

ELEMENTARY SCIENCE PROGRAM
MATH, SCIENCE & TECHNOLOGY EDUCATION

A Collection of Learning Experiences on
**POWDERS AND
CRYSTALS**

Revised August 2006

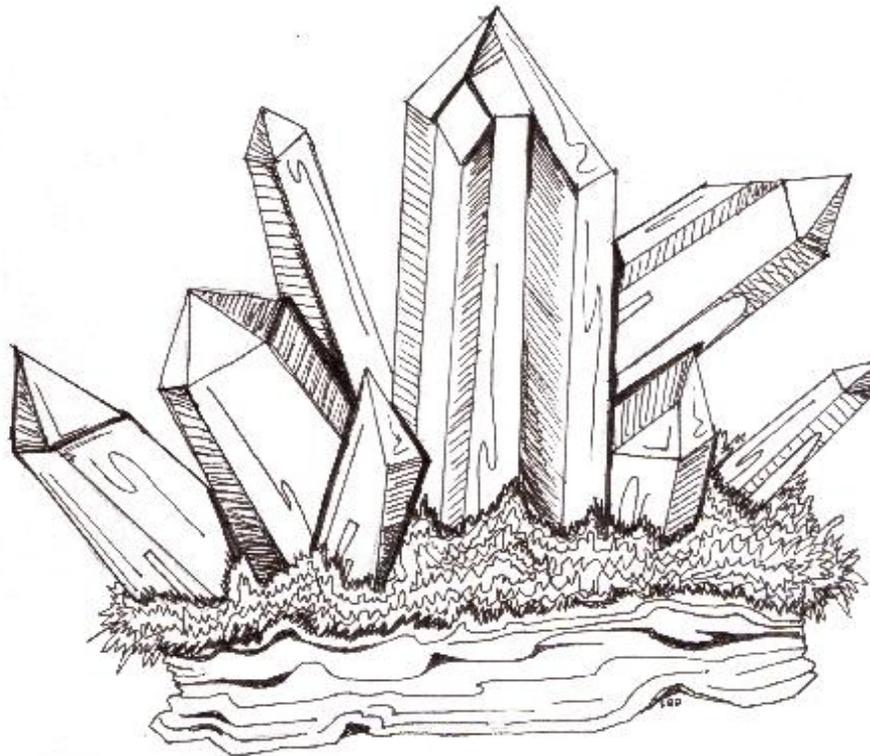


TABLE OF CONTENTS

Unit Overview.....	2
Format & Background Information	2-11
Learning Experience 1 - Moon Rocks	12-13
Learning Experience 2 - Sensing.....	14-15
Learning Experience 3 - Using a Pocketscope	16
Learning Experience 4 - Heat Test	17-18
Learning Experience 5 - Water Test	19-20
Learning Experience 6 - Vinegar Test.....	21
Learning Experience 7 - Iodine Test	22-23
Learning Experience 8 - BTB Test.....	24
Learning Experience 9 - Classifying Powders and Crystals	25-26
Learning Experience 10 - Conquering the Unknown.....	27-28
Learning Experience 11 - Super Sleuth	29-30
Powders and Crystals Review Sheet and Key.....	31 -34
Powders And Crystals Student Assessment And Answer Key	35-37
More Ideas	38-39
Inquiry & Process Skills	40
Glossary.....	41-42
Teacher References	43
Major Science Concepts	44-45

POWDERS AND CRYSTALS

GRADE 4

Unit Overview

Powders and Crystals introduces students to chemical and physical properties of familiar substances. Students perform experiments with chemical and physical reactions and chemical indicators. Students learn rules for proper use of chemicals, and eye safety. Skills emphasized are observing, classifying, collecting, interpreting data, communicating, discussing, manipulating, making decisions, generalizing, and formulating hypotheses.

Scheduling

This unit may take from four to six weeks to complete depending upon the goals of the teacher and interests of the students. Use of the section included in this manual called More Ideas may extend the time span of this kit.

Materials to be obtained locally:

Please make **one** student activity book for **each** student.

scissors	overhead transparencies	folders
paper towels	overhead	metric rulers
chart paper	colored pencils	notebooks
felt tip markers	picture of a space suit	white paper
detergent, milk, soda		water

Caution

Except iodine, none of the other chemicals in this kit are hazardous to the skin. Iodine may cause a skin reaction. Please confirm with students before each experiment if they are allergic to iodine. Please remind students to wash their hands after completing a learning experience. To prevent contamination, do not return unused powders or crystals from the plastic cups back into the large containers. Throw the unused chemicals in the wastebasket. Safety Goggles: Students should be assigned a pair of safety goggles to use throughout the kit. Due to sanitary reasons, students should not share goggles.

About the Format

Each learning experience is numbered and titled. Under each title is the objective for the learning experience.

Each learning experience page has two columns. The column on the left side of the page lists materials, preparations, basic skills processes, evaluation strategy, and vocabulary. The evaluation strategy is for the teacher to use when judging the student's understanding of the learning experience.

The right column begins with a "Focus Question" which is typed in italicized print. The purpose of the "Focus Question" is to guide the teacher's instruction toward the main idea of the learning experience. The "Focus Question" is not to be answered by the

students. The learning experience includes direction for students, illustrations, and discussion questions. These discussion questions can be used as a basis for class interaction.

A **Student Assessment** has been included in the **Teacher's Manual** and the **Student Activity Manual**. If you do not want the students to have the assessment beforehand, remove it from the **Student Activity Manual** before printing a class set of the student manuals.

Background Information

Chemical Reaction

As chemicals react, a new substance is being created. **Reactants** are chemicals that take part in a chemical reaction while the **products** are the new substances that the reactants form. Evidence such as color changes, production of a gas, and odor are all clues that a chemical reaction is taking place. A temperature change shows that energy is being released or used as new substances are being formed.

Water

Most of the materials that we come in contact with everyday are **mixtures**. Mixtures are two or more substances that can be separated by physical means. Many of the mixtures are solutions. A **solution** is a homogeneous mixture that has the same makeup throughout itself, and where one substance is dissolved into another. The **solvent** in a solution is the substance that does the dissolving, and is present in the larger amount. The **solute** is the substance that is dissolved, and is present in the smaller amount. In most solutions, the solvent is a liquid and the solute is a solid, liquid, or gas. If water is the solvent, which is the case in most solutions, the solution is called an **aqueous** solution. When a solute is placed in a solvent, it dissolves. When sugar is put into water and is stirred, the sugar dissolves. The sugar molecules spread out evenly among the water molecules. Sugar molecules are held together by attractive forces. For the sugar to dissolve, the forces must be overcome. This happens when the attraction between the water molecules and sugar molecules is greater than the attraction between the sugar molecules alone. In a solution, the solute particles are not able to be seen. They will not settle to the bottom, even if it stands for a long period of time. Parts of the solution cannot be separated by filtering either. The rate at which a solution forms is based on the size of the solute particles, stirring, and the temperature of the mixture. A **suspension** is different from a solution in several ways. A suspension is a heterogeneous mixture in which particles of a substance are temporarily mixed with a liquid (e.g. salad dressing (if left standing), oil and vinegar). The particles in a suspension occur in large clusters. The clusters can be seen in the suspension quite clearly. They can also be separated from the liquid by filtering. The opposite is so for a solution.

Vinegar

When vinegar is added to baking soda, a chemical reaction occurs. Vinegar is an acid and baking soda is a base. In this chemical reaction, the substances that are mixed change into a completely new substance. When the vinegar is added to baking soda, it forms a new chemical, salt. Bubbles that are full of carbon dioxide form when the

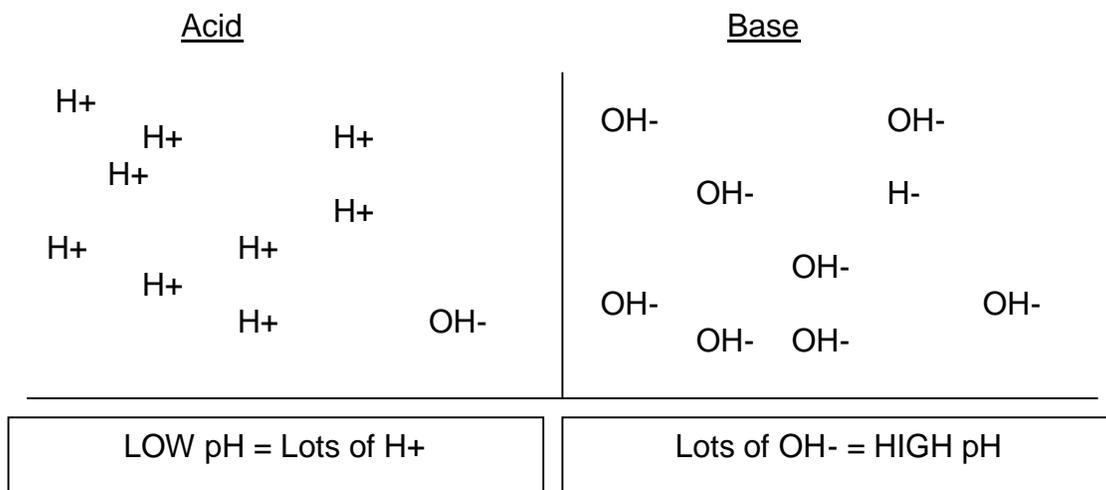
vinegar is added to baking soda. Carbon dioxide gas is released during the chemical reaction.

