HOW SCIENTISTS DO WHAT THEY DO – Inquiry Style

GENERAL INFORMATION

Lesson Title & Subject(s): *Science – "How Scientists Do What They Do"*

Topic or Unit of Study: *Scientific Method*

Grade/Level: *5th Grade*

Instructional Setting:

Self-Contained fifth grade classroom with twenty-two students. The students are arranged in groups of twos facing the front of the room towards the Smartboard.

There are several students with IEP's and 504's. Most of the rest of the class is at least two to three grade levels below fifth grade. There are four "higher" students, who are on grade level. One of the IEP students is "seeing impaired", who sits in the front row, right in front of the Smartboard.

There are two ELL students in the room. One is on grade level and the other is lower and receives Speech to help with his English. This school is a low-income, Title I school.

STANDARDS AND OBJECTIVES

Your State Core Curriculum/Student Achievement Standard(s):

Observe and measure variables in an experiment and give a conclusion.
Describe the steps in the scientific method.
Explain how scientists use the scientific method.

Lesson Objective(s):

Given the worksheets "Build a Rocket" and "Investigate Further", students will complete the experiment found therein while observing, measuring variables, making predictions, and giving conclusions all while working in pairs, and must receive an 85% on both to show proficiency.

Given their science textbooks and a blank sheet of lined paper, students will list and describe the steps in the scientific method and will explain how scientists use this method in a letter to Mr. Zoinks (our alien friend who doesn't have access to education on his planet) with 90% accuracy.

Given a worksheet with the scientific method steps on it, students will follow those, including observing and measuring variables, to find out what the conclusion is of what the best way is to keep bananas from going bad for as long as possible while obtaining at least an 85%.

MATERIALS AND RESOURCES

Instructional Materials:

Slick string
Rough string
Drinking straws
Long balloons
Other balloons of various shapes and the same size as the long one
Timer/stopwatch
Tape measure

Tape
Ripe banana
Green banana
Science books

One worksheet of the "Rocket Experiment" to be completed as a class without the steps of the scientific method explicitly stated, but with a place to write them in, and an area to write the measuring of variables.

One more worksheet also of the "Rocket Experiment" to be completed by students in pairs with the steps of the scientific method listed along with a place to record the measuring of variables.

Another worksheet called "Bananas" for students to finish at home again with the steps of the scientific method listed along also with a place to list the measuring of variables.

Resources:

The "Rocket Experiment" and much of the lesson comes from:

Bell, M., Krockover, G., DiSpezio, M., McLeod, J., Frank M., Brink B., . . . Deman, B. (2006). Science. Harcourt Publishers.

The first two lab worksheets were designed by me with reference to the lab manual that accompanies this book.

INSTRUCTIONAL PLAN

Sequence of Instructional Procedures/Activities/Events (provide description and indicate approximate time for each):

1. Student Prerequisite Skills/Connections to Previous Learning:

*Students need to know what a **variable** is and what **inquiry** is.*
*They need to know what **observations** and **data** are and how to record these.*
Students need to know why it is important for them to write down the procedures and results for experiments.

2. Presentation Procedures for New Information (15 min):

ENGAGE –

I will have two bananas, one that is green and unripe and another that is dark and overly ripe. I will tell students that I have a problem with bananas! I purposefully buy unripe, green ones, so that they will last longer. But, even with that, they ripen so quickly that my children won't eat them, and I have to throw them away.

I will tell the students that I am going to ask three rhetorical questions and that rhetorical means that I don't expect an answer. These questions are: is there anything I can do to make sure my bananas don't ripen as fast? How can I find out what to do? Are there certain steps I can take to discover what works and what doesn't work?

EXPLORE –

I will say to the students that we are going to conduct a different experiment together to see if we can find the answers to those questions, and we will come back to my banana issue later. When ask questions to solve problems it is called ***inquiry****.*

I will start the activity with having two chairs close together. I will also have a long balloon, tape, and a straw with me.

I will tell the children that we are going to conduct an experiment to see what happens if we change something in order to observe what the reaction will be. I will explain that the things we can change in experiments are called ***variables*** *and when we* ***observe*** *something, we watch to see what happens to it. What happens is called the* ***results*** *or the* ***data****.*

I will also mention that we will also be learning about the scientific method or the steps scientists use to discover solutions to problems, while we do this.

