MELTING WAX MOLECULAR MODEL

MIDDLE SCHOOL LEVEL 3

Candle wax drips onto a cake because the flame at the top adds thermal energy to the solid wax. The added thermal energy between the molecules gives the molecules more energy and causes them to move quickly and further apart. This added distance between the molecules causes a weakened force between the molecules and causes a state change. Although we cannot see the change at the molecular level, we see wax change to a liquid phase.

EDUCATIONAL STANDARDS:

NGSS CONNECTION:
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

COMMON CORE CONNECTION:
ELA/Literacy
RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). *(MS-PS1-4)*

Mathematics
6.NS.C.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4)

DOK:

Level 3 - Strategic Thinking
Level 4 - Extended Thinking

MATERIALS NEEDED:

- ❏ Lego-style bricks
- ❏ Cardboard
- ❏ Any other materials they can upcycle!
- ❏ Specific materials for activity sequences are in the lesson cycle

DIRECTIONS:

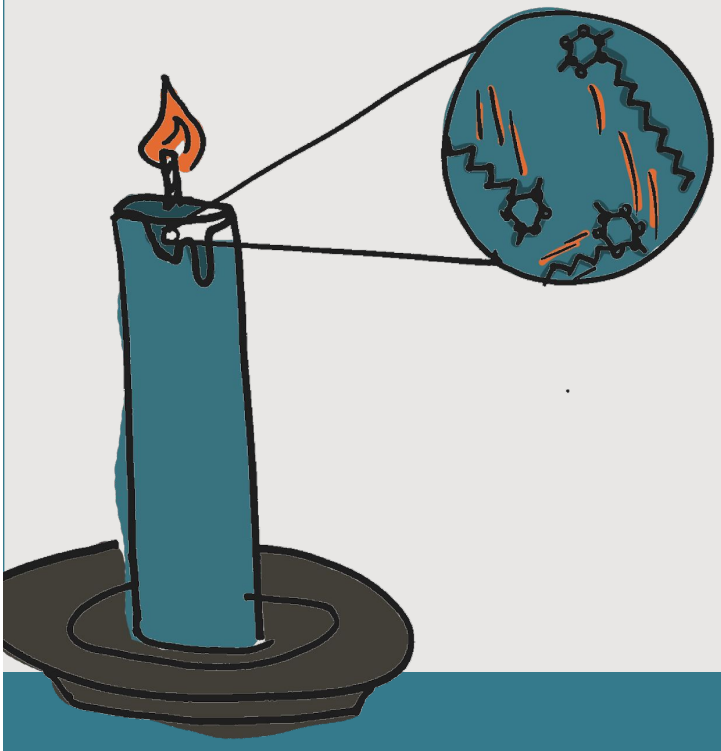
1. Students will follow an iterative process of modeling consistent with NGSS “modeling”
2. Throughout the sequence students have opportunities to construct a 3D model of molecular motion to explain a melting candle
3. Most importantly, allow students time to revisit their model and make changes as their knowledge increases and they correct previous misconceptions.

OBJECTIVE:

Students will be able to develop a model to explain how thermal energy affects the motion of particles.

ESSENTIAL QUESTIONS:

- Why does candle wax drip onto a birthday cake?
- How does thermal energy affect particle motion?
- Does thermal energy always increase temperature?



FUN FACTS

A. **In 2006, Ashrita Furman broke the record for lighting 75,585 candles on a birthday cake.**

B. **A wax sculpture takes 350 hours, more than 250 measurements and over 24,000 lbs of wax to create.**

C. **Madame Tussauds Wax Museums are located internationally with over hundreds of wax figures.**

ENGAGE:

1. Provide each group of students with a burning candle.
2. Allow them to observe the candle burning
    a. Ask them what they think is happening and why?
    b. Have students respond using 2 Bit Circus materials to model their explanation of what is occurring
    c. Do not worry about correctness in their models - this is just an initial experience for students.
3. Monitor students and support their modeling process - **do not correct them or tell them answers**
4. Informally evaluate students initial models

EXPLORE:

1. Allow students the opportunity to explore the motion of water at various temperatures with food coloring
    a. Provide each group with water with ice, room temperature water, heated water (not boiling), and food coloring
        i. Make sure to discuss with students that the water may be hot and take necessary safety precautions.
    b. Provide students with measurement devices
        i. Stopwatch
        ii. Thermometer
2. Have students perform a simple lab to observe the differences in the rate of mixture with the food coloring
    a. Ask students, what do you think will happen when putting drops of food coloring in each beaker of water?
    b. Students may choose to do qualitative or quantitative measurements
        i. The experiment ought to be controlled (equal amounts of drops in each container, systematic method of observing(drops placed at the same exact time or time measured to determine rate of mixture).
    c. Students should record their observations
    d. Do not tell students the objective of the lab (allow for self discovery)
3. After gathering their observations, ask students to **revise** their models of the candle
    a. The objective of this activity was to allow students to see that atoms and molecules can move. Their motion changes based on the amount of energy added/subtracted from them.
4. Evaluate
    a. Informally student models and growth/understanding/misconceptions
    b. Formally evaluate their lab

EXPLAIN:

1. Have students perform an experiment to determine the heating curve for water.
    a. Students heat a beaker of ice/water mixture until it gets to a boil
    b. Record measurements of temperature every minute
    c. Students will then have a data table temperature vs time
        i. Plot the data
        ii. Have students draw conclusions about the pattern in the data
    d. Teacher should support through guided questions to observe that heat doesn't always change temperature - during phase change the energy weakens bonds to cause phase changes to occur (latent heat).
2. Have students draw images of particles and their motion during each portion of the water curve to support an understanding of particle motion.
3. Evaluate their lab

ELABORATE:

1. Ask students to use their new knowledge of phase changes, heat, temperature, particle motion to make final revisions to their model of the melting candle.
2. They can share their models with the class through gallery walks, presentations, etc.
3. Evaluate students' models for correct explanation of what occurs when candle wax melts and drips.