Iodine

Iodine turns purple/black when it is in the presence of starch. This is quite a sensitive test that can be done on other materials such as paper, wax paper, and even confectioner's sugar. Iodine can stain clothes. To remove iodine stains, soak items in a mixture of vitamin C and water. Iodine is sensitive to air and light so it can evaporate and lose its strength if not contained properly.

BTB (Bromothymol Blue)

BTB is a chemical indicator that changes color in acids. BTB stays blue in a basic or alkali solution; however, it turns light green in a weak acid and yellow in a strong acid. A base is a solution that has an excess of OH⁻ ions. (Ion – an electricity charged group of atom or group of atoms.) An acid is a solution that has an excess of H⁺ ions. It comes from the Latin word “acidus” which means sharp. A weak acid is an acid that partially ionizes (changes into ions) in a water solution. In other words, not every molecule breaks apart in the water. A pH scale is used to measure the strength of acids and bases. The scale runs from 0-14. Acids are from 0-7 on the pH scale and bases are from 7-14 on the pH scale. A solution that has a pH of 7 is neutral or not acidic or basic. BTB stays blue in the pH 6.0 to pH 7.6 range. BTB can also stain clothing so extra caution is required.



Heat

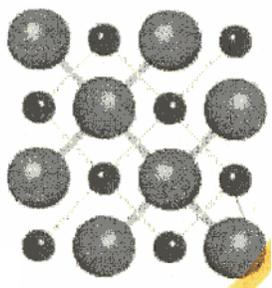
When sugar and starch are heated, they decompose. Sugar melts and then burns and gives off an odor, which is one of the indications that a chemical reaction is occurring. Starch smokes and turns brown or black. Citric acid melts and produces a strong odor. Salt crystals break into smaller crystals, which results in a popping effect. Baking soda and Plaster of Paris do not react to heat.

Crystals

Crystals are found in our everyday life. Table salt, sand, and diamonds are all examples of crystals. The study of these crystals is crystallography and the scientist

who participates in the study of crystals is a crystallographer. The word crystal comes from the Greek word “krystallos” meaning ice. When the Greeks first found quartz crystals, they believed that they were a form of ice that was frozen so hard it could never melt.

The way to describe how crystals are formed is to think of the smallest particle of any substance or molecule. Each molecule is composed of one or more atoms. Atoms are the smallest particle of an element. An element is one of a hundred or so materials that can be combined with other elements to make all the substances in the universe. A sodium element (Na) bound to a chlorine element (Cl) makes a molecule of sodium chloride or table salt (NaCl). The form the crystal makes depends on the arrangement of the molecules within it. When the material changes into a solid, the molecules lock together. As they do, they link in a regular or uniform geometric pattern (a repeating arrangement of its atoms). When a crystal grows, layer is added upon layer repeating the geometric pattern. Depending on the molecules involved in making the crystals, different shapes may result. There are seven shapes in which crystals may form. They are cubic, hexagonal, tetragonal, orthohombic, monoclinic, and triclinic. For example, the molecules of table salt are arranged in a cubic pattern, therefore, the crystals of salt are cubic in appearance. The three dimensional pattern made up of many units that are lined up in all directions, is the **crystal lattice**.



Mystery Powders and Crystals

Students should not be told what the powders and crystals actually are until all tests have been completed. In one of the activities, students bring in common known substances from home to test, analyze, and compare them to the classroom powders that have been tested throughout the unit to help them identify the unknown powders and crystals. Students will have negative test results while using iodine, BTB, and vinegar. For example, if iodine does not turn blue-black in a substance that means that starch is not present. If a negative result occurs, students can record “no reaction” on their observation charts.

Powders and Crystals in Kit:

Red Dot Container-	Baking Soda
Orange Dot Container-	Plaster of Paris
Yellow Dot Container-	Salt
Black Dot Container-	Starch
Green Dot Container-	Sugar
Blue Dot Container-	Citric Acid
Container A-	Starch and Baking Soda

Container B- Citric Acid and Starch
Container C- Salt and Baking Soda

It is recommended that after the water test, new cups with one level teaspoon of each substance are again provided for the students . The vinegar, iodine, and BTB test can be done in the same cup as long as students put the specified amount of the indicator in the substance. To prevent contamination, do not return unused powders or crystals from the plastic cups back into the large containers. Please do not dump used powders in sinks. Throw the unused powders into the wastebasket.

Inquiry/Scientific Method/Guided Inquiry

Experiments are often designed after making observations that lead to further questions. Experiments are designed to help answer those questions. This process is called inquiry and results in experiment design and utilizes the scientific method.

Experimental Design

This unit begins with students observing powders and crystals. Then students write experiments in which the powder and crystal has changed. As students begin to learn how to write experiments, you may find that teacher guidance will be necessary. The key to success is to start with simple experiments (like the ones in this unit) and give them time to practice and work with others as they are learning. With time and guidance, you will begin to see students understanding the concept of experimental design and be able to apply their knowledge to writing their own experiments.

There are five main components of experimental design:

1. Independent Variable
2. Dependent Variable
3. Control
4. Constants
5. Repeated Trials

A **variable** is the factor(s) that change in the experiment.

Independent Variable

The **independent variable** is the variable in the experiment that is purposefully changed or manipulated. All other factors should remain constant during the experiment. If you ask the question, "What did you change in the experiment?" your answer will lead you to the independent variable. For example, let's say that you wanted to know if different amounts of fertilizer given to a plant effect its growth (height). You could set up an experiment with twenty identical plants and you fertilize five of the plants with five grams of fertilizer, five with ten grams of fertilizer, five with fifteen grams of fertilizer, and there are five plants that receive no (zero grams) of fertilizer. The different amounts of fertilizer you give to the various plants is the independent variable. The different amount of fertilizer is the part of the experiment that you control. You made the change on purpose! It is important that there is only one independent variable in an experiment. If you have more than one independent variable, when you look at the results, you will not know which independent variable caused the results to occur.

For example, if you give the plant different amounts of fertilizer and different amounts of plant food in the experiment, you will not know if it is the fertilizer or the food that causes the plant to grow taller.

Dependent Variable

The **dependent variable** is the variable that responds to the independent variable. The dependent variable occurs because you changed something in the experiment. In the experiment mentioned previously, we added different amounts of fertilizer to twenty plants. We are observing how the different amounts of fertilizer effect the growth (height) of the plant. The height that the plant grows is the dependent variable – it is the variable that you observe.

Title of Experiment

When you write the **title** of an experiment, it should include the independent variable and the dependent variable. The title is written in the following format:

The effect of the (Independent Variable) on the (Dependent Variable).

If we were to write a title for the plant experiment it would read:

The effect of different amounts of fertilizer given to a plant on the growth (height) of the plant.

Notice that the independent variable (different amounts of fertilizer given to a plant) effects the dependent variable (growth (height) of the plant).

Hypothesis

Students formulate a **hypothesis** “educated guess” or prediction before beginning their experiment that is designed to test the prediction. The hypothesis is a prediction about the relationship between the variables. The hypothesis is usually based on background knowledge and experiences with the materials/events of the experiment.

The hypothesis is written in the following format:

If I change an independent variable then the dependent variable will change.

If (Independent Variable) then (Dependent Variable).

If we were to write a hypothesis for the plant experiment it could read:

If I add ten grams of fertilizer to a group of five plants, then it will cause that group of plants to grow the tallest of all the groups (30 cm).

Some students may write “I think . . .” as the beginning of their hypothesis. When writing a hypothesis for experimental design the If ... then statement is preferred. Each student in the class may have a different hypothesis based upon what they believe will happen in the experiment.

Control

The **control** in an experiment is the standard for comparing the effects of the experiment. It is needed in all experiments because all the results are compared to it. For example, in the plant experiment, we added different amounts of fertilizer to the plants. The plant that receives no fertilizer (zero grams) is the control because it is unchanged and the growths of the other plants are compared to it. If the plant that receives no fertilizer hardly grows, and the plants that received fertilizer do grow, then we know that the fertilizer had an influence on the growth of the plant.