During this experiment, I will ask the students who volunteer, questions that will help guide the classes' thinking towards understanding the steps in the scientific method. I will not tell them what the names of the steps are at this point, although those are included for reference.

I will project the worksheet "Rocket Experiment" without the steps onto the Smartboard and will let the pupils know that even thought the worksheet is projected on the Smartboard, we will only be filling out the data or results during this stage of the lesson.

1. *Observe and ask:*

    - *Finding our variables:*

        - *I will have someone come up front and blow up the long balloon until it is full.*
        - *I will have them tie the end while I ask:*
            - *What shape is the balloon?*
            - *Do you think the shape of the balloon will make a difference in how fast and far it travels?*
            - *Why?*
        - *Another student will come up and take the slick string from me and I will question:*
            - *What type of string is being used, how does it feel, is it slick or coarse?*
            - *Do you think the type of string will make a difference in how fast and far the balloon travels?*
            - *Why?*
        - *I will have another student blow a small amount of air into another long balloon and I will question:*
            - *The first person to come up blew their balloon up until it was full, you only put a little bit of air in yours, do you think how far and fast the "rocket" travels will depend upon the amount of air you put into it?*
            - *Why?*

    - *Finding our question*

        - *The amount of air, type of string, and kind of balloon are all variables. Changing them will affect the outcome of the experiment.*

- *Which of these variables do we want to focus on for this experiment?*
- *What question can we ask to help us discover how this variable will affect the speed and distance of the balloon? Example: Will more air or less air in the balloon make it go farther and faster?*

2. *Hypothesis*

- *Vote on what the majority of the class thinks the answer to our question will be.*

3. *Plan an experiment*

- *For this experiment, I will guide you through the steps.*
- *First, we will put two chairs a short distance from each other and tape one end of the string to one chair. Then, we will tape the blown-up balloon to the straw, push it through one end of the string, and tape the other end of the string to the other chair.*
- *What can we do with the variable we have chosen to be able to test our question and see what works best? Examples: we can use different shapes of balloons, different amounts of air, or various kinds of string.*
- *Last, we will measure the speed and distance of the balloon per trial by using a stopwatch and measuring tape.*
  - *Ask: If someone else wanted to conduct the same experiment, we wanted to repeat it, someone didn't believe our results, or we wanted to publish our findings, what could we do to make sure we had evidence of what we did?*
  - *We need to write it down, which we will do during the next stage of the lesson.*

4. *Conduct the experiment*

**Note: You will change the variable during the experiment according to which one the students chose to test.*

- *One student will come up and tape one end of the string to one of the chairs.*
- *Two other students will come up and will tape the straw to the top of the balloon, thread the side of the string not taped to a chair through the straw and tape the other side of the string to the other chair.*
- *Two different students will come up and one will use a stopwatch to time how long the balloon keeps traveling. The other will have a measuring tape to measure how far the balloon went.*
- *Record the results*
- *Change the variable agreed upon (more or less air, type of string, or type of balloon)*
- *Repeat the experiment and record the results*

5. *Draw conclusions/communicate results*

- *Based on our data, what is the answer to our question or the solution to our problem?*
- *Was our hypothesis correct?*
- *Why or why not?*

EXPLAIN -

I will tell the class that, as we walked through the exploration together, my questions were meant to help them think through the steps of the scientific method.

During each of the following steps, I will fill out the worksheet, "Rocket Experiment" without the scientific method steps, that I have already projected onto the Smartboard, as we go through the explanation of the experiment.

