Home Heating Efficiency and Interior Storm Window Insert Construction

LESSON PLAN

Age range: 5–adult (This activity works well with multi-ages and can be shortened and simplified for younger students.)

Class time:
90 minutes for introduction and window measuring.
3-4 hours for window insert construction.
Total: 6– 7.5 hours over two weeks, including volunteer time.

Objectives:

- To instruct and demonstrate the principals of thermal energy efficiency through the construction of interior storm windows
- To encourage community engagement and intergenerational educational opportunities.

Learning Outcomes:

- Participants will understand the three modes of heat transfer and how they impact home heating, the concept of weatherization, why it is important, and how they can make their homes more energy efficient.
- Participants will understand the triple envelope that storm window inserts form, and feel confident participating in construction.
- Participants will understand and be able to calculate payback periods, and learn how to quantify savings. (Island specific importance of thermal efficiency is emphasized throughout.)

Materials:

- Infrared camera
- Sample window for demonstration
- Instruction Sheet
- Window supplies (see instructions)
- Measurement sheet (and copies), tape measure
- Chalk or white board for group note taking

Resources:

- Interior Storm Window instructional video
- Save Like an Islander video
- Infrared imaging introduction sheet

Procedures:

Two weeks before construction:

1. Activity leader introduces concept of thermal envelope, how buildings lose heat, the purpose of insulation and weatherization. Optional: use IR camera to demonstrate these concepts by testing parts of the classroom – windows, ceilings, etc. (45 minutes)
2. Activity leader explains the use of storm window inserts for weatherization to participants. A demonstration window can be used for this purpose (optional). Then students work with the activity leader to measure windows for inserts. (45 minutes)
3. Completed measurements are emailed to Community Energy Staff to input into spreadsheet, order wood/supplies to be delivered to island. (10 minutes)

Approximately one week before construction:

4. Activity leader and community members cut wood to length on site, with or without student help. (1.5 – 2 hours)

Day of building workshop:

5. Frames are assembled with student help. See instructions for frame and window assembly. Community member participation is encouraged during this stage due to use of power tools, etc. Students split into different teams to work on particular aspects of the windows with adult supervision. Students may rotate throughout the activity. (3.5-4 hours)
6. Finished windows are installed at school, or taken by residents if they were built for homes. For windows in school, IR camera may be used to demonstrate the effectiveness of the inserts. (30 minutes)
7. Activity leader facilitates a final discussion on the resources saved by new inserts, and why it matters even more on islands than elsewhere (high cost of energy, climate change impact, etc.). (30 minutes)

Modifications:

- This activity can be completed in a classroom or as part of a community window build.
- Step 2 can alternately involve demonstrating the measurement procedure, and then sending the students home with instructions to collect measurements at their homes with parents as homework.
- Each student can also build one window for their home, to share what they learned with family.

Guiding the discussion:
Below are a series of short discussion/fact checking questions meant to reinforce key ideas and terms. Select questions based on age/level of participants. Additional questions may be chosen as needed.

- What is weatherization?
    - Why is it important on islands?
    - What are 3 benefits of weatherizing?
    - Who can explain how the IR camera works?
    - Who pays for your heat at home?
    - Where does your heat at home come from
    - Is the school's heat free?
        - Who pays for the school's heat?
        - Where does it come from?
- Why are storm window inserts used when weatherizing?
- What do inserts have to do with climate change?

Answer sheet

What is weatherization?
Weatherization refers to a number of different processes that improve the thermal envelope of a building, increasing its ability to hold heat and prevent cold air to enter; Improving heating efficiency by reducing air leakage and improving insulation in a home or other building.

Why is it important on islands?
Island communities pay a higher price for heating fuels in general. This means that inefficient, leaky homes cost more to heat than they would if they were on the mainland. It also means that islanders stand to save much more money by weatherizing, as the cost they are avoided is higher. Islands also have cold, stormy winters, making a weatherized home very important. Islands are also starting to experience the impacts of climate change, making reducing our carbon emissions very important.

What are 3 benefits of weatherizing?

1) *Saving money 2) increasing comfort 3)reducing carbon emissions / the effects of climate change*

Who can explain how the IR camera works?
Heat gives off infrared (IR) light, which humans cannot see with the naked eye. Different temperatures provide different IR frequencies. The IR camera is able to "see" different IR frequencies, and assigns them colors so humans can interpret them. We can use it to spot leaky sections of walls, floors, or ceilings. It is even used by firefighters to locate fire without entering a building!

Who pays for your heat at home?
Your family, or your landlord, likely pays for your heat at home.

Where does your heat at home come from?
What kind of fuel do you use? All fuels come from the ground, they are fossil fuels. If electricity is used in your home, much of that electricity also comes from fuels – but some comes from hydro power and other ***renewable sources.***

Is the school's heat free?
Nope!

Who pays for the school's heat?
The tax payers support the school's budget, and the school contracts for their heat.

- **Where does it come from?**
  All fuels come from the ground, they are fossil fuels. If electricity is used in the school, much of that electricity also comes from fuels – but some of it comes from hydro power and other ***renewable sources.***

Why are storm window inserts used when weatherizing?
They are inexpensive, fairly easy to build, and save a lot of energy. They pay for themselves quickly.

What do inserts have to do with climate change?
Inserts prevent some heat from leaving your home, and prevent cold drafts of air from getting in. By reducing the amount of work your furnace must do to maintain the same comfortable temperature at home, the inserts help you to conserve fuel! When we burn less fuel, we emit less carbon, and so the inserts help us reduce climate change effects. (consider walking through climate effects as a chain of individual impacts, to illustrate directly.

Standards that could be incorporated include:

MS-PS3-3.

Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

MS-ESS3-3.

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. *[Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]

MS-ESS3-4.

Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]