Introduction to Research

OVERVIEW:

In this activity, students will be introduced to the concept of research. Gathering and analyzing data, one aspect of research, is practiced by students as they work through the activities.

CONCEPTS:

National Science Education Standards:

Standard A: Science as Inquiry (Abilities Necessary to do Scientific Inquiry)

- Different kinds of questions suggest different kinds of scientific investigations. Some investigations involve observing and describing objects, organisms, or events; some involve collecting specimens; some involve experiments; some involve seeking more information; some involve discovery of new objects and phenomena; and some involve making models.
- Current scientific knowledge and understanding guide scientific investigations. Different scientific domains employ different methods, core theories, and standards to advance scientific knowledge and understanding.

Benchmark 1: The Nature of Science

A. The Scientific World View

- When similar investigations give different results, the scientific challenge is to judge whether the differences are trivial or significant, and it often takes further studies to decide. Even with similar results, scientists may wait until an investigation has been repeated many times before accepting the results as correct.

B. Scientific Inquiry

- Scientists differ greatly in what phenomena they study and how they go about their work. Although there is no fixed set of steps that all scientists follow, scientific investigation usually involve the collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected evidence.
- If more than one variable changes at the same time in an experiment, the outcome of the experiment may not be clearly attributable to any one of the variables. It may not always be possible to prevent outside variables from influencing the outcome of an investigation, but collaboration among investigators can often lead to research designs that are able to deal with such situations.

OBJECTIVES:

Students will:

- Identify the components and types of research.
- Identify the reasons as to why research is done
- Collect and analyze data.
- Identify types of errors that can occur why conducting a research experiment

PROCEDURES:

- Allow 3 hours to complete the activity.
- Present background information.
- Activity: (Part A)
- Follow up activity with discussion questions (see Part B). These questions can be used for assessment purposes.

MATERIALS:

- Background information: Research
- Transparency Master – Class Results (M&M)
- M & M's, 1 package per student
- Data Collection Sheet
- Calculator
- Pennies, 3 per student
- Cup, 1 per student
- Ruler

BACKGROUND:

Research is a process of studying behavior in order to learn what you don't already know about something.

Types of Research:

- **Original research** – Learning about something no one knows about
- **Secondary research** – Supporting or disproving someone else's research
- **Basic research** – Research for the sake of knowledge
- **Applied research** – Practical application to solve problems

There are various reasons why we do research, some of which are; to describe a behavior or phenomenon; to predict a behavior; to determine the causes of a behavior; and to understand or explain a behavior.

What do we want to know?

What question are we attempting to answer? Ideas for researches that are conducted come from common sense, observation, theory, past research, and practical problems.

Gathering evidence.

Evidence is information that supports a conclusion, sometimes even if it is not what you want. Where can we go to look for the answer? We gather evidence by direct observation or looking into existing records. There are two kinds of proof:

Legal – This looks at the motive and opportunity

Research – observations; are they subjective (room for argument) vs. objective (no room for argument)

The next question that comes up is, 'How much data do we need?' There are several factors to keep in mind when collecting data:

- **Sample size** – the more samples you collect, the more valid your study becomes
- **Time-** limitations prohibiting more extensive research
- **Money**- limitations prohibiting more extensive research

Interpreting the data is very different from interpreting the results. In interpreting the data we look at what the numbers mean; significance, correlation, causation, etc.

Significance:

What are the odds that the result is not just a random chance? Example; Flip a coin 100 times. Will the number of times you get heads be equal to the number of times you get tails and all add up to 100?

Levels of significance:
The lowest level is .05 or 5 times out of 100, usually marked "p<.05"
Other common levels are .01, .005, and .001

Causation vs. Correlation:

- Causation: Lightning causes thunder (the occurrence of one causes the other). How do we determine causation? Every time it rains, there is a puddle of water in the driveway. This is cause and effect. Nevertheless, just because you see a puddle, it does not mean it rained.
- Correlation: Think about your shoe size and reading ability. When you were a baby, you wore a small shoe size. Now that you are a teenager, you wear a larger size shoe. However, the fact that your feet get bigger requiring a larger shoe size does not make you able to read better than you did in a smaller shoe size. In this case, one event does not cause the other. Correlation does not mean causation.

Other Factors:

Bias – An error in design or conduct of experiment that yields a false result.

Types of bias:

1. **Recall bias** – How you frame the question. What did you have for dinner last night?
2. **Non-Response** – missing field
3. **Interviewer bias** – a more favorable response by the interviewer
4. **Confounding** – hidden factors that influence the results. A great example is a study carried out in 1981, which was looking at the link between coffee and pancreatic cancer. Coffee drinkers and makers did not like the results and after more research, they found out that coffee drinkers also tended to smoke more.
5. **Interaction** – extra factors that influence results, such as additive, synergistic, antagonism. In this case, two items are necessary in order to get the out come you want. For example, you cannot bake chocolate chip cookies if you are missing the ingredients or if you do not have an oven.

Research Example

Hypothesis: Watching violent TV makes children more aggressive.

How do we test this hypothesis?

