Lesson 7: Chemical reactions: Investigating Temperature change as evidence

Objective: Students will be able to evaluate a change as either chemical or physical (based on criteria) and use evidence to prove if the change is exothermic or endothermic.

Learning Goal: Chemical changes must produce a new substance. Exothermic reactions release energy and endothermic reactions absorb energy.

Vocabulary: Chemical change, physical change, endothermic, exothermic, reactants, products

Engage:

1. Students are asked to build a simple model of water, H_2O, with any classroom supplies (idea is to make sure students have a something representing a chemical bond)
2. Students are asked to discuss in groups, "What holds the atoms in water together? Does it take energy to hold atoms together? Do you think energy is needed to form a chemical bond? What happens to energy when a chemical bond breaks?"
3. Teacher demonstrates an exothermic or endothermic reaction for class. Teacher presents students with the chemical equation, and drawings of the molecular compounds involved (to have students see the chemical bonds holding the atoms together). Teacher asks students, "What holds the atoms together in the molecular compounds? Just by looking at the chemical equation, what happens to bonds during the reaction?" Then, asks questions in above activity, "What do you think must be needed in order to break bonds or form bonds? So when bonds break, there must be a change in energy and when bonds form there must be a change in energy."

Explore:

4. Students are reminded of culminating project: design of self-heating/cooling device for application of their choice i.e. glove, coaster, headband that cools or warms (Teacher can choose to go as in-depth as needed about project at this point, earlier, or later)
5. Teacher explains during chemical reactions chemical bonds are formed or break apart, and that there is a change in energy. Energy is either released or absorbed. (Final Project: Do students want a reaction that absorbs energy or released it.) Teacher discusses (and modeled earlier) how you can measure the energy released or absorbed (by touch, not very accurate, or with a thermometer).
6. Students are presented with various chemicals, supplies, etc. to design experiments in order to help them choose what chemicals to use in their self-warming/cooling device.
7. Teacher can divide chemicals as needed. This will depend of amount of chemicals available, number of students, time concerns, etc. (recommended amount is
8. Ideally, pairs of students will choose from the chemicals to design a test to see: Does a chemical reaction or physical change has occurred? What is the evidence? Is energy released or absorbed? How much energy is released or absorbed? Would this be a possible reaction you could use in you final project?

Exothermic/Endothermic Chemicals List:

Exothermic Reactions	Endothermic Reactions
Steel wool and vinegar (copper wool as another example)	Citric acid solutions and baking soda
Laundry detergent and water	Vinegar and baking soda
Calcium chloride and water	Ammonia chloride and water
Magnesium sulfate (Epsom salt) and water	

Other chemicals to investigate: alka-seltzer and water, etc

9. Students choose which chemicals they want to use and design an experiment to investigate if the chemicals they chose produce chemical changes (or just physical), and if there is an exothermic or endothermic reaction. Students limited to 3-5 grams of each chemical to carry out initial investigations.

- Teacher note: Depending on time, students can prepare a formal lab report or some shortened version to analyze and present their results of the experiment. Students should make a materials list and procedures for their experiment that is reviewed by teacher to ensure safety and reliability of results.
- Groups share experimental procedures with other group (then checked by teacher) and revise as needed.

10. Students perform experiment and record observations/results on handout to report to class. Groups of students may pick the same chemicals for their experiment; however teacher should ensure that most chemicals are used to give students a variety of results to choose from when designing their self-warming/cooling device.

11. Students share results by one or more of the following (students record results of other groups on handout): 1) present results to whole class, 2) Gallery walk looking at results with group member explaining the results at each poster, 3) student pairs make appointments with other groups to share findings.

12. Students fill out handout (which includes table of reactants used, products formed, type of change, evidence of change, and temperature change) after sharing results of experiment

Explain:

13. Teacher goes over vocabulary to use when classifying the reactions (endothermic/exothermic) and some other common examples students may know about and asks them to classify as either exo/endo: burning wood or paper, etc.

14. Teacher has students label the reactions, done in pairs, as exo or endothermic on handout. Class discusses which reactions may be used in the self-warming/cooling device.

15. In groups, students brainstorm other factors that may influence choice of chemicals in design of device, for example: cost of chemicals, safety of chemicals, amount of chemicals needed, amount of temperature change, ideas to have chemicals mix in the device, etc.

Elaborate:

16. Students evaluate the results of the experiments, choose and justify the chemicals (two combinations of chemicals to use) that they will test to use in their self-warming/cooling device. (For example: One group of students may choose baking soda and vinegar, and magnesium sulfate and water to further investigate later.)

17. Students can research other chemicals (not available in class) that might make good choices or predict compounds (based on elements in the same group having similar characteristics) that could be used.

18. Students begin to brainstorm a device that could use the chemicals to self-warm or cool itself.

Evaluation:

19. Student choice and justification of chemicals serves as assessment.