Constants

The **constants** are all the factors that remain the same in an experiment. When an experiment is created, there is one variable or change that we make (independent variable.) Everything else in the experiment must stay the same. If it does not, then another variable is added into the experiment and, again, we will not know which variable caused the results.

Plant experiment:

Independent Variable – Different amounts of fertilizer.

Constants – Same type of plant, same soil used for each plant, same amounts of water given to each plant, same amounts of sunlight provided for each plant, plants located in same place.

Any one of the constants of an experiment could be made into an independent variable and another experiment would evolve.

Ex: Independent Variable – ***Different amounts of water for each plant.***

Constants – ***same amount of fertilizer***, same type of plant, same soil used, same amounts of sunlight provided for each plant, plants located in the same place.

This results in an unending supply of ideas/extensions of experiments.

Procedure

Every experiment needs to have a detailed list of procedures. The procedures in an experiment provide step-by-step direction of how the experiment was conducted. The steps should be detailed enough so someone else could read the procedure and be able to recreate the experiment exactly how it was done. Asking students to write procedures to tasks they are familiar with may help them in writing scientific procedures for an experiment. Once students begin writing procedures, they begin to see that they should not “assume” the reader will conduct the next step as they did. If they do, they will see that the reader will vary from what the original experimenter did.

Repeated Trials

Repeated trials are the number of experimental repetitions. They increase the confidence of the results and conclusions by reducing the effects of chance or random

errors that may occur in a single trial. In our plant experiment, we are added five grams of fertilizer to five plants, ten grams of fertilizer to five plants, etc. The five plants represent the repeated trials. Students should be asked the question, "How many times did you perform the experiment before making a conclusion?" In this unit, students repeat each level of the independent variable three times. More trials may be necessary if no conclusion can be made from those trials. The amount of repeated trials in an experiment should be determined by time, expense, the amount of variation in the organisms used, and the consequences of coming to a wrong conclusion. The reliability factor of repeated trails makes it a necessary part of results from an experiment.

Results

The results are the outcome of the experiment. The results are the collected data or information found by observing, measuring, and carefully recording the data.

Conclusion

A **conclusion** in an experiment describes the major findings of an experiment, an explanation for those findings, and recommendations for further study. Students should remember that there is no such thing as a perfect experiment so there is always ways it can be improved. In this unit, students answer three questions in their conclusions to summarize the results of their experiment. The results of the experiment are to also be provided in a table and graph format that proceeds the conclusion. Analyzing their table and graph will help students in writing their conclusions.

POWDERS AND CRYSTALS – WORK MAT

EXAMPLE

DIRECTIONS: Take one leveled teaspoon of powder from the large container labeled black and place it in the small black plastic cup. Do the same for the other five colors. Place each cup on the circle labeled the same as the color of the cup on the work mat.

SAFETY RULES

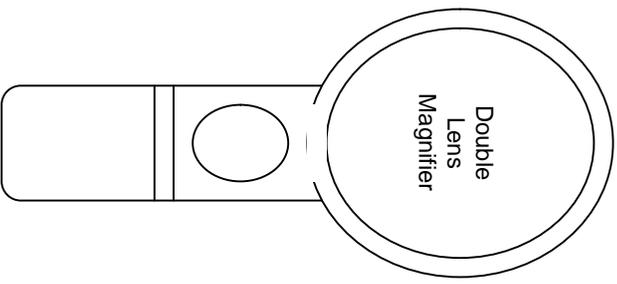
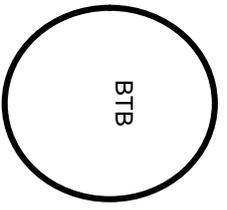
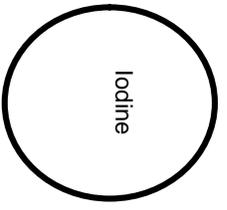
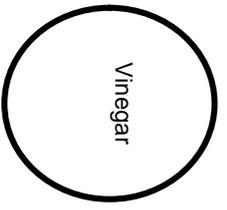
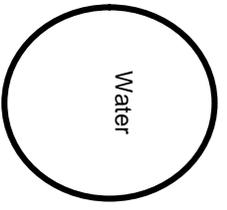
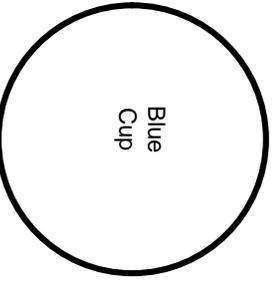
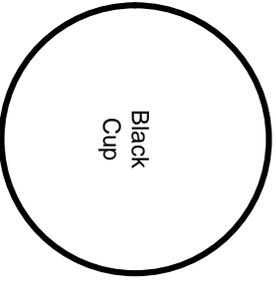
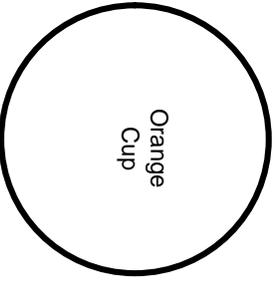
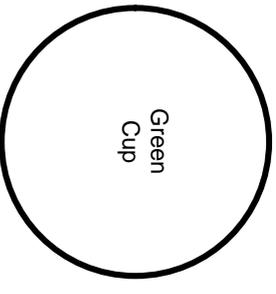
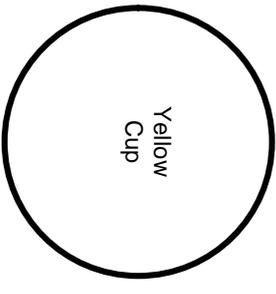
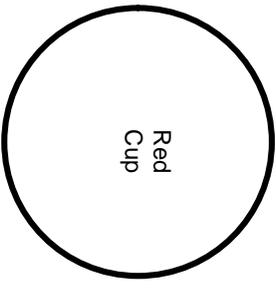
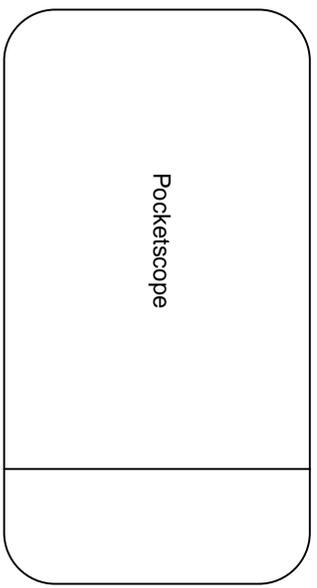
Eye Prevention

Always wear safety goggles when using vinegar, iodine, and BTB.

Avoid Contamination

Do not return powders to containers once you have removed them. **Dispose of all powders in a trash can.**

Use the black square area on the work mat to observe the powders and crystals



CLASS OBSERVATION SUMMARY CHART ANSWER SHEET

CONTAINER	SENSES	MICROSCOPE	HEAT TEST	WATER TEST	VINEGAR TEST	IODINE TEST	BTB TEST
RED Baking Soda	White Smooth	Fine Crystals Irregular Spear-like	No reaction	Dissolves becomes a solution	Bubbles or fizzes	No reaction	No reaction
ORANGE Plaster of Paris	Gray-white Fine Gritty Powdery	Fine Powdery	No reaction	Does not dissolve, hardens, gives off heat, and becomes suspended	No reaction or very slight bubbling reaction	No reaction	No reaction
YELLOW Salt	White Crystalline Grainy	Cubes Crystals	No reaction	Dissolves and becomes a solution	No reaction	No reaction	Turns light green
BLACK Starch	Yellowish- white Smooth Powdery	Fine Powdery	Darkens to brown and smokes. Then turns black. Odor	Does not dissolve and becomes suspended	No reaction	Turns blue, black or purple	Turns yellow
GREEN Sugar	White Crystalline	Crystals Variable shapes	Bubbles and melts. Then turns shiny. Odor	Dissolves and becomes a solution	No reaction	No reaction	No reaction
BLUE Citric Acid	White Grainy Crystalline	Irregular Crystals Larger	Melts, smokes and evaporates. Odor	Dissolves becomes a solution	No reaction	No reaction	Turns yellow

Learning Experience 1: Moon Rocks

Objective: Students will observe “moon rocks” and describe them using one word descriptions.

Materials:

For each pair of students:

2 Powders And Crystals Student Activity

Books

Sugar cube

Paper towels*

Picture of a space suit*

*provided by teacher

Preparation:

This learning experience serves as an introduction to this unit. A picture of a space suit may be necessary for students to have a better understanding of what a space suit entails. During this learning experience, the teacher should stress that the “moon rocks” and the powders, crystals, and other chemicals in the unit are not to be tasted or eaten. Scientists use safe methods to determine what a substance is rather than to taste. For example, sight, smell, and touch are used. The purity of the chemicals in the kit cannot be guaranteed. This learning experience also teaches the students to make one-word observations. One-word observations are the desired type of observation to be made on the activity sheets in the learning experiences. One-word observations force a student to observe rather than compare.

