ACAP
Alabama Comprehensive Assessment Program
SUMMATIVE

# Grade 8
# Science

# Alabama Educator Instructional Supports

## Alabama Course of Study Standards

DATA RECOGNITION
DRC
CORPORATION

**Phase 2 Sample**

| Grade 8 |
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| Matter and Its Interactions |
| **8.PS.5** Observe and analyze characteristic properties of substances (e.g., odor, density, solubility, flammability, melting point, boiling point) before and after the substances combine to determine if a chemical reaction has occurred. |

## Connections to A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas:

### Focus for Scientific and Engineering Practice(s):

- Analyzing and Interpreting Data
- Engaging in Arguments from Evidence

### Focus for Crosscutting Concept(s):

- Patterns
- Cause and Effect

### Focus for Disciplinary Core Idea(s):

- Structure and Properties of Matter
- Chemical Reactions
- Matter and Its Interactions

## What are some common physical properties of substances?

### Background

Pure substances have unique physical properties. Physical properties can be tested without changing the chemical nature of the matter being examined. Examples of physical properties are included below.

*boiling point*: the temperature at which a pure substance changes from a liquid to a gas at a given pressure

*melting point*: the temperature at which a pure substance changes from a solid to a liquid

*malleability*: a material's ability to be shaped and formed

*ductility*: a material's ability to be drawn into a wire

*density*: the amount of matter in a given space (mass/volume)

*solubility*: a material's ability to dissolve

*hardness*: a mineral's resistance to scratching

*color*: the hue of a material as seen by the human eye

*odor*: the smell of a material

*luster*: the interaction of light with a material

*electrical conductivity*: a material's ability to conduct electricity

*state of matter*: a substance's state at a given temperature (i.e., solid, liquid, gas, or plasma)

*thermal conductivity*: a material's ability to transfer thermal energy (heat)

## Activities and Considerations

### Activity 1

Brainstorm physical properties of a piece of bread. Students could separate into lab groups (each with a piece of bread) or this could be done as a teacher demonstration. Do not allow the students to change the bread in any way. Possible answers could be that the bread is white, that it has a hard outer portion and a soft inner portion, that it is a solid at room temperature, or that it is malleable.

### Activity 2

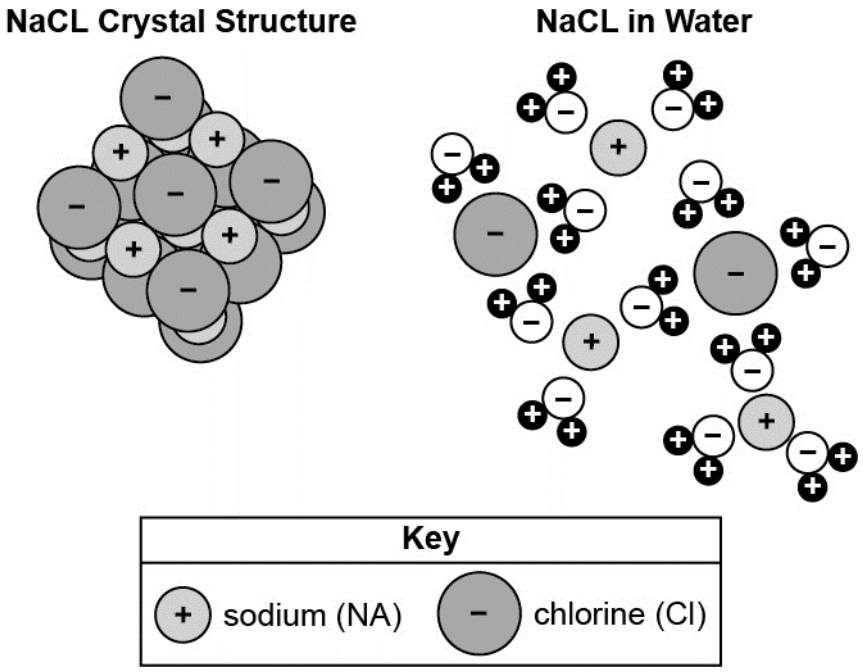
Allow the students to test specific physical properties of solid salt (NaCl). Provide students with conductivity meters and a small sample of salt. This could be done as a teacher demonstration as well. The students will observe that solid salt does not conduct electricity. The students will add the salt sample to water and observe that the salt dissolves. Upon testing the electrical conductivity of the salt water, the students will observe that the salt water does conduct electricity. Students can make a chart of salt's physical properties.