1. Show some children violent shows on TV and other non-violent shows.
2. Confounds to be careful about: gender, length of viewing, program types, conditions in room, instructions given, time of day, age of children.
3. What do you think will happen? (discussion question)

ACTIVITY:

Part A:

Activity 1: M&M's

Materials:

- 1 bag of M&M's
- Student Sheet

Scenario:

- M&M/Mars wants to make sure that they are not putting too many blue M&M's into each bag.
- Brown, Yellow, Orange, Red, and Green M&M's cost 1¢ each to produce.
- Blue M&M's cost 4¢ each.
- Each bag should contain around 57 M&M's.
- 10% means about 6 blue M&M's per bag.
- Total cost of 75¢.
- Bags sell for 80¢.

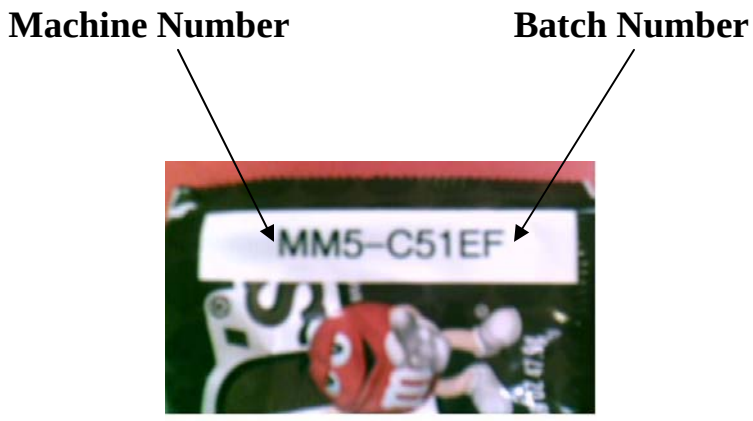
Question: What percentage of the package should contain blue M&M's?

Hypothesis: 10% of the M&M's in each pack should be blue.

Directions:

Give each student a pack of M&M candies.

1. Mark each pack with a sample number.



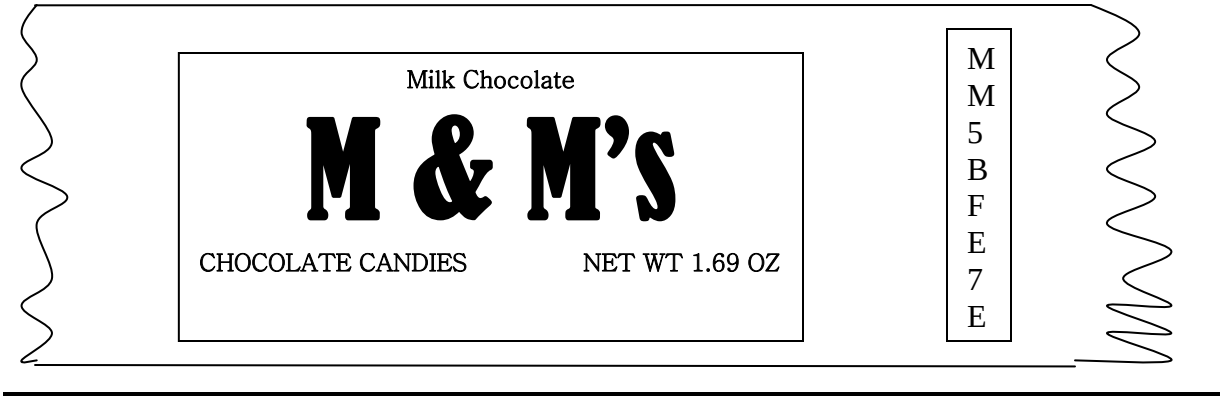
2. Put your name and sample number on the data collection slip.

3. Conduct the research by counting out each color and recording the results on the data collection sheet.

4. Was your conclusion correct?
   Are 10% of the M&M's in each pack blue? Why or why not?

5. Compare results to others in the class. (See "Class Results" sheet. Can be used as a transparency for whole class viewing/discussion.)

6. What is your conclusion?



Data Collection Slip

Name: _____

Sample #: _____

Number of Each color:

BROWN	YELLOW	ORANGE	RED	GREEN	BLUE	TOTAL

Percentage of each color:
(To calculate the percentage, take the number of each color, and divide by the total number of M&M's in each package. Multiply that number by 100.)

BROWN	YELLOW	ORANGE	RED	GREEN	BLUE	TOTAL

Activity 2: Heads or Tails

Materials:

- **1 Penny for each student**

Probability is the chance that an event will occur.
If you flip a coin 100 times

- Heads = 50
- Tails = 50

The odds are 1:2

- 50%

Directions:

1. Place a penny in the cup.
2. Place you hand over the top of the cup and shake the penny.
3. Turn the cup upside down and release the penny from a height of 6 inches.
4. Do this 100 times, keeping track of the number of heads and the number of tails.
5. Place 2 pennies in the cup and repeat steps 2-4.
6. If time permits, place 3 pennies in the cup and repeat steps 2-4.

	HEADS	TAILS
1 PENNY		
2 PENNIES		
3 PENNIES		

What were some of the controls used in this investigation?

Does your odds increase or decrease as the number of coins increase? Explain.

Part B:
Ask the following questions and allow time for discussion.

Share:
Share your "Heads or Tails" results with the class.

Process:
In doing an investigation, what things should be held constant? Why is that important?

Generalize:
How does sample size play a role in an investigation?

Apply:
Would you be willing to take a new drug/medicine that was only tested on a few individuals? Explain.

Class Results (M&M Study)

	Brown	Yellow	Orange	Red	Green	Blue	TOTAL
Count							
Percent							**100%**
Range							
Average							