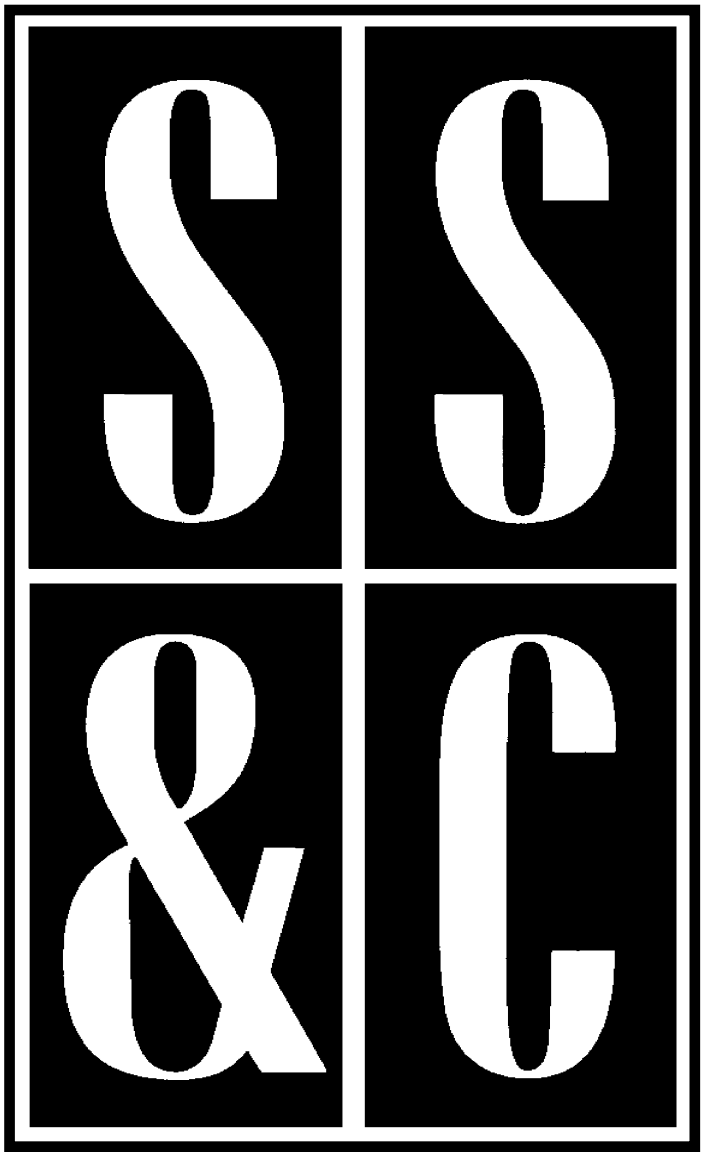
Scope, Sequence & Coordination

A National Curriculum Development and Evaluation Project for High School Science Education



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Scope, Sequence & Coordination

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National Science Education Standard—Physical Science

Structure and Properties of Matter

An element is composed of a single type of atom. When elements are listed in order according to the number of protons (called the atomic number), repeating patterns of physical and chemical properties identify families of elements with similar properties. This "Periodic Table" is a consequence of the repeating pattern of outermost electrons and their permitted energies.

Chemical Reactions

Chemical reactions occur all arround us, for example in health care, cooking, cosmetics, and automobiles. Complex chemical reactions involving carbon-based molecules take place constantly in every cell in our bodies.

Teacher Materials

Learning Sequence Item:

964

Models of Chemical Families

March 1996
Adapted by: Sandra McCann, Ghassem Mozaffari and Dorothy Gabel

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Structure and Properties of Matter. (a) Students should develop a model to help explain observed properties of families of elements. "Black box" activities can provide experiences in constructing models and testing them. (*Chemistry, A Framework for High School Science Education, p. 54.)*

Chemical Reactions. (b) Students use word equations to represent chemical reactions. Given galanced formula equations, students should use ball and stick models to show how atoms (but not molecules) are conserved when chemical reactions occur. (*Chemistry, A Framework for High School Science Education, p. 64.)*

Contents

This micro-unit was created by **Sandra McCann** (Northside H.S., Pinetown, N.C.),
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964
Learning Sequence

Structure and Properties of Matter. (a) Students should develop a model to help explain observed properties of families of elements. "Black box" activities can provide experiences in constructing models and testing them. (*Chemistry, A Framework for High School Science Education, p. 54.)*

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Science as Inquiry	Science and Technology	Science in Personal and Social Perspectives	History and Nature of Science
Believing Without Seeing **Activity 1** Solving the Mystery **Activity 2** Opening the Box **Assessment 1**			The Elephant Problem **Assessment 2**

Suggested Sequence of Events*

Event #1

Lab Activity

1. Believing Without Seeing (30 minutes)

Alternative or Additional Activities

2. Solving the Mystery (20 minutes)

Event #2

Readings from Inquiry, Science and Technology, Personal and Social Perspectives, and History of Science. Students select two or three from list.

The above readings can be found in the student version of this publication.

Assessment items can be found at the back of this volume.