Basic Skills Development:

Observing

Discussing

Describing

Writing

How can “moon rocks” be described?

Students are to pretend they are astronauts who have just landed on the one of the moons of Saturn. They are wearing spacesuits and have brought a radio transmitter and small hand tools with them. The cold temperature on the moon requires that they conserve their energy and the energy in the battery pack for the radio transmitter. Their mission is to explore the surface of the moon for rocks.

Distribute one sugar cube to each pair of students. Tell them these are the first “moon rocks” that they, as astronauts, have discovered, and they will use their radio transmitter to relay back to earth their one word observations of these rocks. Words like cubic, white, and/or small are appropriate; however, “looks like a sugar cube” is a comparison rather than a descriptive observation. Record on the chalkboard all the “radio transmissions.” You may have to remind the astronauts to use only one-word observations and that they are wearing a spacesuit during this exploration. Have students record their observations on their moon rocks on the activity sheet for Learning Experience #1 in the Powders And Crystals Student Activity Book.

Discussion Questions:

What senses will it be impossible for the astronauts to use while wearing a spacesuit? Why?

All radio transmissions are to be only one word. Explain why?

Learning Experience 1 continued

Page 2

Evaluation Strategy:

Students will create a list of at least 15 different one-word observations of the sugar cube "moon rocks." Reinforce the term "properties" with the students. Break the student observations down into types of properties. Such properties are color, size, shape, texture, and smell.

Vocabulary:

senses
transmitter

What small hand tools might the astronauts have to break open or crush the rocks?

What can you use from your desk?

Students can use materials from their desk to try to break apart the "moon rocks" on their paper towels and continue with their observations. How do these rocks compare to the rocks on earth?

In addition to orally giving their observations, students could write the observations they make about these "moon rocks" for the scientists back on earth to find out what they know about these rocks. Students can write about the properties they observe and ask questions about the rock that will help the scientist provide them with more information about it.

Learning Experience 2: Sensing

Objective: Students will use their sense of touch, sight, and smell to describe the variety of powders and crystals.

Materials:

For each pair of students:

2 Powders And Crystals Student Activity Books
Powders And Crystals Work Mat
6 plastic cups (red, orange, yellow, green, blue, black with one leveled teaspoon of the matching substance)
Double lens magnifier
Cardboard tray
Toothpicks
Notebooks*
Folders*

For the class:

1 set teaspoons (red, orange, yellow, green, blue, black)
6 containers of the powders and crystals
Overhead*
Overhead transparencies of Class Observation Summary Chart*

*provided by teacher

Preparation:

Identity of the powders and crystals can be found in background information on page 5. Identity of the powders and crystals should not be revealed to students until after the learning experiences are completed. Arranging the materials on a table or counter top so students may pick them up and return them "cafeteria style" may be the easiest method of organization. Open the containers of powders and crystals and place a teaspoon of its matching color into the containers. Students will use the teaspoons to scoop up the substance.

How can the powders and crystals be described?

Before distribution of materials, it is important that students review the seven tips for safety sheet in their Powders & Crystals Student Activity Book. Discuss these tips as a class and why they are so important when using this kit.

Distribute the Powders And Crystals Work Mat. (See copy on page 10)

Students should also read and discuss the directions and safety rules printed on the Work Mat. Students are to follow the same directions and safety rules throughout the unit. Have one member from each pair of students scoop one teaspoon of each powder or crystal out of the containers. Students can use their toothpick to level off the teaspoon scoop. Students should note the color dot on the container they are taking the teaspoon out of and place the substance in its matching color cup.

Students should use the flat end of the toothpick to transfer a small portion of one of the powders and crystals onto the black area of their Work Mats. Students can use their double lens magnifiers to examine their powders and crystals. Students should use their senses of sight, touch, and smell to make one-word observations of the powder or crystal. Students should record their observations on the activity sheet for Learning Experience #2 in the Powders And Crystals Student Activity Book. Students should continue with the other powders and/or crystals. As a class, summarize and discuss the

Learning Experience 2 continued

Page 2

Students can use their toothpick to level off the teaspoons before putting the substance into the cup. The Powders And Crystals Work Mat is to be placed in the bottom of the cardboard tray. The plastic cups can be arranged on the mat accordingly. Creating an overhead transparency of the Class Observation Summary Chart, may help with the discussion of this learning experience.

Basic Skills Development:

Describing Collecting
Observing Measuring
Discussing
Writing

Evaluation Strategy:

Given the different powders and crystals, students will describe each one by using their sense of sight, touch, and smell.

Vocabulary:

powder	crystal
baking soda	citric acid
Plaster of Paris	salt
senses	texture
contamination	dispose
conserve	

observations from this learning experience. As a class, decide what words are the most accurate in the description of these powders and crystals and record them in the "senses" column of the Class Observation Summary Chart (Sample answers page 11) also found in the Powders And Crystals Student Activity Book).

Students will use the Class Observation Summary Chart for Learning Experiences #2-8.

Students should keep these and other activity sheets in a Powders And Crystals notebook or folder.

Discussion Questions:

How are the powders and crystals similar/different based on observations? When have you used your senses of sight, smell, and or touch to explore an unknown item?

Do you recognize any of these mystery powders and crystals?



Learning Experience 3: Using a Pocketscope

Objective: Students will use a pocketscope to observe the mystery substances and decide which are powders and which are crystals based on their appearance.

Materials:

For each pair of students:

2 Powders And Crystals Student Activity Books

Powders And Crystals Work Mat

Pocketscope

Depression slide

6 plastic cups (one of each color containing one leveled teaspoon of the matching substance)

Toothpicks

Cardboard tray

White paper*

For the class:

6 containers of the powders and crystals

*provided by teacher

Preparation:

Demonstration of how to use the pocketscope may be necessary. You may want to have students refer to the previous learning experience as a source of information about the substances.

Discussion of how crystals are formed and sample pictures of crystals may be necessary. Read background information on crystals on pages 4 and 5.

Caution:

Never allow students to place wet powders or crystals on a microscope stage or depression slide.

Basic Skills Development:

Observing Describing

Writing Measuring

Drawing Classifying

Discussing

Evaluation Strategy:

Students will use the pocketscopes to identify which substances are powders and which are crystals.

Vocabulary:

microscope magnify
specimen

Which substances are powders and which are crystals?

On the activity sheet for Learning Experience #3 in the Powders And Crystals Student Activity Book, page 1 describes how to use the pocketscope. Discuss the steps and demonstrate if necessary.

Distribute the pocketscopes and allow students time to examine them. Students should put a small amount of the first substance they choose on the flat end of the toothpick. Place the small amount on the pocketscope depression slide and observe. Students should draw what they see under the pocketscope and decide if the substance is a powder or a crystal and why they came to that conclusion. Discuss their observations from this learning experience. As a class, decide what words are the most accurate to describe the microscope pictures of the powders and crystals. Record these on the Class Observation Summary Chart in the microscope column.

Discussion Questions:

Have you ever used a microscope or magnifying glass to observe something closely? What did you see?

What geometric shapes do you see when you observe the substances in the pocketscope?

Do you think you recognize any of the mystery powders and crystals?

Learning Experience 4: Heat Test

Objective: Students will add heat to the powders and crystals and describe the results.

Materials:

For each pair of students :

2 Powders And Crystals Student Activity

Books

Powders And Crystals Work Mat

6 plastic cups (one of each color containing one leveled teaspoon of the matching substance)

Cardboard tray

2 pairs of safety goggles

Candle

Aluminum drip pan for candle

Clothespin

Toothpicks

Metric ruler*

Scissors*

For the class:

Aluminum foil

6 containers of the powders and crystals

Box matches

Match jar

*provided by teacher

Preparation:

Read background information on heat test on page 4. Enlisting a parent volunteer to help with this learning experience will help with safety management. Setting up a “heat station” that is monitored by an adult or completing this learning experience as a teacher demonstration may be more appropriate for some classrooms.

Basic Skills Development:

Discussing

Measuring

Observing

Describing

Writing

What will happen when the powders and crystals are heated?

Students will cut the piece of aluminum foil into 6 (10 cm x 10 cm) squares. Students are to place their candle in the aluminum drip pans. Teachers should light each pairs candle and dispose the match into the match jar. Have students place the amount of powder or crystal that will fit on a flat end of a toothpick into the frying pans made from the 10 cm x 10 cm squares of aluminum foil.

Hold the “frying pan” over the lighted candle with the clothespin until the flame is almost touching the foil for 30 seconds or until no further changes occur. Repeat the procedure until all powders have been tested.

