

University of Mary Division of Education Instructional Sequence for:

Scientific Method

By: Ann Balster

Grade Level: 9-10th grade

Subject(s) Area: Biology- Scientific Method

Material Needed: Worksheet, flow chart, overhead projector, and white/chalk board, aforementioned knowledge on how to make a bar graph on graph paper (but I will be doing it on the overhead with them so they don't need to be solid on it)

Key: *Diverse student techniques= italicized*

The information on the board= bolded

Regular font is notes to self/ teacher

Sandard:

- HS-LS2-4: Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

Objectives: Students will be able to:

- Demonstrate knowledge of the elements of scientific methodology (identification of a problem, background research, hypothesis formulation, performance of experimental tests, analysis of data and compile results, develop a conclusions).
 - Use a sequence of those elements to solve a problem or test a hypothesis.
- Recognize the desired variables in the question and formulate an experiment that will produce the answer to that question.
- Perform mathematical computations that represent that data found in their scientific study.

Learning Activities:

- I. Attention Getter- Pop Quiz! Give about 1 minuet to answer the questions. They shouldn't be able to answer them so they shouldn't need more time. They will probably start complaining that they didn't get to finish or that they failed because they didn't know that answers. Good! Rioting is good. *Make sure they don't get too loud if noise bothers some students.*

- a. *If there is a student who has an anxiety, let them know ahead of time that the pop quiz is going to be a trick, so they don't stress about not having enough time.*
- II. I will not hand in the papers. Say that No one should be able to answer these questions because they have no proof. They need to go through the Scientific method to find the answers.
- III. Go over what the book covered in the chapter on scientific method
- a. *On the board list the steps of the scientific method. Write large.*
 - b. *Then put a little summary next to the steps so that the students have a guide as to what each step entails. Make sure that they are writing notes. Make this summary by using the Socratic method (Ask them question and make them explain themselves), and try to get them to think.*
 - c. This is what the summaries should consist of. (The bolded information goes on the board; the side notes are regular font.)
 - i. **Identification of a problem**
 1. Idea starters- What is the 1st step of the scientific method? How do you know there is a problem?
 2. **The scientific method starts when you ask a question about something you observe: How, What, When, Who, Which, Why, Where?**
 3. **But the question has to be something that you can measure or observe. Observation is the key to solving a problem.**
 - ii. **Background research**
 1. Ask the students why they need to do research
 2. **Rather than starting from scratch and putting together a plan of for answering your question, you want to find the best and quickest way to do things.**
 3. Why the quickest? Answer- because problems might be pressing. You want you experiment to be the most efficient.
 - iii. **Hypothesis**
 1. **An educated guess about how things work**
 2. *The template for all hypotheses → "If I do this, then this will happen"*
 3. **The hypothesis should answer the question.**
 - iv. **Experiment**
 1. **Your experiment tests whether you hypothesis is correct or not through the use of variables.**
 2. How do you make the test fair? Answer- you make sure you only change one variable at a time
 3. **Variables are the changing quantities of a test.**
 4. **Independent vs. Independent Variables**
 - a. An independent variable is the one that is changed by the scientist
 - b. A dependent variable is the one that is not changed, but is effected when the independent variable is

tested

v. **Analysis of data**

1. **Compile the results from the experiment and draw conclusions from them.**
2. **Formulate the easiest way to communicate your results.**
3. How can you visually express your data in an easy way?
Answer- **graphs, charts, drawings**

vi. **Conclusion**

1. **Make a summary about the experiment.**
2. **The 5 Essentials of a conclusion: your Question, Hypothesis, a brief summary about the data and your Findings, a statement about whether you were Correct in your hypothesis or not, and finally a Suggestion to make the experiment better.**
3. ***QHFCs- Quick Horses Frantically Clear Stables. Question, hypothesis, findings, correct?, suggestion.***

IV. Step 4: Present the handout with *the flow chart* and worksheet, say that we are going to be doing a mock scientific method in class.

