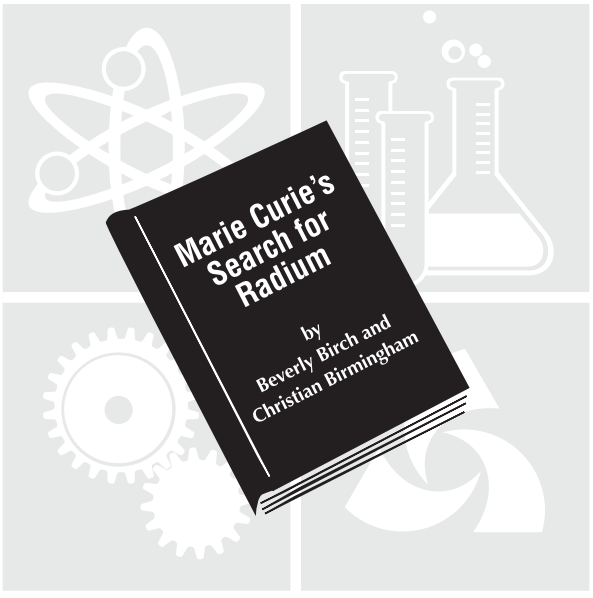
Grade

5

Strategic Science Teaching



Title of Lesson:

Unlocking Mysteries

Essential Question:

What are physical and chemical properties of some common elements?

Conceptual Statement:

Elements and their compounds account for all the varied types of matter in the world. These elements are organized in the periodic table based on their chemical and physical properties.

Conceptual Learning Sequence:

This lesson is part of conceptual unit on matter. It is appropriate after students understand that matter occurs in three states, is made of smaller particles (atoms), and has observable physical and chemical properties.

Student Outcomes:

- Students learn that matter can be identified by its properties, and that the periodic table organizes elements based on their properties.
- Students select appropriate tools and tests to observe and identify properties of common elements.
- Students use "Guided Reading" to connect the information in the literature selection to their own scientific investigation.

Lesson Overview:

In this lesson students separate a mixture of sand, iron, copper, and aluminum into the different materials, and investigate the properties of those materials. Students identify which materials are elements identified on the periodic table and which are not. Students explore by reading the process used by a scientist to identify properties of an unknown, and to purify small amounts of an element present in a mixture. Students use tools and tests to identify properties of an unknown material.

English Language Learning:

English Language Development standards are referenced in the lesson where appropriate. The hand icon appears throughout the lesson when learning strategies and lesson components are identified as pathways for academic success and reflect critical developmental differences for students who are English learners.

Literature in the Science Learning Cycle:

The book *Marie Curie's Search for Radium* is used with "Guided Reading" in the second EXPLORE stage. The literature connects the student's experience with separating a mixture to that of a scientist.

Learning Strategy:

"Guided Reading" combines reading and teacher questions to help students apply their cognitive skills of predicting and confirming text information. The strategy guides students to connect text information with scientific investigation. (See Appendix pages 164-166.)

Literature Selection:

Title: *Marie Curie's Search for Radium*

Author: Beverly Birch and Christian Birmingham

Publisher: Barron's Publishers, 1996 ISBN: 0812097912

Annotation: The story of how Madame Curie's persistence and determination proved the existence of radium.

Genre: Biography

California Science Content Standards:*

Science: Grade 5, Physical Science

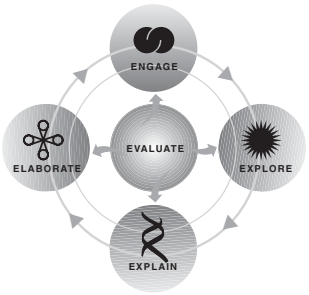
1. Elements and their compounds account for all the varied types of matter in the world. As a basis for understanding this concept:
   c. Students know metals have some properties in common, such as high electrical and thermal conductivity. Some metals, such as aluminum (Al), iron (Fe), nickel (Ni), copper (Cu), silver (Ag) and gold (Au), are pure elements; others, such as steel and brass, are composed of a combination of elemental metals.
   f. Students know differences in chemical and physical properties of substances are used to separate mixtures and identify compounds.

6. Investigation & Experimentation

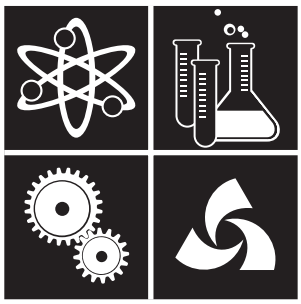
Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations and conduct tests.