Students should record their observations from the heat test on the activity sheet for Learning Experience #4 in the Powders And Crystals Student Activity Book. As a class, decide what words are the most accurate in describing the reaction of the powders and crystals when they are heated. Record these descriptions in the Heat Test column of the Class Observation Summary Chart.

Discussion Questions:

What did you observe about each substance when it was heated?

What did you observe about each substance after it cooled?

Did any of the substances release a smell when heated? Describe.

Learning Experience 4 continued

Page 2

Caution:

Make sure students wear their safety goggles while performing this learning experience. The aluminum foil “frying pan” must have a flat bottom or the powder or crystal may erupt when heated.

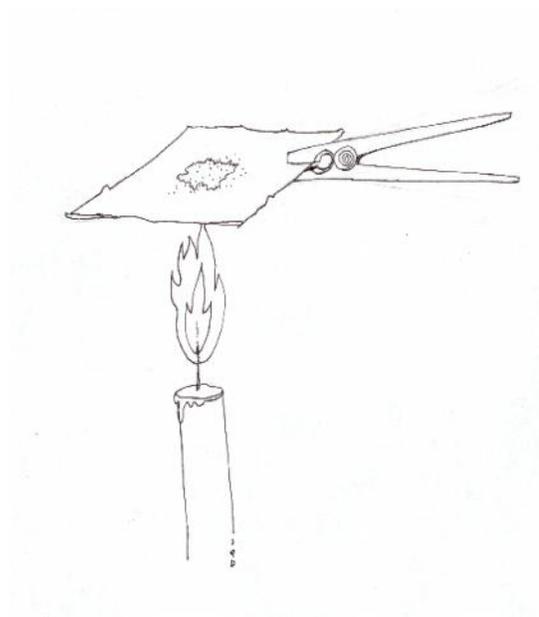
Evaluation Strategy:

Students will describe the reaction heat has on each of the powders or crystals.

Vocabulary:

reaction

What did you learn about the substances from the heat test that you didn't learn from the previous tests?



Learning Experience 5: Water Test

Objective: Students will add water to each of the powders and crystals and describe the results.

Materials:

For each pair of students:

2 Powders And Crystals Student Activity Books

Powders And Crystals Work Mat

6 plastic cups (one of each color containing one leveled teaspoon of the matching substance)

Dropper bottle of water

Toothpicks

Cardboard tray

2 pairs of Safety Goggles

Paper towels*

Water*

For the class:

6 containers of the powders and crystals

*provided by teacher

Preparation:

Read background information about the water test on page 3. Demonstrate for students what one drop of water looks like so they are not adding too much water to each substance. Be sure to hold to dropper bottle upright.

Basic Skills Development:

Observing Measuring

Writing Collecting

Discussing

Describing

Evaluation Strategy:

Students will observe and record the results of mixing water with the powders and crystals.

Vocabulary:

mixture suspension

solution dissolve

How do the powders and crystals change when mixed with water?

Students should pick up the materials needed and proceed with the water test as follows: Students should add a total of approximately 30 drops of water to each powder or crystal in the plastic cups, being sure to hold the dropper bottle upright. Students should add 5 drops of water at a time then stir with a toothpick and observe. Continue this procedure up to 30 drops. Students may place some of the substance on the black area of the Work Mat to further examine the results of the water test. Using their senses (sight, touch, and smell), students should observe the results of mixing water with the powders and crystals.

Students should record their observations of the water test on the activity sheet for Learning Experience #5 in the Powders And Crystals Student Activity Book. As a class, discuss the observations made from this learning experience and decide what are the most accurate descriptions of the powders and crystals mixed with water and record them in the water test column of the Class Observation Summary Chart.

Discussion Questions:

Which powders or crystals act the same when mixed with water?

Is there a powder or crystal that acts differently than the others?

Was there a powder or crystal that was familiar to you?

Learning Experience 5 continued

Page 2

Extension:

Allow the contents of the plastic cups to dry for 24 hours. Break up and crush hardened contents and repeat the learning experience.

Learning Experience 6: Vinegar Test

Objective: Students will add vinegar to each substance and describe the results.

Materials:

For each pair of students:

2 Powders And Crystals Student Activity

Books

Powders And Crystals Work Mat

6 plastic cups (one of each color containing one leveled teaspoon of the matching substance)

Dropper bottle of vinegar

2 pairs of safety goggles

Toothpicks

Cardboard tray

Paper towels*

For the class:

6 containers of the powders and crystals

*provided by teacher

Preparation:

Read background information on vinegar test on page 3. It is recommended to get new cups for each substance due to the addition of water to the current cups.

Basic Skills Development:

Observing Measuring

Writing Collecting

Discussing

Describing

Caution:

Make sure students wear their safety goggles while performing this learning experience.

Evaluation Strategy:

Students will observe and describe the results of adding vinegar to the powders and crystals.

Vocabulary:

vinegar

What reactions will occur when vinegar is added to each of the powders or crystals?

Students should collect the materials needed and proceed with the vinegar test as follows.

Add 3-5 drops of vinegar to each powder or crystal in the plastic cups and observe. Write observations on the chart on the activity sheet for Learning Experience #6 in the Powders And Crystals Student Activity Book to describe how the vinegar reacts with all the powders and crystals.

Students may use the black area of the Work Mat to further examine the substances of the vinegar test. The powder in the black container (starch) is interesting to pick up with the fingers if mixed to a consistency of "silly putty."

As a class, discuss observations from this test and record the fact that the vinegar bubbles in baking soda on the Class Observation Summary Chart. There is no reaction from the vinegar in any of the other substances.

Discussion Questions:

How did the vinegar react with each unknown? How were the reactions similar? Different?

How were the vinegar test results similar to those of the water test?

Learning Experience 7: Iodine Test

Objective: Students will add iodine to each of the substances and describe the results.

Materials:

For each pair of students:

2 Powders And Crystals Student Activity

Books

Powders And Crystals Work Mat

6 plastic cups (one of each color containing one leveled teaspoon of the matching substance)

Dropper bottle of iodine

2 pairs of safety goggles

Toothpicks

Cardboard tray

Paper towels*

For the class:

6 containers of the powders and crystals

*provided by teacher

Preparation:

Read background Information on the iodine test on page 4.

Basic Skills Development:

Observing Measuring

Writing Collecting

Discussing Describing

Caution:

Make sure students wear their safety goggles while performing this learning experience.

Evaluation Strategy:

Students will observe and describe the results of adding iodine to the powders and crystals.

Vocabulary:

iodine

starch

indicator

What occurs when iodine is added to starch?

Explain to students that iodine reacts in the presence of starch. Students should discover what the reaction is. Students should pick up materials needed and proceed with the iodine test as follows: Add 3-5 drops of iodine to each powder or crystal in the plastic cups and observe. Encourage students to observe the color of the iodine when it leaves the dropper bottle. Students are looking for the iodine to turn purple/black in the presence of starch. This is the one test that students may figure out one of the mystery substances. Starch in the black cup is the only substance that reacts with iodine.

Students should record the iodine test observations on the activity sheet for Learning Experience #7 in the Powders And Crystals Student Activity Book. As a class, discuss observations from this test and record the fact that iodine turns blue/black in starch in the iodine test column on the Class Observation Summary Chart. There is no reaction from the iodine in any of the other substances.

Extension:

Students may accidentally drop iodine on a piece of paper in their work area. They may observe that where the iodine is dropped on the paper it turns blue - black. If students miss this observation, call their attention to it. What

Learning Experience 7 continued

Page 2

other types of paper turn the indicator blue/black? Try a tissue or a dollar bill.

Discussion Questions:

What have you learned about the mystery substances from this test?

Have any of the mystery substances acted similar to each other in different tests?



Learning Experience 8: BTB Test

Objective: Student will add BTB to each of the substances and describe the results.

Materials:

For each pair of students:

2 Powders And Crystals Student Activity Books

Powders And Crystals Work Mat

6 plastic cups (one of each color containing one leveled teaspoon of the matching substance)

Dropper bottle of BTB

2 pairs of safety goggles

Toothpicks

Cardboard tray

Paper towels*

For the class:

6 containers of the powders and crystals

Detergent, milk, soda pop*

*provided by teacher

Preparation:

Read background information on the BTB indicator and acids and bases on page 4. Discussion of what acids and bases are may be necessary for this learning experience.

Basic Skills Development:

Discussing Measuring

Observing Collecting

Writing Describing

Evaluation Strategy:

Students will test the substance with BTB to determine if it is an acid or a base.

Caution:

Make sure students wear their safety goggles while performing this learning experience.

Vocabulary:

BTB acid

base indicator

What will occur when the powders and crystals are tested with BTB?

