

TEACHERS GUIDE



HEAT PACKS
ITEM # 3227- SERIES

CHEMISTRY - PROPERTIES OF MATTER

Create a chemistry lesson; learn how the use of potential energy and chemical reactions are found in simple, vinyl-sealed packs used by hundreds of cold sports spectators and pain sufferers. Just flex a small concave, stainless steel chip with gratings. The snapping gratings agitate the molecules in the sodium acetate solution, creating a chain reaction of crystallization of those sodium molecules. This returns the solution to a more stable, solid state and generates 130 degrees Fahrenheit.

- Where does chemistry get used in real life?
- What common products of today rely on predictable chemical reactions?



Materials

- 3-4 heat packs
- 3 pans of boiling pan of water
- vocabulary sheet
- salt
- sugar
- baby powder
- microscope
- quiz

Goals & Objectives

Students will:

- compare the characteristics of simple physical and chemical changes.
- describe the physical properties of matter in various states.
- practice hypothesizing from observations.

ASSESSMENT

Participation,
Vocabulary sheet,
Quiz

VOCABULARY AND WORKSHEET

1. thermochemistry: Chemical reactions that produce heat
2. super cooled: cooled to below melting point
3. supersaturated: melted into a liquid until the liquid will hold no more.
4. chemical energy: energy produced from a change or motion in atoms/ molecules
5. mechanical energy: created with technology
6. gravitational energy: a force between two masses
7. heat transfer: transition of thermal energy (heat) from a hotter to a cooler object
8. temperature: degree of hotness or coldness
9. Heat: form of energy caused by motion of molecules
10. Flexing the metal disc causes heat to be generated, from what motion of atoms/molecules?
11. If the salt will change so easily, it is because the over saturated solution is considered _____.
12. Is the smaller or larger heat pack hotter? Why?
13. Which size contains more energy? Why?

PRE-TEST

1. What is thermochemistry?
2. What are three ways to produce energy, and often heat?
 - a)
 - b)
 - c)
3. What does it mean when a substance is super cooled?
4. What does it mean when a substance is over saturated?
5. What state is the substance in when it has been over saturated &/or super cooled?
6. Can you make the heat that is produced raise in temperature by using more of the solution? Why/why not?
7. Is there more energy contained in a small or large heat pack? Explain.
8. Explain how things "heat up" or "cool down," (heat transfer).

Answers:

1. Chemical reactions that produce heat
2. a) mechanical, b) chemical, c) gravitational
3. cooled to below melting point
4. melted into a liquid until the liquid will hold no more.
5. unstable
6. No, The chemical reaction that causes the crystallization and therefore the heat happens at 130 degrees for every crystal, no matter how many.
7. The large one does, as it contains many more crystals forming, each which produces energy.
8. The warmer item transfers its heat to the cooler one, making it feel like it got warmer, but it only received the heat.

HIGH SCHOOL

ACTIVITIES

- 1 Fill out the vocabulary sheet together. For primary grades, allow them to place name cards onto pictures of each item.
- 2 Let students take turns looking at and describing a small pile of sugar, a small pile of salt, and a small pile of white powder.
- 3 Now ask students to look at a slide of each item under a microscope.
- 4 Discuss what is similar about the salt and sugar, reinforcing the word crystal.
- 5 Ask students whether the powder also contains crystals. (no)
- 6 Now melt all three substances, each in their own pan, as students watch. Allow them to describe what each material looks like melted.
- 7 The substances in the pans look nothing like the original substance. Does this mean they have magically turned into other substances? (No, they are just in different states.)
- 8 Now show the students the heat pack. Have them compare the liquid in the heat pack to each of the boiling pans of melted substances. Could any of these substances be what is in the heat pack?
- 9 Have a student bend the metal chip to begin the crystallization of the contents.
Pass around the pack as it heats up and develops the crystals. (It may be helpful to have several, as this happens fast, so all can see.)
- 10 Now have students write a hypothesis about which two substances is most likely the solution in the heat pack.
For very young students, you can create a fill-in-the-blank like:
_____ may be the solution in the heat pack because it looks similar when melted into a liquid, and also when it is in crystal form.
- 11 Advanced students might also want to hypothesize what information they would need to decide which of those two substances would have the most likelihood to be the solution in the heat pack. (What reaction does each substance have to the metal chip.)
- 12 Now you can tell students that inside the heat pack is a salt solution that reacts to the metal chip, causing it to turn to crystals, which causes heat.

VOCABULARY SHEET

- Crystals
- Powder
- Liquid
- Solid
- Color
- Hypothesis

Vocabulary sheet answers:

Crystal- a grain with edges, Powder-very fine, loose particles, Liquid-flows like water, Solid-having the inside completely filled up, Color-Choices found in your crayon box, seen because of light, Hypothesis- an educated guess based on scientific information

QUIZ

1. What were each of the substances in this lab?
2. Which two were more similar to each other?
3. How were they similar in structure?
4. When the substance changed from one form to another, did that make it a different substance? (Did it quit being the original substance?)
5. What is a hypothesis?

