5E Lesson Plan Template

Teacher: Ms. Farnsworth

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Subject area/course/grade level:

Grade 7 Science: Heat Unit lesson 1- Measuring Temperature. 90min

Material

6 buckets (1/3 full) each of cold and warm water (label buckets A for warm & B for cold), 6 pop bottles (~500ml), molding clay, 6 straws, ~1 L rubbing alcohol, ~ 1 L water (room temperature), food coloring, 6 rulers, 6 water permanent markers (very fine tip), 24 data sheets, 6 glass thermometer, 6 digital thermometers, paper towel/towels to clean up spills, power-point presentation & timeline-definition handout.

Lesson objectives/outcomes:

Students will identify the multiples uses of and need for temperature measuring devices in science as well as our daily lives and briefly describe the historical development of thermometer.
Students will construct their own thermometer and use it to collect data. Students will identify ways to improve their device, including the need of a standardized unit of measurement.
Students will develop their own class unit of temperature measurement.
Students will be able to discriminate when to use the different units of temperature measurement (°C, °F, K) currently used today.
Students will collect data using a glass thermometer and digital thermometer and compare the results with those they obtained using their homemade devices, discussing possible sources or error in each.
110-7 provide examples of technologies used in the past to meet human needs
112-1 describe how an individual's needs can lead to developments in science and technology
113-4 analyze the design of a technology and the way it functions on the basis of its impact on their daily lives
209-3 use instruments effectively and accurately for collecting data
210-10 identify potential sources and determine the amount of error in measurement
210-11 state a conclusion, based on experimental data, and explain how evidence gathered supports or refutes an initial idea

210-13 test the design of a constructed device or system
211-2 communicate questions, ideas, intentions, plans, and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language, and other means
308-1 compare various instruments used to measure temperature

Differentiation strategies to meet diverse learner needs:

Content: based on what students know about how temperature is measured, ask more or less 'what if' questions when going around to groups or in class discussions. If finding temperature and heat are confused (when students give explanations when discussing in groups) take a few minutes to go over some points from tomorrow's kinetic energy lesson to show difference.
Process: students are free to describe the temperature however they like… even with a drawing or acting out a scene (hot vs. cold). Students can connect to how they use temperature measurements in various aspects of their daily lives (cooking, car gauge, whether or not to go to the beach/pool). Try and connect students to a time when they were at a loss because they didn't know the temperature and relate to how people must have felt before thermometers were invented. How did the students compensate? How did the people back then?
Product: students can make suggestions about how to alter their device (and pick their own food coloring color for the liquid inside), however, due to need for accuracy and consistency across groups, each group must do the same basic product (as long as it doesn't effect the ability to read the scale, it can be decorated).

ENGAGEMENT (10 min)

- Students in their science groups (4 people) Show pictures on power point and ask them to write down what they think each is- they can work as a team (car temperature gauge, digital thermometer, weather map showing temperatures of local surrounding areas, temperature stickers, infrared sensor of human body, and tie-breakers of mood ring and if needed coldest recorded place on earth: Antarctica (Vostok Station, -89.2°C) and hottest recorded place on earth: Death Valley, California; 56.7°C). Team with most correct gets prize from bag.
- Ask students what these things seem to have in common (is there a theme among them)? i.e. temperature (more specifically the measurement thereof)
- What are some things we measure the temperature of everyday?

Have students come up with ideas-go back to some pictures of weather map, or digital thermometer if need prompting.

- Why importance is temperature to science? Physical properties of different substances such as boiling point, freezing point, killing bad bacteria & viruses, incubation etc…

EXPLORATION (13 min)

- Show sample of data collection sheet on board and tell students that they are now scientists working in groups of 4 and each group is in a different lab. Their mission is to describe the temperature of 2 liquid substances (A & B) so that someone outside their lab will be able to get an idea of the approximate temperature. Show students where to write their descriptions on the sheet. Any questions (yes, they all speak same language and understand each other's cultural references)? They have 5 min.
- One student per group will collect an 'A' bucket and another will collect a 'B' bucket from the side counter
- Hand out worksheets while students are collecting buckets
- Walk around and engage in discussion of what the water temperature feels like. Does it feel the same to everyone in the group (how can we know this for certain)? What are common experiences with water and how can we use this to describe to another what temperature it is (would you consider taking a bath in water of this temperature? Would it be refreshing to drink on a hot day? Could you make tea with it? How does it compare to the local swimming pool? etc)
- Give 1 min wrap up warning.
- Get attention and remind them of safe space and that science is about discovery (mistakes are welcome).
- Ask class: When you stick your hand in, what does the water feel cold or hot in relation to? (body temp… also when you go outside or inside into cold or heat, what is that perception of temperature in relation to) Why are some people cold when others are warm in the same room? If A and B were samples taken from different places on earth, what assumptions could we make about where they came from (i.e. what are some natural factors that affect temperature? Elevation, season, exposure to sun or shade, etc.) (3min)
- Ask one group to give their explanation to another group for bucket A or B. Ask the 2nd group to respond with 2 good things about the explanation and 1 thing to work on (usual process). Ask