Explain to the students that BTB reacts with substances to show the presence of acids and bases. If the indicator turns yellow, it shows the presence of a strong acid. Light green shows the presence of a weak acid. If the indicator stays blue, it shows a basic solution. A response of "no reaction" is appropriate when the indicator stays blue. Students should collect materials needed and proceed with the BTB test as follows: Add a few drops of BTB to each powder or crystal in the plastic cups and observe. Students should record test observations on the activity sheet for Learning Experience #8 in the Powders And Crystal Student Activity Book. As a class, discuss observations from this test and record observations on the Class Observation Summary Chart in the BTB test column. BTB turns yellow in the black and blue cups and light green in the yellow cup. There is "no reaction" from BTB in the other substances.

Extension:

Students may wish to test other common household substances such as detergent, milk, and soda pop to see if they are an acid or a base.

Discussion Questions:

What do you know now about the mystery substances that you did not know before testing?
In what way are they similar? Different?
Do you have any thoughts as to what the mystery substances are?

Learning Experience 9: Classifying Powders And Crystals

Objective: Students will observe the properties of various powders and crystals and classify them into different groups based on common properties.

Materials:

For each pair of students:

2 Powders And Crystals Student Activity Books

Colored pencils (one for each color of the powders & crystals)*

For the class:

Chart paper*

Felt tip markers*

*provided by teacher

Preparation:

Remind students that they should identify a property/characteristic that is common to all the powder/crystals they put in that group. The property/characteristic for group two does not have to be the opposite property of group one. Students can use the word "not" in their descriptions. (e.g. red and not red) Lastly, each new group property/characteristic should be different from the previous group's property/characteristics.

Basic Skills Development:

Brainstorming

Classifying

Interpreting Data

Describing

Evaluation Strategy:

Students will accurately group the powders and crystals by common properties.

Vocabulary:

properties

classify

What properties do the powders and crystals have in common?

Brainstorm with students a list of properties or characteristics that could be used to describe these mystery substances. (Properties or characteristics could include color, color they turn when an indicator is added to it, texture, appearance under the pocketscope, etc.)

Once students have brainstormed a class list, they can use the properties/characteristics on this list to classify the powders and crystals into groups. They can use their Class Observation Summary Chart, as well as their experiences with the powders and crystals to complete the activity sheet for Learning Experience #9 in the Powders And Crystals Student Activity Book.

On their activity sheet for each group, they are to write the property/characteristic that they are grouping the substances by then coloring in the circles of the appropriate color powder and crystal that fits into that group. Students should create four different classifications of the powders and crystals.

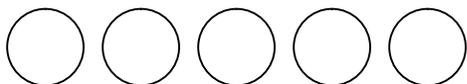
Learning Experience 9 continued

Page 2

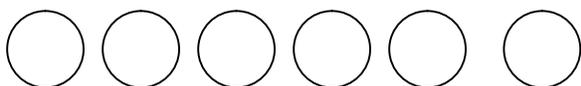
For example:

Property:

Group 1 Powder under pocketscope



Group 2 Crystals visible under pocketscope



Discuss with students the results of their classifications.

Discussion Questions:

Are there any powders/crystals that are very similar to one another based on their properties? Explain.

Did you find any powders or crystals that were difficult to place in a group with another substance because it was so different? Explain.

Did you find any powder or crystal that fit into many groups? Explain.

Learning Experience 10: Mystery Powders and Crystals

Objective: Students will compare tests on known substances to the tests on unknown substances in order to identify the unknown substances.

Materials:

For each pair of students:

2 Powders And Crystals Student Activity

Books

Powders And Crystals Work Mat

4 clear plastic cups

Dropper bottle water

Dropper bottle vinegar

Dropper bottle iodine w/eyedroppers

Pocketscope

2 pairs of safety goggles

Toothpicks

Double lens magnifier

Paper towels*

*provided by teacher

For the class:

Clothespins

Aluminum foil

Candles

Matches

Match jar

Aluminum drip pan for candles

6 containers of the powders and crystals

Preparation:

This learning experience may take several days to complete due to the testing of the various substances from home. Students have speculated as to what the powders and crystals are. This learning experience is designed to settle all speculating and teach a basic scientific method for identifying an unknown substance. A letter may need to go home to parents explaining the learning experience and what the

How does a scientist identify an unknown substance?

Discussion Questions:

What do you think the powders are?

How could we find out?

Session 1:

Brainstorm with the students what they think the powders and crystals are. Explain that a scientist usually has or develops a procedure or method for solving a problem. A scientist uses skills such as observing and collecting data to find an answer or a conclusion. The way a scientist puts all this together is called the scientific method. The scientific method consists of coming up with a hypothesis, writing a procedure to test the hypothesis, testing the hypothesis, and coming to a conclusion based on the testing. Lead your class in using the scientific method to identify the mystery of powders and crystals.

Students or teacher should bring in the materials needed to complete their own investigations on finding out what the names of the mystery powders and/or crystals are by comparing them with the known powders from home.

Session 2:

Now that the students have brought in their materials, they can begin to test the substances they brought from home. Each student from the team of two are to place one leveled teaspoon of their

Learning Experience 10 continued

Page 2

students need to bring in. If there are students that forget their substance, you may want to have samples of the uncommon substances, like citric acid or starch, for these students to test. Students could be assigned to bring in specific substances and they can test the substances that they brought in. Teams can then share their results with the other teams. Another way of completing this learning experience is to assign students substances that they are responsible to bring in and share some of their substance with the other teams. By doing this, each team is testing all the substances again. Distribution of plastic cups would then change from 4 to 8 per team of two.

Safety:

A heat test station will need to be developed so that students are conducting this test under controlled conditions. Students can then rotate through the station to test their substances. Be sure students bring their goggles to the heat station.

Basic Skills Development:

Observing Describing
Brainstorming Making Decisions
Discussing Interpreting Data

Evaluation Strategy:

Students will use a scientific method and analyze their data to identify their mystery substances.

Vocabulary:

scientific method
hypothesis

substance in two of the four plastic cups. As they complete their tests, they are to record their results on the activity sheet for Learning Experience #10 in the Powders And Crystals Student Activity Book. Ask students to compare the results from the substances brought from home and their Class Observation Summary Chart to try to find a match in results. When they find a close match, they can answer the two questions at the bottom of the activity sheet.

Each team can share their results and a class discussion should then follow as to what each of the mystery powders and crystals are.

Once a discussion of results has come to a close and the class has come to a consensus as to what each powder or crystal is, students should then label each cup on their Class Observation Summary Chart with the name of the powder or crystal.

Discussion Questions:

What are each of the mystery powders and crystals?

What was the deciding factor in identifying the powders and crystals?
Did you feel like a scientist during this learning experience? Why or why not?



Learning Experience 11: Super Sleuth

Objective: Students will use a variety of tests to identify the composition of a mixture.

Materials:

For each pair of students:

2 Powders And Crystals Student Activity Books
2 Powders And Crystals Work Mat
2 clear plastic cups (each containing one leveled teaspoon of the mixture the team has been assigned to test)
Pocketscope
Double lens magnifier
2 pairs of safety goggles
Dropper bottle water
Dropper bottle BTB
Dropper bottle vinegar
Dropper bottle iodine w/eyedroppers
Toothpicks
Cardboard tray
Paper towels*

*provided by teacher

For the class:

Clothespin
Containers A, B, and C
Candles
Aluminum drip pan for candle
Matches
Match jar
Aluminum foil

Preparation:

The substances that are in each mixture are listed on page 5.

Safety:

A heat test station may need to be developed so students are conducting this test under controlled conditions. Students can then rotate through the

What is the composition of substances in each of the containers?

This learning experience has students pretending they are chemists. The police have found three bags of white powders and crystals. The containers labeled A, B, and C are samples from the three bags. As chemists, students are to identify the composition of each container.

One-third of the class should investigate the contents of container A. Another third of the class should investigate the contents of container B, while the remaining third of the class should investigate the contents of container C. Students can record their results on the activity for Learning Experience #11 in the Powders And Crystals Student Activity Book.

Students should use all the tests they have learned to identify what makes up the composition of the substances in Container A, B, or C. The students that tested the same mixture can get together and discuss their findings. They are to come to a decision as to what is in the containers and why they came up with this decision and then share their information with the class. Students can then record the information about the rest of the mixtures on the chart. You may want teams to test each mixture and find the results. Six plastic cups, instead of two would need to be given out to the teams.

Learning Experience 11 continued

Page 2

heat station to test their mixture. Be sure students bring their goggles to the heat station.

Basic Skills Development:

Observing	Interpreting Data
Discussing	Making Decisions
Writing	Describing

Evaluation Strategy:

Students will recognize the contents of Containers A, B, and C as mixtures and correctly identify the composition of each mixture using the indicators.

Vocabulary:

composition
mixture

Discussion Questions:

What test was the deciding factor in figuring out what was in the mystery mixture?