*Selected standards addressed within this lesson.

Lesson at  a Glance

Science Learning Cycle	Objective Science Thinking Process	Suggested Time
ENGAGE	Students engage in observing properties of a metal and locate it in the periodic table. Observing, Comparing, Communicating	45 minutes
EXPLORE #1	Students explore and separate a mixture of compounds and elements, and record properties on a data table. Observing, Comparing, Ordering, Communicating	45 minutes
EXPLAIN #1	Students explain information from the data table to locate placement of elements in the periodic table. Communicating, Comparing, Ordering	30 minutes
EXPLORE #2	Students, guided by the teacher, explore the literature selection to understand the author's intention. Communicating, Relating	60 minutes
EXPLAIN #2	Students explain connections between their investigation and the literature selection. Communicating, Relating	30 minutes
ELABORATE	Students apply skills and knowledge learned in this lesson to a new material (magnetite) and record their data. Observing, Comparing, Ordering, Communicating, Inferring	30 minutes
EVALUATE	Students evaluate their understanding by comparing the processes they used to those used by Madame Curie. Teacher evaluates student understanding of student outcomes in this activity as well throughout the lesson. Relating, Applying	15 minutes



Teacher Background:

All matter is made of atoms, which have definite physical and chemical properties. Each element is made of one kind of element, and the elements are organized in the periodic table according to their chemical properties.

The periodic table groups elements that have similar properties such as the metals, non-metals, and the noble gases. Dimitri Mendeleev, a Russian chemist, discovered the pattern used to create the periodic table.

The relatively small number of elements combine to form the millions of different kinds of materials in the world. These compounds are formed when two or more different atoms join to make a particular substance having its own physical and chemical properties. For example, water (a liquid that puts out fires) is a compound formed from hydrogen (an explosive gas) and oxygen (a gas necessary for fires).

Mixtures consist of several different compounds and/or elements, and can usually be separated by using different physical processes. These processes include sorting by size, solubility, magnetism, or evaporation. For example, sand and salt can be separated by adding water, filtering out the sand, and boiling the water to recover the salt.

Simple tests can be conducted to determine physical properties of elements and compounds. A magnet can be used to determine if a substance has magnetic properties (contains iron, cobalt or nickel). Battery and wires can be used to determine properties of electrical conductivity of a substance. A hammer can test malleability of a substance.

Related California Content Standards

Language Arts Grade 5

Reading Comprehension

- 2.1 Understand how text features make information accessible and usable.
- 2.2 Analyze text that is organized in sequential or chronological order.

English Language Development Standards

- Advanced - Use text features such as format, diagrams, charts, glossaries, indexes, etc., to locate and draw information from text.
- Early Advanced - Identify some significant structural (organizational) patterns in text, such as sequence/chronological order, and cause and effect.

Writing

- Early Intermediate - Follow a model given by the teacher to independently write short paragraphs of at least four sentences.

Groupings: Whole group, groups of 4, Partners

For hands-on activities, mix the EL with the native speakers. For debriefing, include at least two EL with native speakers to form discussion groups.

Materials

Per Class:

1 Piece of scrap iron (palm-size, rectangle preferred)
1 Hammer with a rubber tip
1 Magnet
Balances and other measuring tools
1 D-cell battery, thin copper wire (ends stripped), 1.5-volt light bulb
Large periodic table with pictures of elements
Sand, iron filings, aluminum foil, copper wire for group mixture (see below)

Per Group:

1 Cup of mixture (sand, thin copper wire cut up into small pieces, small pieces of aluminum foil, iron fillings) in a container
1 Magnet (small bar or doughnut)
1 1.5 volt light bulb
1 D-cell battery
2 Pieces of thin copper wire (ends stripped)
1 Piece (6" x6") of 1/4" screening material
Chart paper or butcher paper for sorting placemat
Tray
Magnetite (use as the unknown)
1 Metric ruler

Per Student:

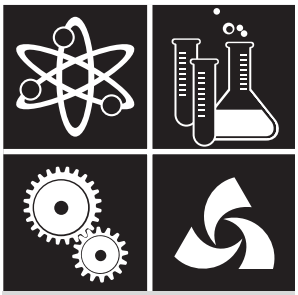
1 Student Page 1.0
Safety goggles
Book: *Marie Curie's Search for Radium*

Advanced Preparation:

1. Combine materials for sorting activity in EXPLORE #1 for each group:
   - Cut up thin copper wire into pieces about 1/2 inch long
   - Cut up aluminum foil into pieces about 1/4 inch square
   - Combine above pieces with a cup of sand
   - Add approximately a teaspoon of iron fillings to mixture
2. Set materials on a tray for each group.
3. Obtain a piece of scrap iron for the teacher demonstration in ENGAGE.

