and schools.

Explain to students that they will be constructing a simple device to detect (locate) drafts. Drafts, especially in older schools and homes in Maine, are one of the biggest culprits (sources) of unwanted heat transfers. While individually drafts may not seem like a big problem, collectively drafts add up!

Provide each student with:

- 1 piece of toilet paper (5" X 2")
- a pencil
- 1 piece of scotch tape
- scissors

Have students construct their Draft Detectors.

Demonstrate how the Draft Detector works by using it near a window or open classroom door. Point out to students how easily the toilet paper moves. Explain to students that they will explore areas of the school (or other designated areas) to find areas of unwanted heat transfer.

Before students begin looking for drafts, brainstorm areas in the school (windows, doors, mail slots, electrical outlets, etc.) that may be suspect. Ask students to predict where they think the "draftiest" area(s) will be. Instruct students to record their prediction (which includes why they think a particular location will be the draftiest) and findings in their scientists' notebooks or provide students with Student Handout 9.1.

Have students work in pairs or small groups to locate drafts and record their locations using the Student Handout 9.1 – Draft Busters! School Draft Detection Recording Sheet.

4 Discuss Draft Detector findings.

Discuss students' findings upon their return. Call attention to patterns in students' findings and help students consider what their findings tell them.

5 Assign Home Draft Detection.

Explain to students that they are going to take their Draft Detectors home and record their findings in the same way they did in class. Ask students to make a prediction (and say why they think so) as to where they think they will find the biggest draft(s). Ask student to record their findings in their notebooks or on Student Handout 9.2 – Draft Busters! Home Draft Detection Recording Sheet.

Reflect And Discuss 

6 Compare home and school Draft Detection findings.

Discuss students' findings at home and compare with findings at school. Ask students what the most surprising finding was and why it was surprising to them. Discuss the connection between their findings and the notion of conserving natural resources (both renewable and nonrenewable). Ask students what ideas they have about how the draft problem could be solved.

7 Introduce Draft Buster media message.

Explain to students that because we use so much energy to heat our homes it is important that we use it in the most efficient ways possible to save money and to protect our environment. Simple actions such as sealing up drafts are a fairly easy way to conserve precious resources. Explain that their class, after some additional research, will be developing some sort of media (Draft Buster newsletter/news story column, poster, video or audio clip, ppt, slide show, skit, jingle, etc.) that portrays unwanted heat transfer issues and offers simple tips and strategies for using energy to heat their homes and schools efficiently. We will be sharing our media messages throughout our school and community.

Let's figure out some ways we can help people in our community to conserve energy. First, we need to figure out what target audience could most benefit from this kind of information. Then we can figure out the best way to get the information to them. Let's brainstorm what types of people in our community would benefit the most from knowing about this? How could we find out what our target audience(s) already knows about heat conservation?

Would a survey be a good way to find out? Let's brainstorm a few questions we could ask people in a survey. Examples could include:

- What are three ways you can conserve energy in your home?
- How do you heat your home?
- Are there places in your home that feel colder than others?
- What steps have you taken to keep the heat in your home?
- Would you like to learn more about how to conserve heat?

> **Note:** *Add any other appropriate questions students would like to ask. Keep it simple.*

Once the list is compiled ask students, "*What is the best way for us to do this survey? On the web with survey monkey, by phone calls, by mail, in the newspaper, in person at school events, take home and interview parents and friends?*"

Conduct the survey and compile the results. What target audience stands out as not knowing about energy conservation? What kinds of things do they seem to not understand? What is the best way of getting information to them? Handouts, news stories, web based info, newsletters, cable TV, video, displays or posters in community, and any other reasonable ideas that students may have.

> **Note:** *There are a variety of formats that can be used for students to share their learnings and offer tips and strategies to a broader community. Teachers may wish to allow students to use multimedia (ex: iMovie) to create short news clips that could be broadcasted on a local TV or school channel. Students could write a short article for a newspaper column. Whatever the medium chosen to reach their target audience, make certain that students have the opportunity to share their work. A newsletter is an excellent and efficient way to share short student-authored pieces with a broader community. In lieu of printing paper copies of students' newsletters for distribution, consider greener alternative by posting their newsletter in the form of a blog or website. Make certain students have permission for their work or likeness to be published on the Internet or elsewhere.*

8 Brainstorm and research ideas.

Revisit the list of ways to stop unwanted heat transfers students generated in Step 2. Using the suggested websites below and any other additional information, students work in small groups to find out other ways to minimize unwanted heat transfers. Encourage students to record their findings in their scientists' notebooks. Give students a certain amount of time (such as 30 minutes) to complete their research.