- *The steps of the scientific method are:*
  - *Observe and ask questions:*
    - *During this step, you normally look closely and watch what is happening in a specific situation to identify a problem you are wanting to solve.*
    - *Within this experiment, we didn't really have to do that because I told you the problem was. It was that we were not sure what we could do to make the balloon "rocket" travel the fastest and farthest.*
    - *During this step, you will also identify some of the variables involved which will help you decide how to set up the experiment and develop your question or questions. The variables we came up with were the type of string used, the kind of balloon utilized, and how much air is in the balloon.*
    - *You will also create a question or questions during this stage that will help you solve your problem. The question we came up with was: _____?*
  - *Hypothesis:*
    - *This is where you logically guess what the answer or answers to your question or questions will be. It is also called an educated guess.*
  - *Plan an Experiment:*
    - *During this part of the method, you choose steps you will take in order to use your variable in different ways while measuring and recording the results to decide if your hypothesis is correct.*
  - *Conduct the Experiment:*
    - *While in this stage of the scientific method, you will put into action the steps you had planned. You will also write down what happened or the data you found.*
  - *Draw Conclusions/Communicate the Results:*
    - *This process is where you write down what you found, and if your hypothesis was proved or not.*
    - *You cannot disprove a hypothesis, it can only be proved or not proved.*

Now, I will ask the students to write to Mr. Zoinks and describe the steps in the scientific method and explain how scientists use this method. I will tell them they have to list all of the steps and tell what to do during each one.

ELABORATE –

I will tell the students that they will be completing the experiment again, exactly the same as we just did, except this time they will choose a different variable and hypothesis. They will work together with a partner and will each have their own worksheet to fill out with the exception of the special needs students, who will have one worksheet between them and their partner, and they will take turns filling it out.

To scaffold their work, I will tell the children to use one of the other two variables we listed that we haven't used yet. I will also write the scientific method steps on the worksheet with clues to help guide them in filling it out. They will follow the scientific method steps to test this new hypothesis using another variable.

After the learners are finished, I will tell them that they can use the steps of the scientific method to solve other problems also. I will ask them if they remember the problem I had from the beginning of the lesson with my bananas? This is an example of a problem that can be solved with this system. (Continued in the next step)

Independent Student Practice:

I will let the students know that they will be conducting an experiment on their own now and it will be discovering the answer to this problem (the banana issue). I will tell them they will be given a worksheet and will use it to follow the steps of the scientific method to figure out what I can do to make my bananas last longer, so they won't go bad before they get eaten by my kids!

EVALUATE –

I will know if students have reached success on the assignment because, given their science textbooks and a piece of paper, students will describe the steps in the scientific method and explain how scientists use this method in a letter to Mr. Zoinks with 90% accuracy.

I will also know if students have learned what they need to because, given the "rocket" experiment from our textbook and one worksheet per child, students will observe, measure variables, and give conclusions while working in pairs to complete the experiment using the steps of the scientific method on the worksheet and must receive an 85% on both to show proficiency.

I will know if the pupils have understood how to conduct an experiment using the scientific method by, given a worksheet with the scientific method steps on it, students will follow those including observing and measuring variables to find out what the conclusion of what the best way is to keep bananas from going bad for as long as possible is while obtaining at least an 85%.

Instructional Strategy (or Strategies):

The 5 Es of Inquiry – Students were asked to answer and come up with many questions throughout the lesson. The teacher served in the role of a guide.

Hands-on -- While students worked with partners to conduct their experiments, they completed hands-on activities.

Differentiated Instruction Accommodations:

Visually impaired student:

- *I will make sure he has a front row seat for the entire lesson.*
- *I will also pair him with a student who is on a higher-level, who will be kind, patient, and helpful while they work together to conduct the experiment and take turns filling out one worksheet.*

All special needs students:

- *I will give them an incomplete letter to Mr. Zoinks that is partially filled out.*
- *I will have them work with a higher-level student when they work with partners during the experiment and will take turns filling out one worksheet together.*
- *I will give them hints or ideas/examples on their homework worksheet.*

Use of Technology:

No technology was used.

Student Assessment/Rubrics:

I will know if students have reached success on the assignment because, given their science textbooks and a blank sheet of paper, students will list and describe the steps in the scientific method and explain how scientists use this method in a letter to Mr. Zoinks with 90% accuracy.

I will also know if students have learned what they need to because, given a worksheet, students will complete the experiment found therein while using a different variable than the modeling section of the lesson, while observing, measuring variables, making predictions, and giving conclusions all while working in pairs, and must receive an 85% on both to show proficiency.

I will know if the pupils can observe and measure variables in the scientific method and can come up with a conclusion by, given a worksheet with the scientific method steps on it, students will follow those including observing and measuring variables to find out what the conclusion of what the best way is to keep bananas from going bad for as long as possible is while obtaining at least an 85%.