The Scientific Method is a systematic approach to problem used by scientists in all fields of study. Typically, it involves a series of steps that guide the scientist in testing hypothesis. After recognizing a problem, a scientist attempts to form a hypothesis or prediction that can be tested. A controlled experiment is conducted in which one factor or variable is changed and others are held constant. Observations and data are recorded and analyzed to allow the scientist to draw conclusions about the original question and their hypothesis. Interestingly, this basic skill of scientist is difficult for students to master. Guided practice of the students through the experiments of this unit allows them to develop the habits of good scientists. Manipulation of a single variable in each scenario encourages students to gain understanding and procedural competency as they answer the question, “How many times can a paper strip be folded in half?” Thus, this unit allow the basics of Paper Folding” to be used as a tool to teach the steps of the

Scientific Method.

**Grade Level:** 2-8

**Materials:** 1” x 11” strips of paper (enough for 3 per student)

**Procedure:**

1. Introduce the steps of the Scientific Method.

I. State the Problem (recognize what you want to study; ask a question)

II. Form a Hypothesis (make a prediction about the problem that can be tested)

II. Test a Hypothesis (conduct a “controlled experiment” in which one factor is manipulated to see its affect on another variable and all other factors are controlled or held “constant” by the experimenter.)

A. Plan (develop the steps of the experiment)

B. Conduct the experiment (follow the procedure ‘to the letter’)

C. Collect and record data (measurements, diagrams, data tables, etc.)

IV. Analyze the data (perform calculations, make graphs, and otherwise organize data)

V. Draw conclusions (make statement about the hypothesis based on the results of the experiment - do the results support/reject the hypotheses?)

**Scientific Method**

**Lab: Paper Folding I**

Lessons in Paperfolding **108** Unit 2

Developed through the National Science Foundation Project *Pattern Exploration: Integrating Mathematics and Science for the Middle Grades*, 1999

2. Pose the following question to the students: “How many times can a piece of paper be folded in half?”

3. Lead the students in making predictions or educated guesses to answer the problem (i.e., experience tells them that 100 folds are unlikely, but that the paper definitely can be folded more than once). Explain to the students that educated guesses are “hypotheses.”

4. Ask the students how they could test their hypothesis - to prove them right or wrong. Lead the students to development of a procedure that will lead to reliable results.

Possible procedure:

1. Fold a strip of paper in half (lengthwise).

2. Continue folding the paper in half (always in the same direction) until the paper cannot be folded again.

3. Record the number of times the paper folded.

4. Complete two more “trials” (fold two additional strips), record the number of folds for each and find the average number of folds for the three trials.

**Conclusion:**

Each student will be responsible for developing a lab conclusion that answers the lab question, “How many times can a piece of paper be folded in half?” Using the information gathered during the experiment (i.e., average number of folds), each student will evaluate his/her hypothesis and give reasoning behind accepting or dismissing it.

**Discussion:**

Discuss the following:

Explanations behind the original hypotheses

Limiting factors for the number of folds possible (paper thickness, size, etc.)

What experiments could be conducted to test these limiting factors?

**Grade Level:** 2-8

**Materials:** 1” x 11” strips of different kinds of paper (i.e., construction paper, tissue paper, notebook paper)

**Procedure:**

1. Ask the question, “Does the kind of paper used affect the number of times it can be folded?”

2. After students develop hypotheses, introduce the concepts of “variable” and “control.” Discuss the importance of having only one variable (the kind of paper) in accurately determining the effect of paper type on the results.

\* A variable is a factor that changes in an experiment.

\*A control is a factor that is kept constant for all trials of an experiment.

**Lab: Paper Folding II - Variation: Kind of Paper**

Lessons in Paperfolding

Developed through the National Science Foundation Project *Pattern Exploration: Integrating Mathematics and Science for the Middle Grades*, 1999

3. Allow students to work collaboratively in pairs to develop a procedure that tests the hypothesis.

Possible procedure:

1. Fold a strip of paper in half (lengthwise).

2. Continue folding the paper in half (always in the same direction) until the paper cannot be folded again.

3. Record the number of times the paper folded.

4. Repeat the procedure for two more paper strips of different kinds of paper. Be sure to record the kind of paper and number of folds for each on a data table.

4. Instruct the students to have the teacher approve their procedure before beginning the experiment. Once the teacher verifies the appropriateness of the lab procedure, the teacher will provide students with the necessary materials to carry out the experiment.

5. The student pairs will complete the experiment and record the necessary data.

**Conclusion:**

Each pair of students will be responsible for developing a lab conclusion that answers the lab question, “Does the kind of paper used affect the number of times it can be folded?” Using the information gathered during the experiment (i.e., the number of folds for each kind of paper), each pair will evaluate their hypotheses and give reasoning behind accepting or dismissing it.

**Discussion:**

Discuss the following:

What was the variable in this experiment?

What things were controlled?

How did your predictions differ from your results?

What other factors or variables, if any, can change the outcome of the experiment?

Summarize the results by discussing how changes in the variable affect the final results.

**Grade Level:** 2-8

**Materials:** Strips of paper that vary in length

**Procedure:**

1. Ask the question, “Does the size of the paper used affect the number of times it can be folded?”

2. Instruct students to work in pairs to develop hypotheses and procedures that allow them to record the dimensions of the paper strips during data collection. Also, remind students of the importance of a single variable which is the size (not the kind or thickness) of paper used.

3. Allow students to conduct their experiments, being sure to follow their directions carefully.

**Lab: Paper Folding III - Variation: Size of Paper**

Lessons in Paperfolding **110** Unit 2

Developed through the National Science Foundation Project *Pattern Exploration: Integrating Mathematics and Science for the Middle Grades*, 1999

Possible procedure:

1. Cut several different sizes of paper strips.

2. Use a ruler to measure the length and width of each strip. Record the measurements.

3. Fold each strip in half (lengthwise) until it cannot be folded again.

4. Record the number of folds for each of the strips in a data table along with the dimensions (length and width) of each strip.

**Conclusion:**

Each pair of students will be responsible for developing a lab conclusion that answers the lab question, “Does the length of paper used affect the number of times it can be folded?” Using the information gathered during the experiment (i.e., the number of folds for each size of paper), each pair will evaluate their hypotheses and give reasoning behind accepting or dismissing it.

**Discussion:**

Discuss the following:

Importance of single variables in controlled experiments

Importance of following procedures and recording data accurately

What is the trend that the experiment results illustrate? (i.e., when the size changes...)

Which has the greater impact —size or kind of paper?

Would the way the paper was folded affect the results?

How could the manner of folding be tested? (develop another experiment)