Teacher Resources:

Periodic tables with pictures of common uses of the elements can be obtained from Flinn Scientific, Inc. (www.flinnsci.com) and from Carolina (www.carolina.com).



VOCABULARY

atom – the smallest particle of an element that can exist either alone or in combination

compound – a combination of two or more elements with properties that are different from the elements that make it up

dissolve – the distribution of a small amount of one substance into a larger amount of another such that the molecules of the first substance become evenly distributed among the molecules of the other substance

element – the simplest type of a pure substance that cannot be broken down into simpler substances by common chemical or physical procedures

evaporation – a change in phase from a liquid to a gas or vapor

filtering – a way to separate one size particle from another

magnet – something that attracts iron or other metals such as steel and nickel

mixture – a substance made of two or more substances that could vary in amount and are often easily separated (e.g. sand and water)

molecule – the smallest participle of a substance that retains all its properties. a molecule is composed of two or more atoms combined with each other (e.g., H_2, O_2, H_20)

Periodic Table: – an organizational tool that groups elements according to their chemical properties

Teacher Tips:

- Be sure to have each student wear goggles when handling iron filings. They are sharp and can get into the eyes. You may borrow goggles from a local middle or high school if your school does not have a set. Teachers should also wear goggles during preparation.
- Caution students not to blow the mixture. It can get into student's eyes.
- Conduct this activity as an open-ended, problem-solving experiment.
- Place all materials on a central supply table for each group to access as needed and/or place materials on a tray for each group.
- Prompt students to think of other methods than "picking it out" to sort the materials in the mixture.
- Do not distribute the magnetite with the rest of the group material. Leave it for the "unknown" and do not reveal its identify.
- Before teaching this lesson, review "Guided Reading" in the Appendix for detailed instruction for how to use this strategy.

Common Misconceptions:

Students may think grains of sand or a piece of material is an individual atom of an element.
They may think sand is an element; it is however, a compound made of several elements.

Related Student Resources:

BCIT Chemistry Resource Center Alphabetical Elements: http://nobel.scas.bcit.ca/resource

Chemical Society Visual Elements Periodic Table: http://www.chemsoc.org

De Saulles, Tony. *Chemical Chaos*, Nick Arnold, Scholastic Publishers, 1998.

Garcia, Marie. *La caceria de lo inestable: Marie Curie- The Hunt of the Unstable: Marie Curie*, CONACULTA Publishers, Mexico, 1992.

O'Brien, Patrick. *The Hindenburg*, Henry Holt and Company, New York, New York, 2000.

Parker, Steve. *Marie Curie y el radio - Marie Curie and Radium*, Celeste Publishers, Spain,1992.

Yahooligans website - search for Period Table of Elements and uses.

The Science Learning Cycle:

Unlocking Mysteries

ENGAGE:

1. Hold up a piece of scrap iron and engage students in a discussion about the properties of iron. Record properties on chart paper (e.g. dull, dark, metal-like, brown, heavier than an eraser, smooth, etc.). Remind students they have used their five senses to observe the scrap of iron.

2. Ask students to brainstorm any tools that could be used to make additional observations on the scrap iron. Lead students to identify tools such as magnets, hammers, measuring tools, balances, batteries, wires and bulbs for conductivity, etc.

3. Select several students to help test the scrap iron using these different tools. (e.g., use battery, wires and bulb to observe conductivity). If necessary demonstrate how to use each tool. Have class make observations and add these observations to the class chart.

4. Display a large version of the periodic table and locate iron in the table. Point out the line in the table separating the metals and the non-metals. Explain to students that elements in the table are organized according to their properties. Are there more non-metals than metals in the periodic table? (No)

5. Ask students to look around the classroom and identify items that are metal or non-metal. Ask students if there are more metals or non-metals (Non-metals). Explain to students that we observe more non-metals in our class because these items are combinations of elements from the periodic table and they have completely different properties than the original elements. Many of the things in our room would be difficult to separate into their component elements.