What test helped you the least? Why?

Can you think of any other powder or crystal you would like to test using these various indicators?



Powders and Crystals Review

Name _____

1. A _____ is a solid shape which is formed in a repeated pattern.
2. A _____ is a mass of fine, loose particles formed from crushing or grinding a solid substance.
3. We used our senses of _____, _____, and _____ to learn about some of the _____ of the powders and crystals.
4. _____ are characteristics or qualities of a material. Examples of properties are: _____, _____, _____, and _____.
5. The _____ has a lens that can be focused to magnify matter, so it is a kind of microscope.
6. When a substance dissolves in a liquid, a _____ is made. The liquid is the _____. The substance that dissolves is called the _____.
7. The pH scale measures how acidic or basic a substance is. A low number on the scale means the substance is an _____. For example: _____ or _____.
8. A high number on the pH scale means the substance is a _____. _____ and _____ are examples of bases.
9. When a _____ reaction occurs, atoms rearrange and a new substance is formed. Vinegar (an acid) mixed with baking soda (a base) forms a _____ and the gas _____.
10. When two or more substances are combined but do not form a new substance, (like stirring sand into water), a _____ is formed. A mixture can be separated into its original parts. A _____ is a kind of mixture.
11. A chemical reaction occurs when iodine is dropped on a _____. There is starch in _____, _____ and _____.
12. BTB chemically reacts with _____ by turning green or yellow.

13. We performed 5 tests (or experiments) on powders and crystals to find their properties. When there is a good question to be answered by testing, we often follow the steps of the scientific method. These are the steps of the scientific method:

- a. First, we make a _____, (or an educated guess), about what will happen in the experiment.
- b. Then we design and conduct fair tests, (_____).
- c. After each part of the experiment, we record our data to study our _____.
- d. Last, we retest to be sure of our results and make a _____.

14. When experimenting with powders and crystals we followed these safety precautions:

- a. Wear _____ when using chemicals, especially when _____ chemicals.
- b. Don't wear _____ safety goggles.
- c. Don't return chemicals to their original containers. They may _____.
- d. Keep your hands, clothing, and _____ away from any flame.
- e. Never use your sense of _____ to test chemicals.
- f. Chemicals that harden, like _____ of _____, should go in a trash container, NOT DOWN THE SINK DRAIN.
- g. Wash your _____ after touching chemicals.

Powders and Crystals Review Key

1. A **crystal** is a solid shape which is formed in a repeated pattern.
2. A **powder** is a mass of fine, loose particles formed from crushing or grinding a solid substance.
3. We used our senses of **sight**, **smell**, and **touch** to learn about some of the **properties** of the powders and crystals.
4. **Properties** are characteristics or qualities of a material. Examples of properties are: **color**, **density**, **hardness**, **solubility** and **pH level**,
5. The **pocketscope** has a lens that can be focused to magnify matter, so it is a kind of microscope.
6. When a substance dissolves in a liquid, a **solution** is made. The liquid is the **solvent**. The substance that dissolves is called the **solute**.
7. The pH scale measures how acidic or basic a substance is. A low number on the scale means the substance is an **acid**. For example: **vinegar** or **lemon juice**.
8. A high number on the pH scale means the substance is a **base**. **Soap** and **coffee** are examples of bases.
9. When a **chemical** reaction occurs, atoms rearrange and a new substance is formed. Vinegar (an acid) mixed with baking soda (a base) forms a **salt** and the gas **carbon dioxide**.
10. When two or more substances are combined but do not form a new substance, (like stirring sand into water), a **mixture** is formed. A mixture can be separated into its original parts. A **suspension** is a kind of mixture.
11. A chemical reaction occurs when iodine is dropped on a **starch**. There is starch in **potatoes, rice, cornstarch, and flour**.
12. BTB chemically reacts with **acids** by turning green or yellow.

13. We performed 5 tests (or experiments) on powders and crystals to find their properties. When there is a good question to be answered by testing, we often follow the steps of the scientific method. These are the steps of the scientific method:

- a. First, we make a **hypothesis**, (or an educated guess), about what will happen in the experiment.
- b. Then we design and conduct fair tests, (**experiments**).
- c. After each part of the experiment, we record our data to study our **results**.
- d. Last, we retest to be sure of our results and make a **conclusion**.

14. When experimented with powders and crystals we followed these safety precautions:

- a. Wear **safety goggles** when using chemicals, especially when **heating** chemicals.
- b. Don't wear **someone else's** safety goggles.
- c. Don't return chemicals to their original containers. They may be **contaminated**.
- d. Keep your hands, clothing, and **hair** away from any flame.
- e. Never use your sense of **taste** to test chemicals.
- f. Chemicals that harden, like **plaster** of **Paris**, should go in a trash container, NOT DOWN THE SINK DRAIN.
- g. Wash your **hands** after touching chemicals.

Name: _____

Date: _____

Powders And Crystals Student Assessment

Directions: Read the question carefully and answer based on your knowledge about powders and crystals. Use a word from the word bank to fill in the blank. Use words only once.

starch	mixture	properties	solution
microscope	acids	powders	baking soda
base	crystal	iodine	salt
solvent	carbon dioxide		

- 1.) Iodine turns purple/black in the presence of _____.
- 2.) An acid reacts with a _____ to form salt.
- 3.) When vinegar is put with baking soda, _____ and salt are formed.
- 4.) When you mix water with salt, the water becomes the _____ in the solution.
- 5.) _____ can be used to identify the starch in a potato.
- 6.) A liquid or mixture formed by dissolving two substances is a _____.
- 7.) BTB is a chemical indicator that will change colors when _____ are identified.
- 8.) A pocketscope is a small _____ that we can use in the classroom.
- 9.) A chemical reaction occurs when vinegar is added to _____.
- 10.) _____ are loose particles that are obtained by grinding or crushing a solid substance.
- 11.) Characteristics or qualities of something are called _____.
- 12.) Two substances put together that are not chemically combined form a _____.
- 13.) What is the solute in saltwater? _____

14.) Explain three safety rules we used to protect ourselves during the Powders and Crystals unit.

1.) _____

2.) _____

3.) _____

15.) We used the Scientific Method to conduct our experiments on unknown powders and crystals. Number the steps below starting with 1 (what we did first) in the Scientific Method that we used.

_____ Conclusion

_____ Hypothesis

_____ Results

_____ Experiment

16.) List at least four properties a scientist might use to classify unknown objects or substances.

1.) _____

2.) _____

3.) _____

4.) _____

Powders And Crystals Student Assessment Key

1. starch
2. base
3. carbon dioxide
4. solvent
5. iodine
6. solution
7. acids
8. microscope
9. baking soda
10. powders
11. properties
12. mixture
13. salt
14. 1-3. Answers should include information from the initial safety discussion in the student activity manual.
15.
 1. Hypothesis
 2. Experiment
 3. Results
 4. Conclusion
16. 1-4: Answers will vary

MORE IDEAS

Language Arts

- ◆ Read Two Bad Ants by Chris Van Allsburg. This story is about two ants and their search for sugar crystals.
- ◆ Read Strega Nona's Magic Lessons by Tomie DePaola. Strega heats potions to make them work as they should.
- ◆ Write a class mystery story. Students can sit in a circle, write a line or two to start the story on chart paper. Roll a ball to a student to write the next line or two. Continue on until the story is finished.
- ◆ Read a great mystery story aloud and discuss the author's writing style. Have each student write his or her own mystery story.
- ◆ Invite another professional whose nature of their work relates to problem solving (detective, mystery writer, engineer, another teacher, etc.). Write letters home to parents asking if they would be willing to share the problem solving experiences they encounter in their job.
- ◆ Write riddles about the powders and crystals based on test results (I turn black with heat but turn blue in iodine. What am I?). Students could write riddles and then exchange them with a partner, and they can solve them.

Social Studies

- ◆ Research the work of Roger Bacon. Discuss how his work helped in the discovery of crystals that make up solids. (He created the first lens out of quartz. His idea was to eventually be used in microscopes, telescopes, etc.)
- ◆ Research the geographic location of diamonds.

Art

- ◆ Create a winter scene. Cut shapes for the picture out of construction paper and paste them on a dark piece of paper. Mix 250 mL of Epsom salt or alum with 125 mL of water. Brush the solution over the picture and let the pictures dry. Students should observe crystals appear over their winter scene.
- ◆ Design and draw safety posters to remind students of the importance of safety rules while using chemicals (ex. picture of a student using safety goggles).

Math

- ◆ Collect geometric shapes (cubs, prisms, cylinders, pyramids, cones) and sort them by attributes. Discuss how they are similar or different than the crystals they observed in the pocketscope.
- ◆ Geometric shapes can be drawn from observations of crystals.