1st group to expand upon explanation (if possible). Ask for class comments on explanation. (5min)

EXPLANATION (35min)

- Ask class: What do we need so that we can accurately describe the temperature of something to someone else? Have students come up with ideas on how to make an accurate temperature-measuring device. Write and keep list on board (Hopefully come up with things such as it has to be the same type of device for each group with same units, etc. so that the data collected is comparable) (3min)
- Ask class when they think the first 'thermometer' was invented? Any thoughts on what it looked like or was made from? (2min)
- First measuring devices were thermoscopes. Write thermoscope vs thermometer on board (don't erase list from earlier). Have one or a few student(s) try and gauge temperature from demo bottle (without scale on it). Ask what temperature they think it is? How much did the water move up or down the straw? They will hopefully then see that they need a scale to accurately measure the change in height of the liquid in the straw. Write class ideas on board. (5min)
- Go through PowerPoint of history of devices used to measure temperature and emphasize when, what, and why each type of scale was invented (Fahrenheit, Celsius, and Kelvin). Give handout and instruct to add to binders. (5min)
- Ask class if there are any changes to the list made earlier on the board as to what is needed for accurate temperature measurement? (2min)
- Go over how to make a homemade thermometer, emphasizing accurate measurement of liquids as well as toxicity on rubbing alcohol label (Show big warning label on PP slide and ask what it means- external use only and highly flammable). (2min)
- Ask class to come up with a class scale (mark off cm on straw?). Have class come up with name for our unit of measurement. (3min)
- Go over how to enter data on worksheet. (1min)
- Have a student from each group collect materials tub.
- Students build and test their devices. Once students have tested their tubs, they should go to other groups and compare their devices to see if results are similar. While the students are building, add hot water to the 'warm' buckets and ice to the 'cold'

buckets so that they are similar temperature to what they were at the start-use thermometer.(12min)

- Get students attention and discuss results. Did we make an accurate device (how do we know this)? Can the different groups better understand when we give a description of the temperature of the buckets? What could we do to make it more accurate (how/why?)? What errors might we be making to make it less accurate (how/why?)? (holding bottle in hands to warm or it getting a lot of sun exposure compared to other groups, not leaving it long enough) (3min)

ELABORATION (30min)

- What is the temperature (in °C, °F and K) of our buckets? (show calculation on board how to convert to Kelvin) (2min)
- Go over proper usage of glass and digital thermometers. (2min)
- One student from each group will go collect a glass thermometer as well as a digital one. Students will use these devices to record data and compare to the homemade thermometers. (5min)
- Students will consider the difference in reference points on each of standard scale units and then connect to what zero means on our class unit scale as well as the conditions that affect it's reliability. (5min)
    - What does zero represent on each of the commonly used scales?
    - What does zero mean on our scale? Will the water level still be at zero tomorrow, a week from now, 6 months?
- Students will consider how the different properties of fluid and even physical bottle shape, straw shape would affect results. (3min)
    - What would happen if we used a different fluid in the bottles, something really thick like oil? Why did we need create a solution with water and rubbing alcohol (why not just water)? A bigger or smaller bottle? Different size or opaque straw?
- Students will begin to consider how matter acts at different temperatures. (3min)
    - Why is the water moving up the straw? (topic for tomorrow's class so get ideas and write them down on smart board and save to go over tomorrow)
- Students will consider the need to measure the temperature of objects that cannot be measured by the tools we used today. (5min)

- What else can we measure the temperature of with these devices? What are our limitations and why?
- How do we measure the temperature of a solid object? A flame?

- Any other questions you would like to be able to find the answers to? (2min)
- Clean up (5min)

EVALUATION

- Collect data worksheets and exit slips (list different temperatures of various units in order from lowest to highest-include a class unit one)
- When going around to groups, each student contributes to an explanation of a question (ask directly if they don't). Give descriptive feedback as to their reasoning.
- Students will be able to peer-assess during verbal descriptions and comparing data (both internal and external to their groups). Encouraging communication in groups will also engage in peer-assessment.
- Students will be able to self-assess their accuracy with which they can read their own device as well as the 2 manufactured thermometers based on the results their group members obtained.