EXPLORE #1:

6. Explain to students they will attempt to separate three different elements that are mixed with sand and determine their properties.

7. Distribute materials to each group. Make available a small hammer, measuring tools, and water.

8. Ask students to design a process to separate materials in the sand mixture and then use their process. Ask students to share how they separated their mixture: what types of materials were separated? What properties did you use for the separation of the materials? Chart responses.

9. Direct the students to Student Page 1.0. Ask students to conduct appropriate tests on each of their separated materials and records results.

EXPLAIN #1:

10. When done, ask students to look at their data table and discuss the following questions: Which samples conducted electricity? Which were magnetic? Which samples were malleable? What other properties did you observe? What do the tests tell you about the properties of the samples? (e.g., aluminum is bendable when thin, conducts electricity, shiny, smooth, is not magnetic; iron is magnetic, conducts electricity, black, non-malleable).

11. Ask students to look at the periodic table and identify if any of the materials from their sorting appear. (Copper, iron, aluminum). What materials are not in the table? (Sand)

12. Hold up a baggie of sand and explain to students that sand is a combination of two elements- silicon and oxygen. Show the pictures of silicon and oxygen on the periodic table. Ask students if sand looks like the two pictures on the periodic table? (No)

13. Explain that none of the methods that we used today would separate sand into its component elements, silicon and oxygen. Scientists have learned that sometimes elements are reasonably easy to separate because they exist in an uncombined state like iron and copper. Sometimes it is more difficult because the elements tend to exist combined with other elements or in such small quantities that extraction is difficult.

14. Explain that we will read a story about a woman scientist, Marie Curie, and her husband Pierre Curie, who worked for years to separate a new element from rock.

EXPLORE #2:

15. Introduce the literatures selection *Marie Curie's Search for Radium* by showing students the front and back cover. This is an opportunity for EL to understand information gathered from features of a book. Chart responses to the following questions. Ask Students:
    - What can we tell they about the book from the cover?
    - What do you expect to read about by looking at the cover?
    - Does the text on the back cover give you any clues?
    - Have you read any books similar to this?

    Before reading the selection, briefly show the pictures in the book. Ask students what additional clues the pictures provide?

16. Using "Guided Reading" begin reading to students as they follow along. Ask the following questions after the first page of reading.
    - What do you think Marie and Pierre are looking at? Do you think it is important? Why or why not?
    - Why do you think all the years of struggle and disappointment were forgotten?
    - Where does the author say the treasure came from?
    - Predict what you think you will find out about the treasure in this book.

    Chart responses.

17. Read the next two pages of text aloud. Ask students to partner to discuss things that surprised them. This is an opportunity for EL to hear text read and participate as appropriate. Conduct a whole group discussion using the following questions. Ask Students:
    - What was difficult for Marie Curie? Why do you think she felt like she was reaching the peak of a mountain after climbing for years?
    - After all that studying what did she read about that was very strange? (X-rays)
    - How were those x-rays similar to the properties we observed in our tests? (You can't see them, but find out they exist by using tools.)
    - Predict what test you think she will try on the samples to get the new element separated.

    Chart responses.

18. Ask students to read to their partner the three pages of text. Check the accuracy of the prediction from previous step. Continue to use "Guided Reading" by asking these questions:
    - What tests did Marie Curie try on the samples she collected? (Pounded, dried, checked for electrical currents, mixed with water, heated, cooled)

    Chart responses.
    - No matter what tests she conducted, what did Marie find out about the samples? (If uranium was present there were stronger rays, less uranium less rays)
    - What did she wonder about after conducting the tests? (If other rocks gave off rays).
    - What would you have named these rays?

19. Have students continue partner reading for the next two pages and find out what she named the rays (radioactive). Ask partners to continue reading the next two pages to find out what was four times more radioactive than uranium. Continue to use "Guided Reading" by asking these questions:
    - How did Marie know it was stronger?
    - Why is Marie so excited about the radioactivity? (She thinks she has discovered a new element)
    - Can we locate this element on the periodic table?

EXPLAIN #2:

20. Read aloud to the whole class the rest of the literature selection. Distribute a piece of blank paper to students and ask them to fold in half. Ask students to draw a picture of the sacks of pitch blend on the left side and on the right side, write notes about the process the Curie's used to separate the pitch blend. This is an opportunity for EL to make connections between cause and effect.