Suggested Sites for Students to Review:

Maine Government Energy page contains links to Do It Yourself Videos: Energy Savings at Home and a Do It Yourself Energy Saving Guide Brochure
http://www.maine.gov/governor/baldacci/policy/energy.shtml

The Wiser Way: Feeling a draft? Here's How to Stop It. (approximately 4 minute video on weather stripping)
http://www.chelanpud.org/5163.html

Energy Savers Blog: Winter Warmth Tips for Senior Citizens
(Lots of no cost tips.)
http://eere.typepad.com/energysavers/2008/10/winter-warmth-tips-for-senior-citizens.html

Reduce Your Heating Bills This Winter: Overlooked Sources of Heat Loss in the Home
http://www.chiff.com/a/cut-heat-loss.htm

University of Minnesota's Dairy Extension: Tips on how to keep dairy animals from being affected by drafts. http://www.extension.umn.edu/Dairy/dairystar/11-08-08-janni.html

Home Energy Saving Tips
(includes areas of energy conservation besides heat)
http://www.saskenergy.com/saving_energy/tips.asp

BBC's Bloom – Learn conservation actions
http://www.bbc.co.uk/bloom/flash.shtml?cc_start_screen=youractions;cc_action_id=22;cc_chosen_action=yes

9 Develop media.

After students have completed their research, bring the class together and add strategies and tips to the list. Provide each student with a tailored version of Student Handout 9.3: Media Guidelines and Rubric. Have students work in small groups of 2-3 students to select and write up a heat saving tip or strategy to convey via chosen media. Emphasize to students that they need to not only provide information about the strategy of tip in their media, but that they also need to explain why slowing heat transfers is critical. Encourage students to include a digital media (photography or video) that shows the tip or strategy in action. Encourage students to peer-edit their media before submitting.

10 Make media public.

Once students have completed their projects, have students distribute and share their media. Consider involving students in making this decision by asking them to reflect on their efforts and make suggestions as to how the information can be disseminated to a broader audience. Consider sharing their finding with the school custodian and/or principal. This would be a positive action that may bring about energy-saving actions in the school.

11 (Optional) Home energy audit.

Students may be interested in performing a home energy audit. These involve a much more comprehensive look at energy use in the home and will require the assistance of an adult.

Consider inviting someone that does home energy audits to the classroom to discuss how energy audits are conducted. Often trained auditors have infrared cameras and other tools, and can describe methods that they use to detect drafts.

A sampling of energy audit websites:

The Home Energy Saver
http://hes.lbl.gov/

WCSH6 – Conducting a home energy audit:
http://search.wcsh6.com/sp?aff=1100&keywords=energy+audit&submit.x=0&submit.y=0&submit=submit

UMaine Cooperative Extension: Energy Audit Tips
http://www.umext.maine.edu/energy/Conservation/audittips.htm

Energy Savers Blog: Winter Warmth Tips for Senior Citizens (Lots of no cost tips.) http://eere.typepad.com/energysavers/2008/10/winter-warmth-tips-for-senior-citizens.html

Reduce Your Heating Bills This Winter: Overlooked Sources of Heat Loss in the Home
http://www.chiff.com/a/cut-heat-loss.htm

Extensions

Student may:

- contact the local fire department to see if they have a thermal imaging camera and if they are able to demonstrate how this technology works during a classroom presentation.
- research periods in Earth history such as the Carboniferous Period.
- connect with art teacher and teach students how to make a draft sock to use to stop door and/or window drafts. See the following link for directions: http://www.epa.state.il.us/kids/teachers/activities/draft-stopper.html

Connection to Maine Agencies

MEEP (Maine Energy Education Program) is a no cost resource for schools and teachers in Maine. Contact MEEP about borrowing a Home Energy Efficiency Audit Kit or a School Efficiency Audit Kit. One of the tools in the school kit is a HOBO which is used to monitor warm and cool spots around school and detect heat loss. The MEEP website is http://www.meepnews.org/classroomactivities

School Energy Efficiency Audit—Students use tools loaned by MEEP to see where energy is being wasted in their school. MEEP staff can visit with their new Infrared Camera to spot air leaks and insulation problems after students have used the other tools to find problem areas.