Example Physical Properties of Salt

- Solid salt is a white crystalline solid, but in water it seems to disappear.
- Solid salt does not conduct electricity, but salt water does.
- Solid salt is soluble in water.
- Solid salt is brittle (not malleable).
- Solid salt is an ionic compound and therefore has a high boiling point.

### Considerations

Dissolving is an advanced topic for students to discuss. For most students at this level, dissolving can be described as a physical property. Dissolving salt in water does not change salt into something new, but it does change the properties of salt on the atomic scale. For advanced students, dissolving can be described as a chemical change or property. When salt is dissolved in water, its electrical conductivity changes, which indicates the movement of charged particles. The ionic bond is broken during solvation. A model of salt dissolving in water is shown below.




## Resources

Dissolving activities: https://www.acs.org/content/acs/en/education/resources/k-8/science-activities/chemicalphysicalchange/dissolving.html

# What are some common chemical properties of substances?

## Background

Pure substances have unique chemical properties. Chemical properties cannot be tested without changing the chemical nature of the matter being examined. Examples of chemical properties are included below.

*reactivity*: the degree to which a material chemically reacts with other substances, such as acids, copper (II) chloride, and air

*flammability*: how readily a substance combusts, which is related to reactivity with oxygen

*heat of combustion*: the difference in energy between reactants and products in a combustion reaction

## Activities and Considerations

### Activity 1

The teacher can demonstrate a chemical property of paper (mixture). Revisit physical properties by asking students to generate a list describing several physical properties of paper (e.g., color, solubility, etc.). Tear the paper in half and ask students whether tearing the paper changed the properties of the paper. Using a match, burn a small piece of the paper. Ask students to generate or discuss the results. Students may notice that the paper combusted easily. Carbon-based compounds, like paper, are often flammable, which is a chemical property.

### Activity 2

Metal (an aluminum pop can tab or a sample of magnesium or zinc) is placed in acid (hydrochloric, nitric, or sulfuric) in a test tube. Students will see the metal surface changing and bubbles forming on the surface of the metal.

# What can be concluded when two substances react to form a new product but the reaction can be reversed to obtain the original reactants?

## Background

There are two types of changes: physical and chemical.

*Physical change:*

> This change does not form a new substance but may form a different version of the same substance. An example is freezing liquid water.

$H_2O_{(l)} \rightarrow H_2O_{(s)}$

A new substance was not formed during the phase change, but solid water has different physical properties than liquid water (e.g. density and state of matter). Physical changes are considered to be reversible because the original substance can be recovered.

*Chemical change:*

This change forms a new substance with new physical and chemical properties. An example of a chemical change occurs when combining zinc metal and hydrochloric acid.

$Zn_{(s)} + 2HCl_{(aq)} \rightarrow ZnCl_{2(aq)} + H_{2(g)}$

All chemical reactions are reversible, although reversing the reaction may be difficult practically. A chemical reaction may proceed in a forward and reverse direction until chemical equilibrium is established.

A stress (e.g., change in temperature, concentration, pressure) can be applied to a system at equilibrium to manipulate the amount of reactants or products produced.

## Activities and Considerations

### Activity 1

Demonstrate examples of reversible chemical reactions

Examples:

- Rechargeable batteries
- Haber process

### Considerations

Students commonly think that the main difference between chemical and physical changes is reversibility. The misconception is that physical changes are reversible and that chemical changes are not. At this grade level, examples of chemical reactions that are reversible are important.

## Resources

Haber Process: http://www.environmentandsociety.org/tools/keywords/first-industrial-use-haber-process

# What evidence could be generated during an investigation to indicate the occurrence of a chemical reaction?

## Background

Common indicators of a chemical reaction are the production of a gas, a change in temperature, a production of light or odor, the formation of a precipitate, and a change in color.

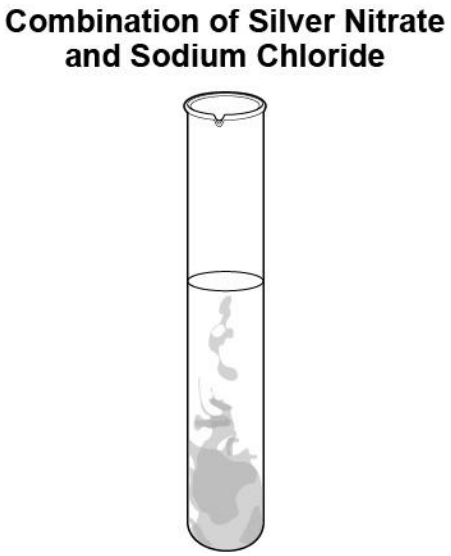
## Activities and Considerations

### Activity 1

Give each student lab group a dull penny (do not use a new shiny penny). Have the students place the penny on a paper towel. Have the students add lemon juice to the penny. After 10–15 minutes, the students will notice that the surface of the copper has changed.

