 

**MIDDLE SCHOOL**

**Math & Engineering**

**What’s In a Window?**

**Teacher Background:** This activity is meant to act as a demonstration to help students better make informed decisions. It is not an exact representation so students will have to make inferences.

**Goals:** To understand R=value and how properties of air relate to window efficiency.

**Objectives:** Students will…..

* Record temperatures
* Calculate differences
* Make predictions
* Analyze results

**Standards met:**

Data Analysis:

* Develop and evaluate inferences and predictions that are based on data

Problem Solving:

* Solve problems that arise in mathematics and in other contexts

**Time required:** 45 -60 minutes

**Materials: (per class of 30)**

* 30 copies of “What’s In A Window” Chart
* 30 copies of “What’s In A Window” Student Reflection Sheet
* 30 copies of material choices and comparison charts
* Calculators
* 6 stackable coffee cups
* Hot water (electric tea kettle works well)
* 3 thermometers
* timer

**Prep:**

* Stack cups and place on desk
  + One stack of 2
  + One stack of 3
  + One single cup

**Procedure:**

* Stack cups on desk in front of room
* Boil water
* Place 1 thermometer in each cup
* Pour hot water into each set of cups. Fill ½ way. (be sure to be consistent!)
* Register temperature and record opening temperature on board. Have students fill this information in student chart.
  + Boiling water is 100 Celsius or 212 Fahrenheit
* Set timer for 3 minutes
* During this time, allow students to fill in their predictions in the student chart.
  + You may want to have students or a student touch the cups to feel the amount of heat to inform their predictions
  + Ask students to share their predictions and rationale
* Once time has elapsed, register temperature in each cup
* Have students record the actual temperatures and calculate the difference for each set of cups
* Ask students to reflect on the actual temperatures
  + Were their predictions correct?
  + What variables might impact the temperature?
  + Which set of cups would they like to contain their hot, tasty beverages of choice?
  + Which property of air is at work? (air has thermal properties, the air between the cups is the major reason why the liquid does not cool as much)
  + How might this inform your decision about window choices?
* Share window information about R-values
  + R-value = the measure of thermal resistance (how much heat is lost through a window)
  + The higher the R-value, the better
* Ask students which stack of cups has the highest R-value

**Assessment:**

* “What’s In a Window” chart
* “What’s In a Window” Student Reflection sheet

**What’s In a Window? Student Chart**

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Class Period:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Opening Temperature | Prediction  In which cup will the temperature be high? Medium? Low? | Actual Final Temperature | Difference between opening and final temperature |
| 1 cup |  |  |  |  |
| Stack of 2 cups |  |  |  |  |
| Stack of 3 cups |  |  |  |  |

**What’s In a Window? Student Reflection Sheet**

1. Was your prediction correct?
2. Which variables might have impacted the temperature?
3. Which set of cups would you like to contain a hot beverage of your choice?
4. Which property of air is at work?
5. How might this inform your decision about window choices?