Quiz answers:

1. salt, sugar, baby powder
2. salt, sugar
3. both have crystals
4. No
5. an educated guess based on scientific information

ACTIVITIES

- 1 Allow students to take the pretest.
- 2 Grade pretests in class, stating that missed questions are the concepts they need to make personal goals to improve comprehension about.
- 3 Remind students that energy can be released in many ways, and when it is, it often produces heat, as well as other things.
- 4 Pass out vocabulary/worksheets to each student and a heat pack to every 3rd to 6th student.
- 5 Ask students with heat packs to flex the metal disc and activate a reaction.
- 6 Discuss that the heat they feel is energy. Ask if this energy is a result of mechanics, gravity, or chemistry. (Chemistry) Remind students that they should look for places to fill in on the worksheet as the lab is discussed.
- 7 Remind students of the process of a simple metal disc disrupting the over saturated, super cooled salt solution, causing the salt to return to crystalline form. This change in form generates heat, 130 degrees F.
- 8 If the salt will change so easily, it is because the over saturated solution is considered _____. (unstable)
- 9 Ask students whether the smaller or larger heat pack is hotter. (They are both the same. The chemical reaction that causes the crystallization and therefore the heat happens at 130 degrees for every crystal, no matter how many.)
- 10 Ask students which size of heat pack contains the most internal energy. (The large one does, as it contains many more crystals forming, each which produces energy.)
- 11 Students should place their heat packs on an ice cube, then discuss the chain of events that causes.
- 12 Next students should place their heat pack under a large cold pack. (This should take some time, so allow for questions on how to fill out their sheet, about ten minutes.) If the heat pack feels cooler, has the cold pack transferred cold, or has heat just transferred out of the heat pack to the cold pack. (The latter is correct.)
- 13 Ask students to brainstorm other processes that prove how heat transfers. Some examples might include how an oven heats up a room; focus on good windows holding heat inside a house, or others.

HIGH SCHOOL

Materials

- pretest
- several heat packs 4x4 and 8x8
- bucket of ice cubes
- several large cold packs (used in lunchboxes or coolers)
- vocabulary/worksheet
- test

Goals & Objectives

Students will:

- explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical, and physical phenomena.
- recognize that some atomic nuclei are unstable and will spontaneously break down.
- explain instances of heat transfer.

ASSESSMENT

Participation,
Worksheet,
Post-test.

You might give a bonus to those who chose to focus on the problems forecast in the pre-test and then improved in those areas.

MIDDLE SCHOOL

Materials

- heat pack
- boiling pan of water
- vocabulary sheet
- answer document
- Internet access

Goals & Objectives

Students will:

- become aware of chemical reactions that occur in common household items.
- explain that chemical reactions can release potential energy that can then be used.
- consider conservation of matter when choosing what technology to pursue.

ASSESSMENT

Participation,
Vocabulary sheet,
Answer document.

ACTIVITIES

- 1 Ask students to look at a regular piece of notebook paper. Ask them how it may contain potential energy. Discuss as a class. (Students realize that paper can release heat by fueling a fire, thus releasing its potential energy. Looking at the paper in its present form cannot indicate this potential energy.)
- 2 What other common items have similar, "hidden talents"? (Some ideas may be vinegar and baking soda, coke and sugar, yeast when activated by moisture and heat, a rubber band when stretched.)
- 3 Place a heat pack in front of groups of 4 for ease of seeing/manipulating.
- 4 Tell students this is a heat pack like those used for injuries, aches, or to keep warm with during exposure to cold weather. Note that it is not hot currently. Therefore the potential energy is _____? (Heat)
- 5 Ask students to list a description of the heat pack. (Vinyl pouch, a liquid inside, a small metal, concave disc.)
- 6 Ask each group to discuss and hypothesize about which of those descriptors are responsible for releasing the potential energy. (Students should conclude that it must include a reaction between the liquid and the disc, and that they need to know what kind of liquid it is.)
- 7 Ask each group to snap the disc so that it is concave the other direction and observe the reaction. Students should list a description now, of the heat and what "replaced" the liquid. What do bits and pieces of the solid look like?
- 8 Distribute the vocabulary sheet and let each group use their observation, vocabulary information, and Internet sites to fill out the document. Teacher should circulate to guide, clarify, encourage and promote progress.
- 9 To prepare for the next lab, allow students to observe the melting of the crystals by boiling the bags in the pan of boiling water. If you have both 4x4 and 8x8 sizes of heat packs, allow students to guess about whether the larger will take longer than the smaller to return to normal, and if so by how much.

ASSESSMENT

1. What is your hypothesis about how the heat pack works?
2. When the heat pack reacts to the disc, what does the resulting material look like?
a) solid b) crystal c) liquid
3. Use the following websites to learn about what actually happens with the heat pack. Then summarize the information in a paragraph. (Be complete, don't leave out any information about the process.)
en.wikipedia.org/wiki/sodium_acetate en.wikipedia.org/wiki/heat_pack
home.howstuffworks.com/question290
4. How does this product fit into the idea of conservation of matter?
5. Brainstorm some ideas about how knowledge of this chemical reaction could be used to provide for people's basic needs, or conserve nonrenewable energy, because it takes advantage of the principle of the conservation of matter.

Answer document

(Answers: 1. Answers will vary. 2. b 3. Summaries should include that the liquid is sodium acetate, what that is, why it reacts to the metal gratings, and why the temperature rises to 130 degrees. 4. The packet is reusable; the matter is not lost but just changes form. 5. Maybe this chemical reaction could be used inside cold-weather clothing, so furnaces could be kept on cooler settings, or maybe a furnace could be developed that distributes the heat this reaction creates instead of using fossil fuels. Answers will vary.)

VOCABULARY

- Energy refers to the ability for an object to impact another object with the purpose of accomplishing something.
- Potential Energy is the energy an object has because of its position or condition, such as a coiled spring, a ball in someone's hand, or a dried out piece of wood.
- Crystallization is the process of forming crystals.
- Chemical Stability is a term that describes a substance when it is in its lowest form of energy; it is least likely to change.
- Conservation of Matter means that when there is no external impact, the matter involved does not change, regardless of the form it takes

MIDDLE SCHOOL