### Activity 2

In a test tube, combine silver nitrate (dissolved in water) and sodium chloride (dissolved in water). The students will observe that the two solutions are clear. When combined, a white solid substance (precipitate) is produced.




### Considerations

A common misconception is that any change that involves heat is a chemical reaction. Have the students compare boiling water, which feels hot, and a chemical hot pack, in which two

chemicals are combined and thermal energy is released. Are they both chemical reactions because they both feel warm? Have the students compare the formation of the white precipitate in Activity 2 and the combination of white paint and water. In both examples, the students observe a color change, but both examples are not chemical reactions.

# What are some common examples of chemical reactions and physical changes?

## Background

*Common examples of physical changes*:

- phase changes (e.g. melting, freezing, vaporization, condensation)
- materials being crushed, torn, stacked
- solids being dissolved in water
- particles being mixed (e.g., sand and shells)

*Common examples of chemical reactions*:

- baking bread
- digesting food
- lighting a candle
- combining baking soda and vinegar

## Activities and Considerations

### Activity

Set up stations for students to investigate examples of changes. They will record their observations and determine whether each change is chemical or physical. Some station examples are included below.

Examples:

- Adding baking soda and vinegar to a plastic bag (chemical)
- Sorting iron filings from sand with a magnet (physical)
- Adding food coloring to water (physical)
- Melting an ice cube (physical)
- Mixing chemicals in a glow stick or jewelry (chemical)
- Dissolving sugar in water (physical, at this grade level)
- Lighting a candle (combustion is chemical; melting wax is physical)

### Considerations

Many examples of reactions that students observe in their daily experiences involve multiple reactions, both chemical and physical. Students may think that reactions can only be chemical or physical.

## Why do some properties of a substance change after a chemical reaction?

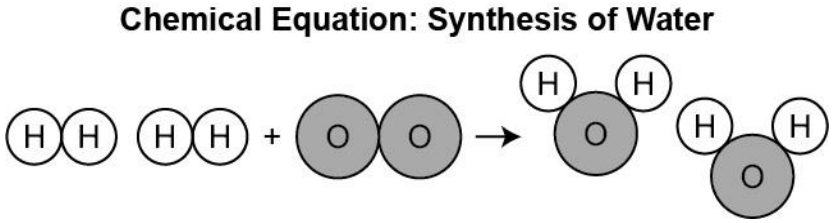
### Background

The properties of a substance may change after a chemical reaction because the substances are different than they were before the reaction. The reactants and products are made of the same types of atoms, but the atoms have been rearranged.

### Activities and Considerations

#### Activity 1

Show students the model of the following chemical reaction:




Diatomic hydrogen and oxygen are both flammable and are both gases at room temperature. Water is not flammable and is a liquid at room temperature. The reactants and products in this reaction are made of hydrogen and oxygen atoms, but the rearrangement of those atoms leads to different properties in the reactants than in the products.

#### Activity 2

Using the same model, the students can count the number of each type of atom on the reactant and product sides. They will determine that the number of each type of atom on each side of the arrow is the same. The only difference is how they are arranged.

#### Considerations

Students may think that in a chemical reaction, all the products must be different than the reactants. A catalyst (used to increase the speed at which a reaction occurs) is a good example of a reactant that is not changed during a reaction. The catalyst is the same before and after the

chemical reaction takes place. When a solution of silver nitrate and a solution of sodium chloride are added together, a chemical reaction occurs. However, in that reaction, water is present as both a reactant and a product.

## Key Academic Terms:

physical change, chemical change (chemical reaction), melting point, boiling point, freezing point, physical property, chemical property, reactant, product, density, solubility, flammability, odor, waft, observation

## Additional Resources:

- https://www.education.vic.gov.au/school/teachers/teachingresources/discipline/science/continuum/Pages/physchem5.aspx
- https://www.acs.org/content/acs/en/education/resources/k-8/science-activities/chemicalphysicalchange/chemicalreactions.html