- a. Tell them to write down the ideas that the class comes up with on their worksheet.
 - i. *Turn on the overhead (or projector) and project the same worksheet on the board. Warn students who had difficulties with light to shade their eyes.*
 - ii. *I will be typing in the students' answers as they give them; that way if a student falls behind on note taking, he can catch up. I will also print out my version of the notes and give it to them as reference to those that want it.*

V. Step 5: *Read the problem out loud* and have the students discuss what to do next.

Interject when the students are lost, need direction, or get rowdy. Make sure that everyone is understanding the information and keeping up by periodically asking if people understand or if there are any questions. Make it seem like it is good to ask questions. Give positive feedback so that other follow suit.

- a. Here are some prompts that I will use to direct the conversation:
 - i. Identifying the problem/ question-
 - ii. The rain makes it hard for plants to take root due to run-off. Runoff is the problem.
 1. Why? Runoff is observable and testable. You can fix/ adjust this problem.
 - iii. Research- What is runoff? Surface runoff is the flow of water that occurs when excess water from rain or other sources flow over the earth and erodes the surface. What would water be likely to run off of?- smooth surfaces, loose material?
 - iv. Form a hypothesis-
 1. What should Suzie do? How would you solve this problem.
 2. Find the sturdiest water absorbing ground cover.
 3. What would be your variables?

4. Which ground cover would stop run off better?
 - a. Soil
 - b. Mulch
 - c. Sand
 - d. Grass
 - e. Rocks
 5. We call these your independent variables.
 6. How would you test this?
 7. What is the measurable factor you can use? Can you observe it?
 8. Water weight. Measure initial water weight, and final water run-off water weight
 9. How much water should be used? Lets say 10 L.
 10. Is there a way to monitor the rate of water? Use the same hose- there will be some error, but for the purpose of explaining this experiment its ok.
- v. Experiment- since this would be super a super messy experiment lets assume that we received the data below, (put information on the overhead worksheet). Remind them that we started with 10 liters of water every time. *Encourage them to organize their information in a table as such.*

Independent Variable	Dependent Variable	Result of dependent variable (amount of runoff)
Soil	10 L water	7 L water
Mulch	10 L water	3 L water
Sand	10 L water	5 L water
Grass	10 L water	4 L water
Rocks	10 L water	9 L water

- vi. Analyze data- Make a bar chart: x axis= independent variable, y axis= dependent variable results. Every graph needs the axes labeled, a title, and an appropriate scale (y-axis scale should be from 1-10).
 1. *If someone needs help on the scale or how to make a graph, I will be going about the classroom to make sure that people are doing it correctly. I will have extra graph paper if people made a mistake.*
 2. *They can use different colors if they want to so that it is easier to see and distinguish which information they are using.*
 3. Conclusion- What do all conclusions need? Answer: The 5 Essentials to a Conclusion! QHFCS (question, hypothesis, findings, correct?, and suggestions).
- VI. Step 6: The students can keep this assignment if they want. *Stress that there will be a similar question like this on the quiz at the end of the week, and that they should use this as a reference and a study tool (make sure everyone*