Science

- ◆ Use litmus paper to test the acidity of household items such as soda, orange juice, milk, etc.
- ◆ Have students bring in a variety of foods such as crackers, flour, powdered milk, bread, lettuce, vinegar, orange juice, salad dressing, etc. Have students test these substances for starch and/or acidity using iodine and BTB.
- ◆ Have students prepare a “special mix” with two different powders. They can exchange their mixtures with other students that can then test them using the indicators they have worked with.
- ◆ Bring in packets of Alka-Seltzer. Read the labels on the package. Test a tablet with a few drops of water and a few drops of BTB. Have students mix one spoonful of red powder in the red container with one spoonful of the powder in the blue container. Test the mixture using BTB and water.
- ◆ Grow crystals.
 - A. Put a drop of iodine on a microscope slide and spread it out with a toothpick. Allow to dry. Observe under a microscope or use a microprojector. Have a student breathe on the slide and observe what happens to the crystals. (cube shaped)
 - B. Boil 1 spoonful of water with 2 spoonfuls of salt in it. Place one drop of the hot solution on a cool slide. The crystals should begin to grow almost at once. Observe under a microscope or use a microprojector. (cubed shaped)
 - C. Boil 1 spoonful of water with 2 spoonfuls of Epsom salts in it. Spread one drop of the solution on a slide. Allow to dry. Observe under a microscope. (thick needle like shapes.)
- ◆ Try red cabbage juice as a natural indicator of acids and bases.

INQUIRY AND PROCESS SKILLS

Classifying	Arranging or distributing objects, events, or information in classes according to some method or system.
Communication	Giving oral and written explanations or graphic representations of observations.
Creating Models	Displaying information by means of graphic illustrations or other multi-sensory representations.
Formulating Hypothesis	Constructing a proposition or assumption of what is thought likely to be true based on reasoning, which serves as a tentative testable theory.
Gathering & Organizing	Collecting information about objects and events which show a specific situation.
Generalizing	Drawing general conclusions from information.
Identifying Variables	Recognizing the characteristics of objects or events which are constant or change under different conditions.
Inferring	Making a statement or conclusion based on reasoning or prior experience to explain an observation.
Interpreting Data	Analyzing information that has been collected and organized by describing apparent patterns or relationships in the information.
Making Decisions	Choosing an alternative from among several and basing the judgment on defensible reasons.
Manipulating Materials	Handling or treating materials, equipment or procedures skillfully and effectively.
Measuring	Making quantitative observations by comparing to a standard.
Observing	Becoming aware of an object or even by using any of the senses to identify properties.
Predicting	Making a forecast or estimate of what future events or conditions may occur.

GLOSSARY

Acid:	an acid is any compound that can react with a base to form a salt. In a water solution, an acid tastes sour.
Baking Soda:	sodium bicarbonate is a substance used as a leavening agent and as an antacid.
Base:	a base is a substance which forms a salt when it reacts with an acid.
BTB:	BTB (Bromothymol blue) is a harmless chemical (acid -base) indicator. It turns green in a weak acid and yellow in a strong acid. It remains blue in a base. It will also turn from yellow to blue in a base. The pH range of BTB is limited to 6.0 -7.6. A pH reading of 7.0 is considered neutral. The complete range of pH is from 0.0 (very acid) to 14.0 (very base)
Citric Acid:	citric acid is obtained from oranges, lemons, and similar fruits used in making flavoring, extracts, dyes, etc. It is slightly corrosive and will cause stomach upset if ingested.
Classify:	to arrange or organize into categories.
Composition:	the act of combining parts to form a whole.
Conserve:	to keep from loss or work.
Contamination:	to make impure by contact or mixture.
Crystal:	a crystal is a solidified form of a substance in which the atoms or molecules are arranged in a definite pattern that is repeated regularly in three dimensions.
Dispose:	to throw away after use.
Dissolve:	to make a solution by mixing with a liquid to disappear gradually.
Hypothesis:	an educated guess based on established facts.
Indicator:	an indicator is any of various substance used to show the acidity or alkalinity of a solution and the presence of certain substances by changes of color.
Iodine:	iodine is a chemical element used as an antiseptic. It is used to test a substance for starch. A change to a blue-black color is a positive test. Iodine is poisonous, corrosive, and certain solutions may be flammable.
Magnify:	to increase the size of an object, as with a lens.

Microscope:	an instrument for magnifying objects too small to be seen by the naked eye.
Mixture:	a combination of two or more kinds of matter mixed together that can be separated by physical means.
Plaster of Paris:	Plaster of Paris is a white, powdery calcium sulfate (CaSO_4). When mixed with water, plaster of Paris forms a thick paste that sets quickly. It is used for casts, molding, etc. Severe stomach upsets may result if ingested. Do not dispose of plaster of Paris in a sink or other plumbing fixture.
Powder:	a mass of fine, loose particles obtained by crushing or grinding a solid substance.
Properties:	quality or characteristic of something.
Reaction:	a chemical reaction is a mutual action of substances undergoing chemical change to form a new substance.
Salt:	salt is a crystalline compound that is the chloride of sodium, abundant in nature, and used for seasoning or preserving food.
Scientific Method:	a procedure for solving a problem that involves coming up with a hypothesis, writing a procedure for testing, then coming to a conclusion based on the testing.
Senses:	the senses are the five faculties of receiving impressions through specific body organs and the nerves associated with them (sight, touch, taste, smell, and hearing).
Solution:	a homogeneous mixture of two substances.
Solidify:	to make or become hard or solid.
Specimen:	a sample used for testing.
Starch:	starch is a white, tasteless, odorless food substance found in potatoes, rice, wheat, etc. It can be identified with the use of iodine. Uncooked starch can cause indigestion when eaten.
Suspension:	a heterogeneous mixture in which particles of a substance are mixed temporarily with a liquid.
Texture:	texture is the arrangement of particles of any material as it affects the appearance or feel of the surface.
Transmitter:	a device for sending signals or messages.
Vinegar:	vinegar is a sour liquid with a sharp odor, containing acetic acid, made by fermenting dilute alcoholic liquids such as cider. Vinegar can cause indigestion.

TEACHER REFERENCES

Jennings, Terry. Everyday Chemicals. Chicago: Children's Press, 1989.

Johnson, Mary. Chemistry Experiments. London: Usborne Publishing, 1981

Mibane, Robert C., and Thomas R. Rybolt. Adventures with Atoms and Molecules. Hillside, NJ: Enslow Publishers, 1987

Robinson, Marlene, The Crystal Kit. Philadelphia Running Press, 1988

Van Cleave, Janice Pratt. Chemistry for Every Kid. New York: John Wiley and Sons, Inc. 1989

Media Library

Call the media library to order media materials and to check on new materials that are available. The number to be reached is (716) 376-8212.

Web Sites:

<http://www.chemistry.about.com>

<http://www.miamisci.org> (pH factor)

<http://www.chem4kids.com/reactions/acidbase.html>

<http://www.unmuseum.mus.pa.us/crystals.htm>

Major Science Concepts To Be Addressed:

Objects and events have distinctive properties.

The properties of an object are dependent upon its material and condition.

Different kinds of materials have different properties.

A kind of material may be divided into smaller parts or changed in shape without changing the properties of the materials.

Under particular conditions, most materials are solid, liquid, or gas.

An object that is composed of two or more different materials that have been mixed may have some properties like each of the original materials and some new properties.

The properties of an event are determined by objects, space, and time.

An event takes time to occur.

Energy and material have forms and properties.

Objects have properties of a material are determined by its form.

The shape of the material can affect properties of a material.

Properties of a material can be affected by the phase of the material (solid, liquid, or gas).

Properties of a material can be affected by the size of solid particles contained within the material.

For example:

Texture or feel

Compactness of a material containing uniform sized particles compared to a mixture of mixed sizes of particles.

Within systems the interactions of materials and energy change their forms and properties. A group of interacting objects is called a system.

Energy in a particular form can be transferred from one object to another in a system.

For example:

Heat can be transferred from one object to another

When energy interacts with objects in a system, the properties of the objects may be changed.

For example:

The heating of an object such as water (ice) can change the water's phase from liquid to gas.

Chemical reactions such as a burning candle, vinegar, and baking soda reaction, or boiling an egg, many change properties of materials.

Energy may exist within a material or in the position or motion of objects.

Energy within the materials of objects may be transferred through them.

The interaction of materials may produce new materials and energy may be absorbed or given off.

Some interactions, which give off energy, may require some energy to start the interaction, others start with no energy being added.

For example:

Gas produced by vinegar and baking soda interaction

Some interactions, which give off energy may require some energy to start the interaction, others start with no energy being added.

For example:

Lighting a candle requires energy to be added.

Energy may be given off when new materials are being produced.

Energy may be absorbed from the surroundings when new materials are being produced.