21. On the back of their paper ask students to compare the investigation they conducted with the sand mixture to what Marie Curie did in her experiments. How was it different? Use Student Page 1.0 to scaffold discussion.

22. Ask students to look at their predictions (Step #12) about the story. Discuss with students: Was the book what you expected? How was it the same as what you expected? How was it different? EL can make connections between predictions about the story and the actual story.

ELABORATE:

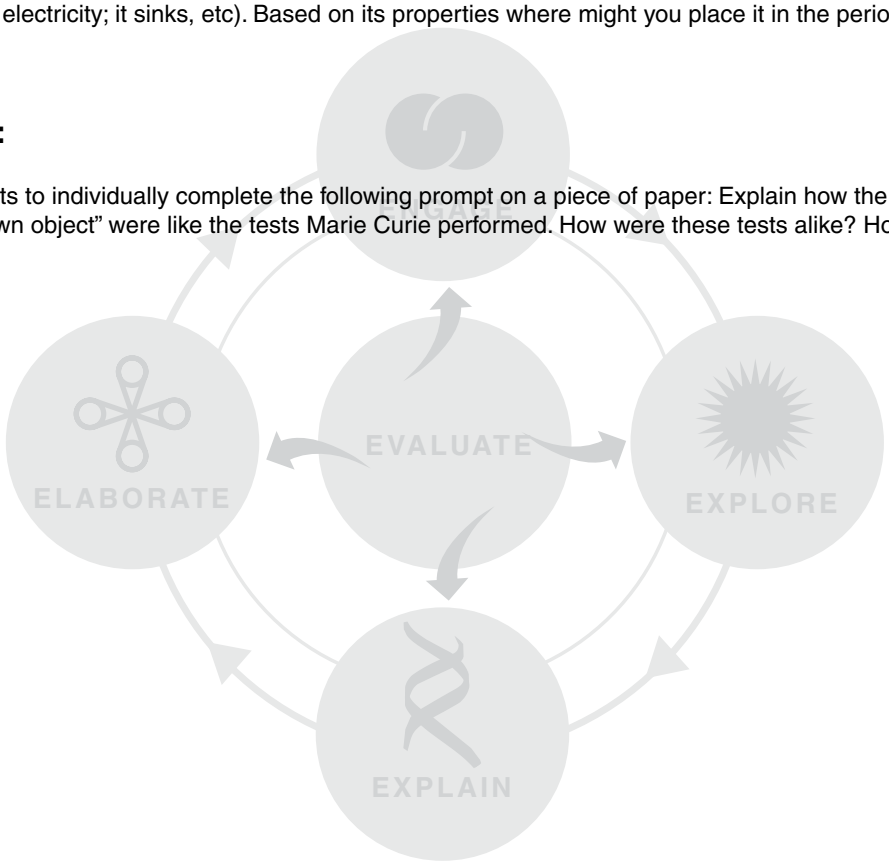
23. Show students the unknown object (magnetite). Explain that this unknown object has not broken down into elements, but contains several elements like the one Marie Curie worked with in her experiments.

24. Ask students what tests they could conduct on this object to determine its properties. Distribute pieces of the "unknown" to each group and ask students to conduct the same tests and record observations on their data chart. (Student Page 1.0)

25. From the tests you were able to conduct, what does your data tell you about the properties of the object? (It is magnetic; it conducts electricity; it sinks, etc). Based on its properties where might you place it in the periodic table: metal or non-metal?

EVALUATE:

26. Ask students to individually complete the following prompt on a piece of paper: Explain how the tests you performed on the "unknown object" were like the tests Marie Curie performed. How were these tests alike? How were these tests different?



Teacher Reflection:

1. How does the student work provide evidence of learning that matter can be described by properties (visible and invisible) and located on the periodic table?
2. What instructional strategies used in this lesson promote student understanding? How do you know?
3. How does the literature selection support student understanding of the science concepts?
4. How would you modify instruction to ensure understanding of student outcomes by all students?

Unknown Object

Student Name: _____ Date: _____

1. Record properties for each material: copper, aluminum, sand, and iron.
2. Record properties for unknown.

Data Table: Properties of Material

Material	Color	Texture	Malleable	Conducts Electricity	Attracted to Magnet	Sifts through 1/4 inch screen	Size	Bendable
Copper								
Aluminum								
Sand								
Iron								
Unknown								