Home Energy Audit Kit—Students use kits loaned by MEEP to find phantom loads—electronics and appliances that use energy even when they appear to be turned off.

For schools in Aroostook County, a Maine Public Service (MPS) representative will come to interested schools, free of charge, to guide and support concepts developed in this lesson. A description of programs is available at www.mainepublicservice.com. Click on the education section of the site. To schedule a presentation contact Nancy Chandler at 207.760.2556 or nchandler@maine publicservice.com.

Online References and Resources

Lesson modified from: David Suzuki Foundation, et al. (2006). Teachers' Guide, Nature Challenge Guide Classroom Edition. Lesson E: Gone With the Wind. Vancouver, BC Canada.
http://www.davidsuzuki.org/

Addresses "tight homes"
http://www.seacoastinspections.com/BlowerDoor.html

How to change a furnace filter
http://www.youtube.com/watch?v=oNj11CvBcdg&feature=related

Inspecting a home heat boiler. http://www.youtube.com/watch?v=P7LXsLmxxEM&feature=related

Energy Star – You can make changes and then click on the starts for energy saving tips. Don't miss the door! (General energy saving tips.)
http://www.energystar.gov/index.cfm?c=kids.kids_index

Draft Busters!

School Draft Detection Recording Sheet

Directions: Look for drafts in your school using your Draft Detector. Use the recording sheet below to record where the drafts and rate the drafts in your school.

Specific Location *(Example: exit door in Library, 7th grade classroom center window)*	Draft Description		
	No Draft	**Small Draft**	**Big Draft**

Draft Busters!

Home Draft Detection Recording Sheet

Directions: Look for drafts in your home using your Draft Detector. Use the recording sheet below to record where the drafts and rate the drafts in your home.

Specific Location *(Ex.: front door,kitchen window, exhaust fan, fireplace, dryer vent, attic door, etc.)*	Draft Description		
	No Draft	Small Draft	Big Draft

Draft Busters! Media Guidelines and Rubric

Create media that describes a strategy or tip related to unwanted heat transfers.
The media should:

- Describe the need for the strategy or tip (How or why does the unwanted transfer occur – what's the science behind it?).
- Describe the tip or strategy clearly.
- Describe conserving energy is important.

Summary Rubric

	Exceeds Standards (4)	Meets Standard (3)	Partially Meets Standard (2)	Does Not Meet Standard (1)
Unwanted heat transfer is identified	Unwanted heat transfer is clearly identified by text and by picture.	Unwanted heat transfer is clearly identified by either text or by picture.	Some reference to the unwanted heat transfer is made, but the reference is not clear.	No reference to the unwanted heat transfer is made.
Scientific reason for unwanted heat transfer is explained	Scientific reason is clear and accurate.	Scientific reason is clear and partially accurate.	Scientific reason is not clear.	A scientific reason is not included.
Preventative Measure	Preventative measure is clearly presented by text and by picture. The information is accurate.	Preventative measure is clearly presented by text and by picture. The information is partially accurate.	Preventative measure is presented by text and/or by picture. The information is accurate or partially accurate.	Information provided is insufficient.
Explanation of why slowing unwanted heat transfer is critical	Two fuel sources are used to clearly show why slowing unwanted heat transfer is critical.	One fuel source is used to clearly show why slowing unwanted heat transfer is critical.	One or two fuel sources are used. The explanations do not clearly show why slowing unwanted heat transfer is critical.	Information provided is insufficient.
Organization and Presentation	Media is organized in a thoughtful manner. Product shows superior effort.	Media is organized in a thoughtful manner. Product shows effort.	Media is organized in a thoughtful manner or the product shows effort.	Media is not organized and the product lacks effort.
Mechanics and Grammar	Contains no punctuation, spelling, or grammatical errors.	Contains few errors in punctuation, spelling or grammar that do not interfere with meaning.	Contains several punctuation, spelling or grammatical errors that interfere with meaning.	Contain numerous punctuation, spelling or grammatical errors.

