**Heating Degree Days**

**Pre-Lesson**

Teacher: "You are going to do some work on a question that has to do with how to save money while keeping a house warm in the winter."

Teacher: “What are some of the things people do here [or in cold climates] to keep warm in the winter? [Either ask the class for volunteer responses or do a 2 minute pair-­‐share followed by whole group sharing.]

* Heat our houses
* Wear coats, sweaters, hats
* Insulate, etc.

If insulation comes up, the teacher can ask the students to share their experiences and/or knowledge about insulation. If it does not come up, the teacher should introduce the concept of insulation.

Teacher: “One of the things many people do is to insulate their bodies or their houses from the cold. Insulation [write on the board] is a material that reduces or prevents the transfer of heat. For example, if you have a lining in your winter coat, the lining is a layer of fabric between your body and the outside of the coat. The lining acts like an insulating layer that helps to keep the heat near your body so you can stay warm.”

Teacher: “What are some other examples of objects that use insulation to keep something warm?”

* Thermos to keep soup or tea or coffee warm
* Thermal underwear under your clothing
* Wearing a hat to keep your head warm
* Wearing gloves to keep your hands warm

Teacher: [If insulating a house is not mentioned] “Has anyone heard of insulating a house?" [If any students say yes, ask them to share what they know about insulation. Ask rest of the class if they have anything to add.]

If no one speaks up, the teacher can explain: “Insulation keeps the heat inside the house in the winter by creating a barrier that keeps the warm air from escaping outdoors.”

Teacher: What might be some of the benefits of keeping heat inside a house? [Could call on students for answers]

* Staying warm
* Saving energy
* Saving money

Teacher: “How might someone put insulation into the walls of a house or an apartment?” [Call on students to share any experiences or prior knowledge they have about insulating a house.]

If no one has any previous experience or knowledge about insulation, the teacher can share the following information that there are two common ways to insulate (keep the heat inside) where we live.

* Family members can do the work themselves or they can hire a person to install insulation. If you hire a person to do the work they are called a contractor.
* There are two common ways to insulate a house or apartment

 Someone can use a special machine to spray insulation materials inside the walls

 Someone can apply stripping around the windows and underneath doors (show example or point out stripping in their classrooms)

* Show 1-­‐2 minute video of installing insulation.

Teacher: “So, we know that insulation can help keep a house warm in cold weather and can help save energy costs. We also know something about how it can be installed where we live. Now, let’s learn some important facts about how our gas bills are calculated. This information will help you to complete our task.”

Teacher: “Gas companies encourage families to install insulation so they will use less gas, which saves energy and money. It would be easy to calculate a gas bill if the average temperature was the same every day. Since the average daily temperature can change a lot over a month, the gas company needs a method for calculating how much the temperature changes during the month.

The gas company uses a formula to determine the number of days that a consumer will need to either heat or cool where they live. The bill shows the total number of Cooling Degree Days and Heating Degree Days each month to help consumers understand how average temperatures may affect their bill. Let’s take a closer look at how these degree days are calculated.”

Write the definition on the overhead or white board: *Cooling Degree Days are a measure of the difference between the average temperature outside and 65°F.*

Teacher: “Why do you think the definition uses 65°F?” Give students an opportunity to brainstorm reasons. If no one responds the teacher can say: “The 65°F temperature is used because most people are comfortable at that temperature. They do not need heat or air conditioning to stay comfortable.”

Teacher shows how to calculate Cooling Degree Days:

Each degree of temperature above 65° F is called one cooling degree day. For example, a day with an average temperature of 75°F is counted as having 10 cooling degree days. (75° F -­‐ 65° F = 10° F, So 10 CDDs.) The more cooling degree days there are, the more people are likely to use fans or air conditioning, which will use energy and cost money on utility bills.

Teacher: “What do you think happens when the temperature is below 65°F? What might we call the degree days if the temperature is below 65°F?” Let students brainstorm responses.

Write the definition on the overhead or white board:

Heating Degree Days are used when the outside average temperature is below 65°F. *Heating Degree Days are defined as a measure of the difference between the average temperature outside and 65°F .*

Teacher shows how to calculate Heating Degree Days:

Each degree of temperature below 65°F is called one heating degree day. For example, a day with an average temperature of 45°F is counted as having 20 heating degree days. (65°F -­‐45°F= 20°F, So 20 HDDs.) The colder it gets, the more heating degree days there are, and the more energy is likely to be used for heating buildings.

The teacher works through the following charts with the students [Option: Call 4 students up to the board to fill in the 4 columns; call on students individually for answers to each and a description of what they did; model the solution for Day 1 and the reasoning and then ask students to fill in the other 3. etc.]

Calculate Cooling Degree Days (CDD in Fahrenheit) for the following week.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Week 1 | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 |
| Average temp | 75° F | 79° F | 94° F | 102° F | 89° F |
| Calculations | 75°F-65°F = |  |  |  |  |
| Cooling Degree  Days (CDD) | 10 CDD |  |  |  |  |

Teacher: “How many cooling degree days in all during this 5 day period?” Calculate Heating Degree Days (HDD in Fahrenheit) for the following week.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Week 2 | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 |
| Average temp | 55° F | 42° F | 53° F | 38° F | 45° F |
| Calculations | 65°F-55° F = |  |  |  |  |
| Heating Degree  Days (HDD) | 10 HDD |  |  |  |  |

Teacher: “How many heating degree days in all during this 5 day period?”

[Teacher (optional): “Now that you have learned about Cooling Degree Days and Heating Degree Days, work with a partner to make a flyer to explain to a consumer what you have learned about Cooling Degree and Heating Degree Days and the likely effects on their energy bills. Be prepared to share your flyer with the rest of the class.”]

Teacher: Okay, now we are ready to look at a situation where a family installed insulation and wasn't sure whether they got their money's worth. [From here introduce the task as usual, which could happen on day 2, depending on how the task is structured.]