*****It is important that this microunit occurs *after* 961. If not, the conceptual sequence will be disrupted.

Assessment Recommendations

This teacher materials packet contains a few items suggested for classroom assessment. Often, three types of items are included. Some have been tested and reviewed, but not all.

1. Multiple choice questions accompanied by short essays, called justification, that allow teachers to find out if students really understand their selections on the multiple choice.

2. Open-ended questions asking for essay responses.

3. Suggestions for performance tasks, usually including laboratory work, questions to be answered, data to be graphed and processed, and inferences to be made. Some tasks include proposals for student design of such tasks. These may sometimes closely resemble a good laboratory task, since the best types of laboratories are assessing student skills and performance at all times. Special assessment tasks will not be needed if measures such as questions, tabulations, graphs, calculations, etc., are incorporated into regular lab activities.

Teachers are encouraged to make changes in these items to suit their own classroom situations and to develop further items of their own, hopefully finding inspiration in the models we have provided. We hope you may consider adding your best items to our pool. We also will be very pleased to hear of proposed revisions to our items when you think they are needed.

Science as Inquiry

Believing Without Seeing

How do scientists determine the structure of something that they cannot see?

Overview:

This activity attempts to demonstrate how indirect evidence can be used to reveal structure.

Materials:

Per student:

1 shoebox

item to be concealed in the box (1):

- pencil
- chalk
- marbles
- rubber stoppers
- magnet

Per class:

metric balance

metric ruler

magnet

Procedure:

Put one item in a box, seal the box with tape, then give one box to each student. Have the students determine the characteristics (i.e., mass, texture, magnetic properties, etc.) of the item in the boxes by performing a series of manipulations—such as shaking the box—to determine whether the item rolls or slides down the box, etc. From their observations and inferences, students draw conclusions as to what is in their box. Students sketch the concealed object based upon these conclusions.

Background:

Chemists are able to determine certain characteristics of elements that enable them to place each element in a particular family. This exercise will give students an appreciation of how chemists can make observations about an object or substance indirectly. Chemist believe that an atom has a nucleus containing particles such as protons and neutrons and outer electrons which determine the chemical and physical properties of the atom. This, along with other defining characteristics, leads to commonalities which are the basis for the placing of elements into particular families/groups on the periodic chart.

Variations:

Metal cans can be used rather than boxes. Also, have the students prepare their own boxes ahead of

time at home with whatever limitations seem appropriate.

Adapted from:
Haber-Schaim, Abegg, Dodge and Walter, *Introductory Physical Science,* 4th Ed., 1982
Prentice Hall Physical Science, Teacher's Resource Book, 2nd Ed., Prentice Hall.

Science as Inquiry

Solving the Mystery

How do inferences made from observations fit into the work of a scientist in determining the structure of an unseen object?

Overview:

This activity is an extension of Activity 1. Do this one as a follow-up or assessment. Students open the box from Activity 1 and compare it to their observations and inferences.

Materials:

Per student (same boxes used in Activity 1):

1 shoebox

1 item to be concealed in the box:

- pencil
- chalk
- marbles
- rubber stoppers
- magnets
- [etc.]

scissors

Procedure:

Each student will open the box they used in Activity 1 utilizing the scissors provided. They compare the object that they now directly observe with the inferences they made in Activity 1.

Background:

See background material for Activity 1. Note that the significance of making "direct" and "indirect" observations may be more useful in the discussion of electron structure and its relationship to family positions on the periodic chart once the boxes have been opened. At this point, students only need to realize that the outermost electrons in a given family are the same for each member of the family.

Scientific evidence is subject to change as technology becomes more advanced and this could lead to a discussion at this point. With the relatively recent invention of the tunneling microscope, chemists can now "see" atoms on the surface of elements that could never be seen before—even with an electron microscope. Perhaps one day scientists will be able to confirm other structures that they now infer.

Note: This activity, depending on time and how you use it, may be done on the same day—or it may follow on another day. Discussion questions might include: How do scientists determine what is in moon rocks? Why might a wise customer take a magnet with him or her when shopping at a

thrift store? What does this lab activity reveal about the current model of the atom?

Adapted from:
Haber-Schaim, Abegg, Dodge and Walter, *Introductory Physical Science,* 4th Ed., 1982
Prentice Hall Physical Science, Teacher's Resource Book, 2nd Ed., Prentice Hall.

Science as Inquiry

Opening the Box

Performance assessment:

Use activity 2 as an embedded assessment of this micro-unit.

Answer:

History and Nature of Science

The Elephant Problem

Item:

There is an old story concerning a group of blind-folded people attempting to describe an elephant. One feels only the trunk and decides that the elephant is a snake. Others feel only the ears and decide that the elephant is a bat. What problem does this approach have? How could you correct it?

Answer:

Consumables

Item	Quantity (per lab group)	Event
none		

Non-Consumables

Item	Quantity (per lab group)	Event
balance	1 per class	1
magnet (to conceal)	1 per class	1
ruler (to conceal)	1 per class	1
shoebox	1	1

Activity Key
1. Believing Without Seeing