Master Materials Checklist

✓	Quantity	Item	Lesson(s)
❑	1	*The Mitten* by Jan Brett	1
❑	1 per student	Student Handout 1.1: The Mitten Problem	1
❑	2 for initial demonstration 2 per student pairs	Thermometers	1,3,4
❑	1 pair per student pairs	Assortment of mittens	1
❑	1 per student	Scientist Notebook	1-9
❑	Individual, pairs, or whole class depending on availability	Computers with access to internet (and/or LCD projector and speakers)	1-9
❑	1	Teacher Resource 1.1: Thermometer Overhead (optional)	1
❑	Enough for student pairs to conduct investigation	Access to water samples at various temperatures and volumes (chilled, cold, room temperature, warm, hot)	2, 3, 4, 5, 6, 7
❑	3	10 oz or larger clear cups or containers that can hold hot water	2
❑	1 bottle	Food coloring (a dark color)	2
❑	2	Index cards to label hot and cold water samples	2
❑	1 per student	Student Handout 2.1: Molecules on the Move (optional)	2
❑	3 per student pairs plus 1 set for teacher demo	Cups, foam or insulated paper	3
❑	2 per student pair	Graduated cylinders	3
❑	1 per student pair	Pipettes	3
❑	1 per student pair and a few extras on hand	Clean cloth rags to wipe up spills	3
❑	1 set	Dust pan and brush	3,
❑	2 per student	Student Handout 3.1: Mixing Water Class Data	3
❑	1 per class or student pair	Temperature probes (optional, if available)	3, 4, 6

Master Materials Checklist *(continued)*

✓	Quantity	Item	Lesson(s)
❑	1	Table lamp with 100 watt incandescent bulb	4, 5
❑	1	Cooler (optional, prop)	5
❑	1 per pair	2-Liter clear plastic bottles with top portion removed	4
❑	1 per pair	Quart size freezer bags (heavy duty)	4
❑	1 per class	Blue food coloring	4
❑	2 per pair	Cups or beakers (500 ml)	4
❑	1 per class or 1 per student pairs	Clock with minute hand, timer, or stopwatch	4,5,6,7
❑	1 per student	Student Handout 4.1 (optional): Temperature Changes	4, 6
❑	1 per student	Graph paper	4
❑	Each student needs 2 different colors	Colored pencils	4
❑	1 set per class	Teacher Resource: 5.1: Heat Transfer Scenes (place in clear page protectors for reuse)	5
❑	Approximately 20 pieces	Chart paper	5
❑	10	Markers	5
❑	1 per student	Student Handout 5.1: How Heat Travels Student Handout 5.2: How Heat Travels Content Organizer Student Handout 5.3: Observing Convection	5
❑	1 set per class	Wax dot demonstration materials: • Metal knitting needle • Wax shaped into pea sized dots • Candle and matches • Aluminum foil (to protect work surface) • Heat resistant apron • Safety goggles • Fire extinguisher	5
❑	1 set per group	Convection materials: • Four 6 or 8 oz cups • Food coloring • Clear pie pan • Water samples (room temperature, hot water, cold water)	5

Master Materials Checklist *(continued)*

✓	Quantity	Item	Lesson(s)
❑	1 set per class	Hot air spiral demonstration: • Paper spiral pattern (Teacher Resource 5.3) • Thread • Candle and matches • Heat resistant apron • Safety goggles • Fire extinguisher	5
❑	1 per class	Brownie mix package (prop)	6
❑	1 set per group	For each group: • four 250 mL containers • five thermometers • dishpan or baking tray • Enough for each group to have a 200 mL sample of: sand or crushed rock, metal BBs or pennies, glass marbles (small decorative aquarium/floral type), shredded paper or cotton balls	6
❑	1 per student	Student Handout 6.1 (optional): Heat Transfer through Different Materials	6
❑	1 per group of 4 students	Student experiment materials: • four 500 ml containers (beakers) of hot water (Alternatively, could use insulated take out coffee cups with covers) • four thermometers • plastic wrap to cover containers and "contain" insulating material around bottles.	7
❑	Enough for class (Students could be asked to bring in items from home.)	A variety of insulating materials such as: • Aluminum foil • Packing "peanuts" • Fiber fill • Shredded or crumpled newspaper • Sawdust • Sand • Plastic bags • Cloth (samples of cotton or wool)	7
❑	1 per student pair plus a few extras	Plastic bottles (12 oz size)	7
❑	1 per student pair	Gallon size resealable bag	7
❑	1 per class	Large storage tube (38 quart or suitable size)	7