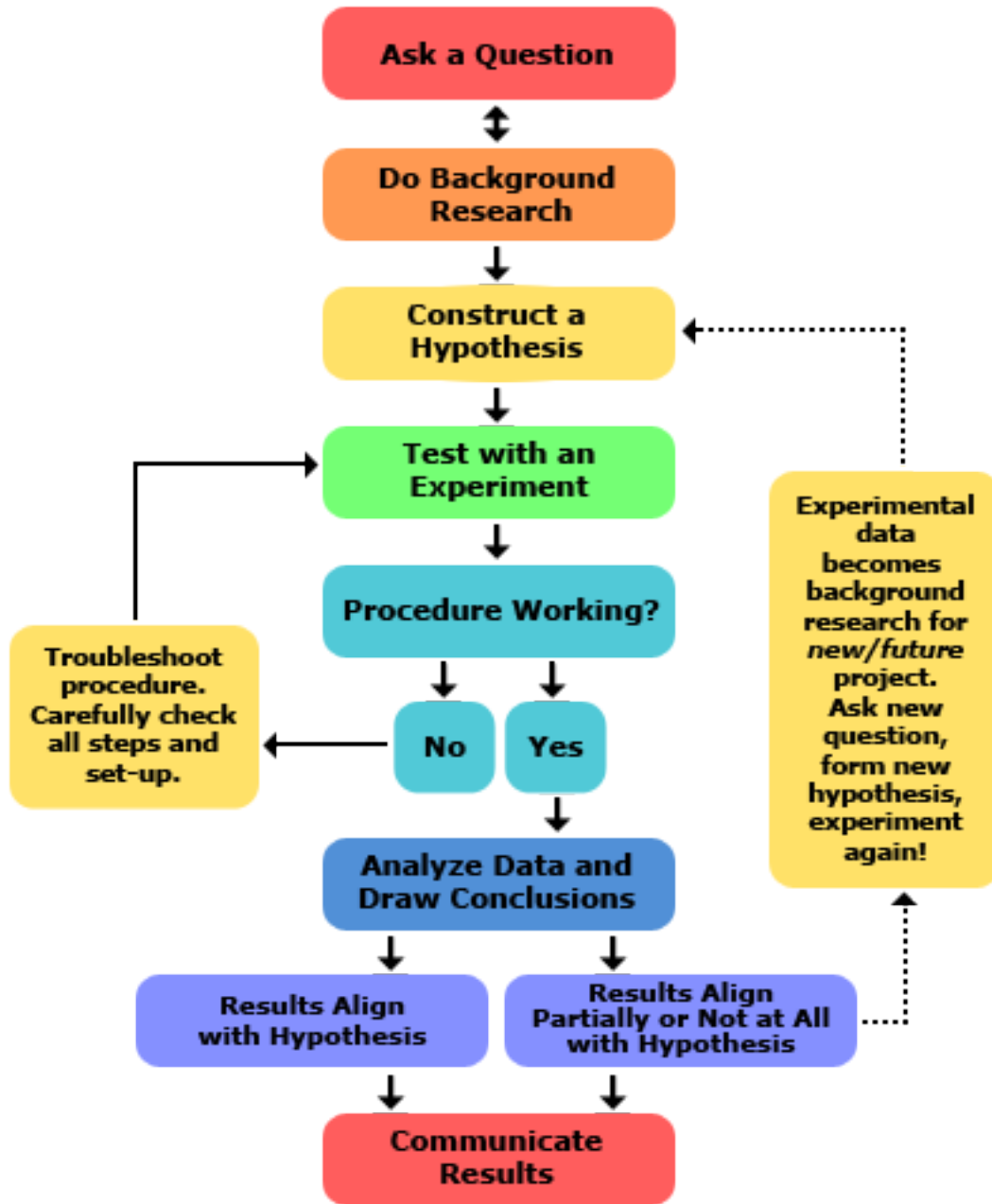
heard that tidbit). Ask if people have questions or would like the notes you wrote on the overhead? If you did not finish the worksheet during the class period, come back to it the next day. It is important that they understand it, so do not make it homework. They will probably need guidance.

- a. Step 7: Announce quiz on Friday
- b. Step 8: End with a comprehensive Q&A such as “What is the question?” “What is the 3rd step of problem solving” “What is the dependent variable” “What are the 5 Essentials to a conclusion?” Class dismissed.

Assessment:

- *Even though this class is has a Socratic method feel, I will modify this class if I feel that all the students aren't following. There will be constant Formative Assessments throughout.*
- *Every class period I will end with a 5 min Q&A about what they read the night before and what they did today in class. Call on as many students as you can get to with the class time remaining. By the end of the week, be sure to have called on each student at least once in order to gage if they comprehend.*
- *Depending on the student, I will make adaptations to the assessment, be that a verbal quiz, or open notes, or more time. There is a flexibility that all science teacher need to learn, since science is usually one of the more difficult class in high school/ middle school for most students, and not just diverse students.*
- *I will monitor how fast the students are learning and change my pace when it is needed. I will also be willing to have alone study time for one-on-one help for those that need quiet to study.*

7th Grade Biology Scientific method flow chart



7th Grade
Pop Quiz!

Name: _____

How long does it take for bread to mold?

How does laundry detergent work?