Master Materials Checklist *(continued)*

✓	Quantity	Item	Lesson(s)
❑	1 per class	Thermos and/or insulated hot/cold food bag – now available in many grocery stores (prop)	7
❑	1 per student	Student Handout 7.1: Insulation Investigation Planning Guide Student Handout 7.2: Sample Data Table and Sample Graphs: Student Handout 7.3: Keeping It Cool: Building an Insulated Water Bottle Student Handout 7.4: The Mitten Problem Redux	7
❑	1 per student	Student Handouts 8.1: Consumer Profiles Student Handout 8.2: Fuel Information Sheets Student Handout 8.3: Fuel Recommendation Guidelines and Rubric Student Handout 8.4: Consumer Profiles and Fuel Information Sheets Group Discussion Guide (optional)	8
❑	1 per student pair	1 piece (square) of toilet or tissue paper (12 cm X 5 cm or 5" X 2") (unwanted VCR tape could be substituted)	9
❑	1 per student	1 pencil	9
❑	Enough for class	Clear tape	9
❑	1 per student	Scissors	9
❑	1 per student	Student Handout 9.1: Draft Busters School Draft Detection Recording Sheet Student Handout 9.2: Draft Busters Home Draft Detection Recording Sheet Student Handout 9.3: Draft Busters Media Guidelines and Rubric	9
❑	1 per class	Digital camera	9

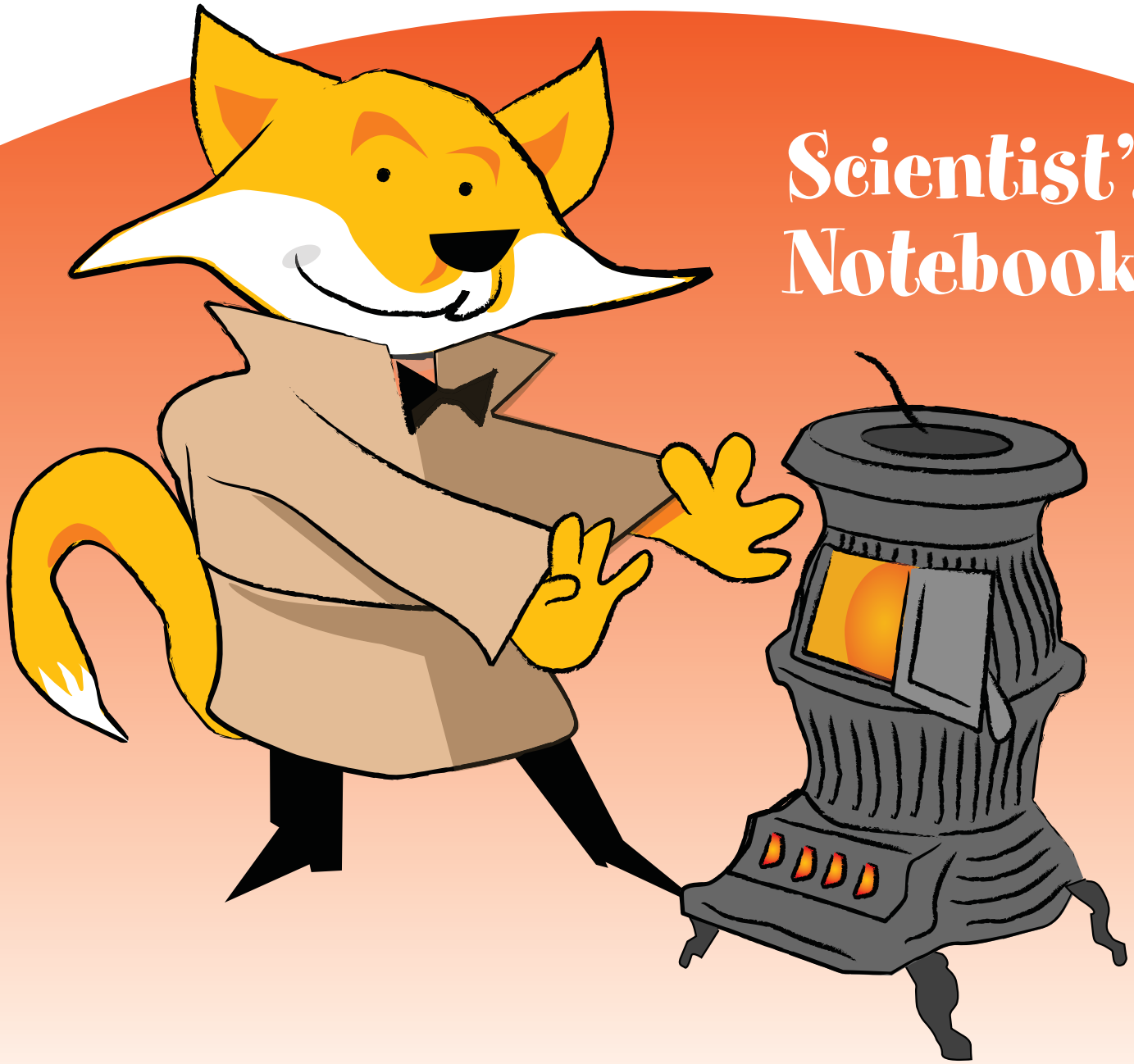
Energy Heats Maine

Master List of Student Handouts and Teacher Resources

PowerSleuth
Maine Energy Education Curriculum

Energy Heats Maine

Scientist's Notebook



Scientist: _____

Energy Heats Maine

Glossary

conduction: the transfer of heat through material by direct contact. (Lesson 5,6)

conductor (thermal): a substance that allows heat to flow through it. (Lesson 6, 7)

conservation: reduction of wasteful or excessive use (consumption) of energy resources. (Lesson 9)

conserve: to avoid wasteful use of energy resources.(Lesson 9)

convection: the transfer of heat in a fluid (gas or liquid) as a result of the movement of the fluid itself. (Lesson 5)

energy efficiency: using less energy to perform the same function. (Lesson 9)

heat: the flow of thermal energy from a warm area to a cooler one. (Lesson 1, 2, 3)

heat transfer: the transfer of thermal energy between substances due to a difference in their temperatures. (Lesson 4, 5)

heat source: anything that produces heat. (Lesson 1)

nonrenewable resource: a resource such as a fossil fuel that does not replenish as part of natural ecological cycles. (Lesson 8)

radiation: the transfer of energy via electromagnetic waves through space. (Lesson 5)

renewable resource: a resource that replenishes itself as part of natural ecological cycles. (Lesson 8)

resource (natural): naturally occurring substances that are considered valuable. (Lesson 8)

temperature: a measure of the average kinetic energy (motion) of the particles (atoms and/or molecules) that make up a substance.

> **Note:** *temperature is not a listed vocabulary word for students. This is here for teacher reference.*

thermal conductivity: the rate at which heat passes through a specified material, or the property of a material that indicates its ability to conduct heat. Also heat conduction is transfer of thermal energy through matter, from a region of higher temperature to a region of lower temperature, and acts to equalize temperature differences. (Lesson 6)

(thermal) conductor: a material that conducts heat well and quickly; metal is a good thermal conductor. (Lesson 6, 7)

thermal energy: the collective energies (kinetic and potential) of molecular motion of a substance. (The higher the temperature, the faster the atoms and molecules that make up the substance are moving and thus the more thermal energy the substance has. Thermal energy of a substance takes into account the amount of matter. The greater the amount of matter, the more thermal energy a substance has. This is why an iceberg contains more thermal energy than a cup of boiling water.) (Lesson 2, 3)

(thermal) insulation: materials used to reduce the rate of heat transfer. (Lesson 7)

Energy Heats Maine

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