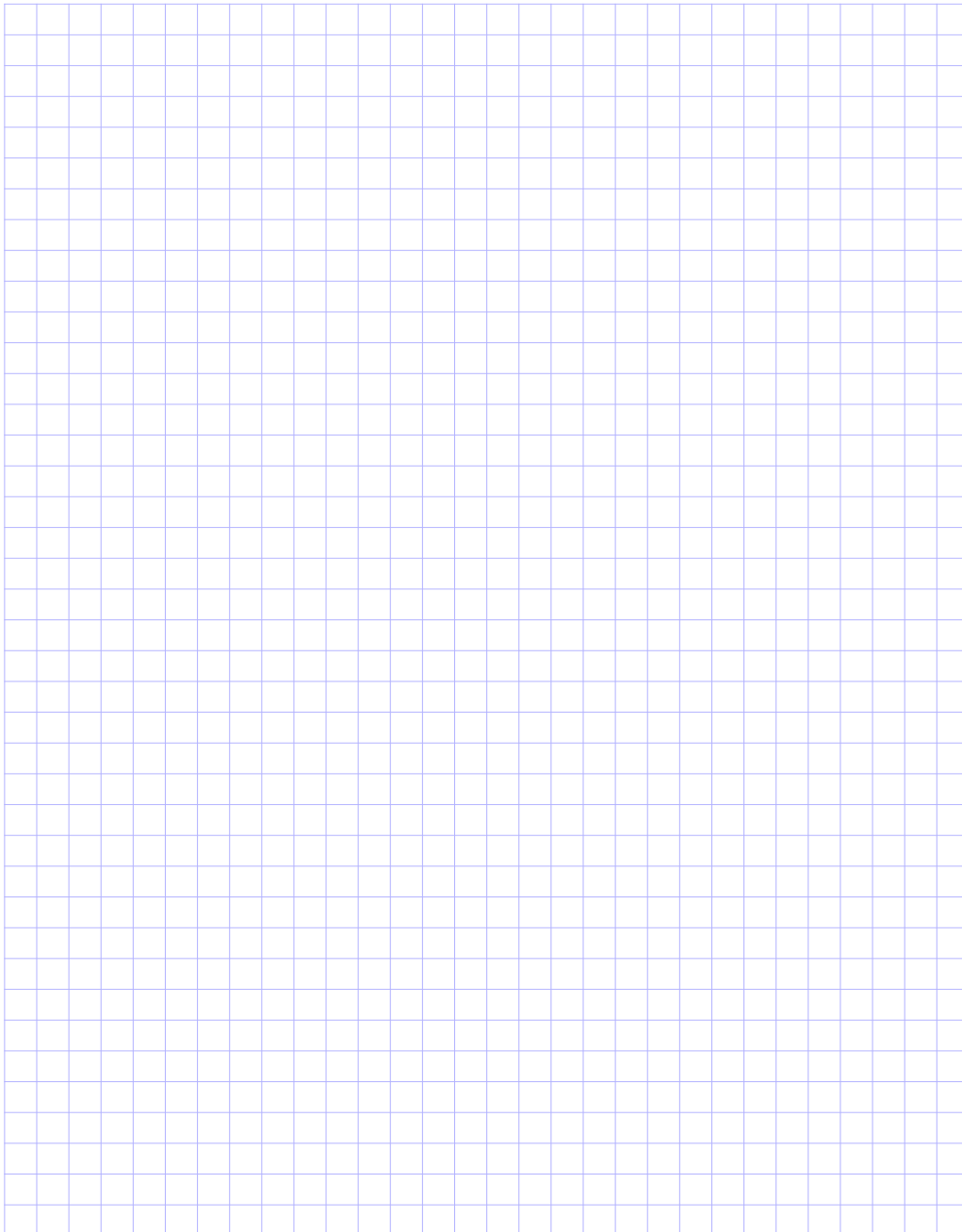
How do the senses taste and smell relate?

What happens if we mix all the primary colors (red, blue, and yellow)?

If you put a plant near unnatural light what happens?

Why do gymnasts cover their hands in flour?

5. Analyze Data: create a bar graph of the data. Make the x axis= independent variable, and make the y-axis= the dependent variable results.



Free Plain Graph Paper from <http://incompetech.com/graphpaper/plain/>

6. Conclusion:

