

Weekly Focus: Scientific Method Weekly Skill: Note taking

Lesson Summary: This week students will review some content from Unit 1 – (Earth and Space Science) the Scientific Method.

Materials Needed:

- Jigsaw Reading Activity Unit 3.1 Handout 1 (5 pages)
- Note Taking Sheet <u>Unit 3.1 Handout 1</u> (1 Page)
- Video Unit 3.1 Scientific Method (4:20 min)
- Scientific Method Explained <u>Unit 3.1 Handout 2 (1 page)</u>
- Scientific Method Diagram <u>Unit 3.1 Handout 3</u> (1 page)
- Homework/Extension Activity **<u>Unit 3.1 Handout 4</u>** (4 pages)
- Homework/Extension Activity (6-way Paragraphs, Introductory Level, pages 144 145)

Objectives: Students will be able to...

- Summarize the steps in the scientific method
- Write the steps of the scientific method in a short response similar to GED 2014 Science module

College and Career Readiness Standards: RI, RST, WHST, SL

ACES Skills Addressed: EC, LS, ALS, CT, SM

<u>Notes:</u> Please review and be familiar with summarizing techniques (<u>Routine 4</u>) and selfmanagement skills (<u>Routine 1</u>). The notes will help with making a smooth transition to each activity.

GED 2014 Science Test Overview – For Teachers and Students

The GED Science Test will be 90 minutes long and include approximately 34 questions with a total score value of 40. The questions will have focus on three content areas: life science (~40%), physical science (~40%), and Earth and space science (~20%). Students may be asked to read, analyze, understand, and extract information from a scientific reading, a news brief, a diagram, graph, table, or other material with scientific data and concepts or ideas.

The online test may consist of multiple choice, drop down menu, and fill-in-the-blank questions. There will also be a short answer portion (suggested 10 minutes) where students may have to summarize, find evidence (supporting details), and reason or make a conclusion from the information (data) presented.

The work students are doing in class will help them with the GED Science Test. They are also learning skills that will help in many other areas of their lives.



Activities:

Warm-Up:Time: 15 minutesAs students enter the class, have the following written on the board or overhead: "The Scientific
Method is used on the GED 2014 test. We have read about the steps in Unit 1, Earth and Space
Science. What do you remember or know about the Scientific Method?" Have students create a
"KWL" chart on a piece of notebook paper (below), and fill out the first two columns: Have students
discuss what they know and want to know in partners; then as a class review. After the activity,
students can fill in the last column.KWL Chart:What do I WANT to know?What did I learn?

What (else) do I KNOW?	What do I WANI to know?	What did I learn?

Activity 1: Scientific Method

Time: 45 minutes

(Unit 3.1 Handout 1) Jigsaw Reading & Reporting

1) Put students into 4 groups/pairs and label each group: A, B, C, D.

2) Hand out one section of the reading in Unit 3.1 Handout 1 (labeled Group A (page 1 of 5), B (page 2 of 5), C (page 3 of 5), D (page 4 of 5) to appropriate group. All groups will get a copy of page 5 of 5 to write their notes

3) Ask students to read their section individually and become experts of the material for their group/pair.

4) After they have read their section, have students turn their papers over and discuss with their group what their section is about. Tell students they should also discuss how they, as a group/pair, will present the material to the class. Circulate to make sure students understand the objective and begin the discussion.

5) Explain that student groups will present their portion of the reading to the class. While they are presenting, the other groups will take notes of the material.

6) If time permits or for homework extension, students can practice paraphrasing and summarizing the information they will present and write it in their notebooks or journals.

Break: 10 minutes

Activity 2: Scientific Method – video w/ note taking handout (Unit 3.2 Handout 2)	Time: 10 - 15 minutes	
1) Hand out <u>(Unit 3.1- Handout 2)</u> for students.		
2) Explain to students they will watch video (Video 3.1 Scientific Method) and take notes and		
2) Explain to students they will watch video (Video	o 3.1 Scientific Method) and take notes and	



answer questions from the video, the notes are for their own information and background knowledge on the scientific method

3) ask students to write down questions they may have from the video

4) After watching video, review answers to questions as a whole class.

Activity 3: Scientific Method – diagram of steps	Time: 30 - 40 minutes
(Unit 3.2 Handout 3)	

1) Hand out (Unit 3.1- Handout 3) to students.

2) Explain how there will most likely be some portion of the GED 2014 Science module (exam) where students will have to write up an experiment or explain about the steps of the Scientific Method. This activity is an example of what they may have to do on the test.

3) Explain to students they should examine the diagram (which may be different from the information learned in their group presentations and/or different than the information from the video. On the GED 2014 Science exam, they will have about 10 minutes to write up a short (3 - 5 sentence) response. This is an example of what may be asked of them on the exam. Ask students to take a few minutes to think about what they will write (brainstorm) then turn their papers over and write answers to questions 1 & 2.

4) Have students work independently if possible to write up their answers to the questions that follow the diagram. Remind students to write complete sentences and use transition words (first, second, next, finally, etc.) in their writing

5) Circulate the class to help students if they are stuck.

6) Have students share their responses with partners or in table groups. They should be peerreviewing for clarity. Then ask for volunteers to read their short responses to the class. If there is time, ask for opportunities to improve the response, or to introduce higher/advanced vocabulary in their writing.

Wrap-Up: Summarize

Time: 5 minutes

Have students turn to a partner (or write in their journals) about one thing they can take away from today's lesson on the Scientific Method. What will they remember for use on the GED 2014 Science Exam? Note: <u>Use Routine 4 Handout</u>

Extra Work/Homework:Time: 30 minutes outside of classStudents can look read further about the Scientific Method (Unit 3.1 handout 4) or review previous
handouts on this (6-way Paragraphs, Introductory Level, #74: The Scientific Method (pp. 144 – 145).

Differentiated Instruction/ELL Accommodation Suggestions	
If some student groups finish early, they can turn their paper over and brainstorm on	Handout
questions to investigate with the Scientific Method.	3.2
Teachers should be aware that ELLs could have some difficult time with pronunciation of	Handout
some vocabulary during the group presentation.	3.1



Online Resources:

Here is a website with reading comprehension questions about atoms and molecules. It also includes digital literacy skills that are needed for GED 2014 (drop down menus). If at **all** possible, have students navigate to the website as a class or on their own to get practice.

http://education.jlab.org/reading/lab_procedure_01.html

Another excellent site is:

http://science.howstuffworks.com/innovation/scientific-experiments/scientific-method3.htm

Suggested Teacher Readings:

• GED Testing Service – GED Science Item Sample (to get an idea of what the test may be like)

http://www.gedtestingservice.com/itemsamplerscience/

• GED Testing Service – Science Module Webinar:

http://www.youtube.com/watch?v=xA9AZ4t0BpY

• Summary of Skills and Content Needed to Prepare for the 2014 GED Test.

http://abe.mpls.k12.mn.us/uploads/summary of 2014 ged test 2.pdf

• Essential Education's 2014 GED Test Curriculum Blueprint (PDF)

http://www.passged.com/media/pdf/educators/curriculum-blueprint.pdf



Unit 3.1 Handout 1 (page 1 of 5)

The Scientific Method Group Presentations – Group A

Group A. You have approximately 10 minutes to read and prepare a presentation to the other groups on your subject matter. You should not read the information to the groups. Your task is to gain an understanding of the material below and then summarize and paraphrase (use your own words) to explain it to your classmates. You are considered the content experts of the material and they may refer to your group to answer questions they have.

The Scientific Method is an organized way of figuring something out. There are usually six parts or steps to it. Your content is: **Step 1: Observation and Step 2: Background Research**. Some information on the two steps is listed below. You can add more information from a dictionary or the Internet.

The Scientific Method – Step 1 - Observation

The first part, or step in the scientific method is the **Observation**. It is curiosity that breeds new knowledge. The process of observation, sometimes called "defining the question," is simple. You observe something that you can't readily explain with your existing knowledge, or you observe some phenomenon that is explained by existing knowledge but which may have another explanation. The question, then, is how do you explain that phenomenon--what causes it to occur?

The Scientific Method – Step 2 - Research

The second step of the scientific method is **Research the existing knowledge about the question**. Suppose you observe that your car won't start. Your question is, why won't it start? You may have some knowledge about cars, so you'll tap into that to try to figure it out. You may also consult your owner's manual or look online for information about the problem. You may even ask your friends about the problem.

If you were a scientist trying to figure out some strange phenomenon, you could consult scientific journals, which publish research that other scientists have already done. You'd want to read as much about your question as possible, because the question may have already been answered, or you may find information that will help you form your hypothesis.



Unit 3.1 Handout 1 (page 2 of 5)

The Scientific Method Group Presentations – Group B

Group B. You have approximately 10 minutes to read and prepare a presentation to the other groups on your subject matter. You should not read the information to the groups. Your task is to gain an understanding of the material below and then summarize and paraphrase (use your own words) to explain it to your classmates. You are considered the content experts of the material and they may refer to your group to answer questions.

The Scientific Method is an organized way of figuring something out. There are usually six parts or steps to it. Your content is: **Step 3: Form Your Hypothesis and Step 4: Experiment**. Some information on the steps is listed below. You can add more information from a dictionary or the Internet.

The Scientific Method – Step 3- Form Your Hypothesis

The third step of the scientific method is to **create a hypothesis**. A hypothesis is a possible explanation for the phenomenon you observed. It is more than a guess, though, because it is based upon a thorough review of the existing knowledge of the subject. It's basically an educated guess that can be tested. The hypothesis should posit, or assume as a fact, a cause-effect relationship. For example, "My car won't start because I am out of gas." It should suggest one possible cause for the effect, and it should be something that you can test and which you can use to make predictions. You can put gas in your car to test the "out of gas" hypothesis, and you can predict that if the hypothesis is correct, the car will start once you add gas. Stating the effect like a fact is more like a real hypothesis. For those who are still stuck, use the "if" and "then" statement: **If** I try to start my car and it doesn't, **then** it is out of gas.

The Scientific Method – Step 4 – Test/Experiment Your Hypothesis

Once you have created a hypothesis, the next, or fourth step is to test it. **Design an experiment** that will either confirm or fail to confirm the hypothesis. The experiment should be designed to try to isolate the phenomenon and the proposed cause. In other words, it should be "controlled." Going back to our simple car question, we can test our hypothesis by putting gas in the car, but if we put gas in the car and change the fuel filter, we can't know for sure whether the lack of gas or the filter was the problem. For complex questions, there may be hundreds or thousands of potential causes, and it can be difficult or impossible to isolate them in any single experiment.

• Keep impeccable records. Experiments must be reproducible. That is, other people must be able to set up a test in the same way that you did and get the same result. It's important, therefore, to keep accurate records of everything you do in your test, and it's essential that you keep all your data. It's critical that you be able to provide all the details.

H. Turngren, Minnesota Literacy Council, 2014 p.6 GED Science Curriculum



Unit 3.1 Handout 1 (page 3 of 5)

The Scientific Method Group Presentations – Group C

Group C. You have approximately 10 minutes to read and prepare a presentation to the other groups on your subject matter. You should not read the information to the groups. Your task is to gain an understanding of the material below and then summarize and paraphrase (use your own words) to explain it to your classmates. You are considered the content experts of the material and they may refer to your group to answer questions.

The Scientific Method is an organized way of figuring something out. There are usually six parts or steps to it. Your content is **Step 5: Analysis and Conclusion and Step 6: Report Findings**. Some information on the steps is listed below. You can add more information from a dictionary or the Internet.

The Scientific Method – Step 5 - Analyze Your Results and Draw Conclusions.

The fifth step in the scientific method is to **analyze your results from the experiments**. Hypothesis testing is simply a way to collect data that will help you either confirm or fail to confirm your hypothesis. If your car starts when you add gas, your analysis is pretty simple--your hypothesis was confirmed. In more complicated tests, however, you may not be able to figure out whether your hypothesis is confirmed without first spending considerable time looking at the data you gathered in your hypothesis testing. Note that you do not prove or disprove a hypothesis, but rather confirm or fail to confirm it. If the question is why your car won't start, confirming the hypothesis (you're out of gas) and proving it are pretty much the same thing, but for more complex questions that may have many possible explanations, one or two experiments cannot prove or disprove a hypothesis.

The Scientific Method – Step 6 Report Your Findings

The sixth or final step in the scientific method is to **report your finding**. Scientists generally report the results of their research in scientific journals or in papers at conferences. They report not only the results but also their methodology and any problems or questions that arose during their hypothesis testing. Reporting your findings enables others to build upon them.



Unit 3.1 Handout 1 (page 4 of 5)

The Scientific Method Group Presentations – Group D

Group D. You have approximately 10 minutes to read and prepare a presentation to the other groups on your subject matter. You should not read the information to the groups. Your task is to gain an understanding of the material below and then summarize and paraphrase (use your own words) to explain it to your classmates. You are considered the content experts of the material and they may refer to your group to answer questions.

Your content is **"Variables and Control"**. Some information on the terms is listed below. You can add more information from a dictionary or the Internet.

Variables and Control

The things that have an effect on the experiment are called variables. There are three kinds of variables that you need to identify in your experiments: **independent**, **dependent**, **and controlled**.

A. Independent Variable

The independent variable is the variable you purposely manipulate (change). This is the part of your experiment that you will test (vary) to answer your hypothesis. It is what you change in the experiment.

B. Dependent Variable

The dependent variable is what you measure. It is the variable that is being observed, which changes in response to the independent variable. This is the difference between the two parts of the experiment that happens when the independent variable is changed.

C. Controlled Variable

The variables that are not changed are called controlled variables. The control should be the part of the experiment where you do not include the independent variable. It is what you do not change.



Unit 3.1 Handout 1 (page 5 of 5) Use the space below to write information from the presentations.

The Scientific Method Group Presentations – Notes for All Groups

Step 1:

Step 2:

Step 3:

Step 4:

Step 5:

Step 6:

Variables:

Α.

B.



Unit 3.1 Handout 2

The Scientific Method Explained

Video on: Properties of Experimental Designs

Watch the video and write the steps to the Scientific Method as explained by Science Teacher Andrew Guy. (You may try to predict what he will explain and write predictions in pencil.)

What is a mnemonic device:

O = _	
? =	
• -	
ц_	
п	
_	
E = _	
A = _	
C = _	
Tell -	it

Do you think his explanation will help you remember the steps on a science test?



Unit 3.1 Handout 2

The Scientific Method Explained – ANSWER KEY

Video on: Properties of Experimental Designs

Watch the video and write the steps to the Scientific Method as explained by Science Teacher Andrew Guy.

What is a mnemonic device: ___(a memory tool to help you remember__

O = observation – what we observe or see with our eyes

? = ask a question – we observe something and ask a question,

H = hypothesis – it is not an education guess, it is a question that is testable

E = carry out the experiment

A = do an analysis

C = arrive at a conclusion

Tell - it - communicate our results (write a research paper or write a report)

O?HEAC - tell it 1 2

1 is report

2 is research paper

H. Turngren, Minnesota Literacy Council, 2014

p.11

GED Science Curriculum



Unit 3.1 Handout 3 The Scientific Method Diagram



Questions and Exercises (use the back of this paper to write your answers.)

- 1. What is the scientific method and its steps?
- 2. How can the scientific method be used to answer questions about daily life? Think of a question in your life that you could answer using the scientific method. Then describe each step of the scientific method as you move toward answering your question.





Answer will vary: Possible answer: The scientific method is an organized or structured way or method to understand. There are usually six steps to the scientific method: 1) begin with a question or purpose, 2) do some background research to get more information, 3) create a hypothesis or a question that can be tested, 4) do experiments to test the hypothesis, 5) analyze the results from the experiment, and finally 6) report or tell about your findings in a conclusion.

2. How can the scientific method be used to answer questions about daily life? Think of a question in your life that you could answer using the scientific method. Then describe each step of the scientific method as you move toward answering your question.

Answers will vary, but make sure there is a question, some background research, hypothesis, an experiment, analysis, and a conclusion present in the answer. This is something that most likely will be present on the GED 2014 Science exam. Make sure students can write up an experiment using the scientific method.



Unit 3.1 Handout 4 – page 1 of 4

The Scientific Method

by Donna Voth

Skim this excerpt from *The Science Fair Handbook*, looking for main ideas and a few details. When you finish, enter your reading time and speed in the box that follows the selection.

Science is based on wondering. You begin to be a scientist when you ask questions:

- Why did that happen?
- What would be different if I changed this one thing?
- How did that happen?
- When did that occur?
- How is this different from that?

You become a scientist when you try to find answers to your questions by using the scientific method.

When you follow the scientific method, your science project begins with a *hypothesis* a question and your own informed guess at an answer, which you *test* by following your *procedure*. A procedure is the steps you take to do an *experiment* or *field work*, which leads you to confirm—or not confirm—your hypothesis. You look at the actual results, compare them with your expectations, and write your *conclusion* based on what you have found out.

In your report, you describe how you followed the scientific method, step by step. At the end of your report, you will mention new questions you would like to look into and things you would like to try based on what you have learned from your results. Let's take some time to understand the scientific method, the backbone of a science project. The scientific method has four parts:

OBSERVATION

You notice something in the world that you want to know more about. You then ask a question about it. This question is what you try to uncover an answer to in your science project. HYPOTHESIS

You predict why, when, where, or how whatever you observed happened, based on information you already have. Sometimes this takes the form of an "if . . . then" statement. A hypothesis is often called an "educated guess" because you base your prediction on facts you already know.

TESTING

You test your hypothesis with a procedure. You can do either an experiment, where everything except the particular thing being tested is carefully controlled, or field work, where you study your subject in the natural world. Careful observations and measurements are recorded in both testing procedures.

CONCLUSION

You state whether or not your hypothesis was correct, based on the results of your testing. If your hypothesis is proven wrong, try to explain why. Also, make any further predictions your results could point to, and describe any changes to your procedure you think would give more accurate results or be helpful to further research.

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Lesson 3.1: Scientific Method 1

Unit 3.1 Handout 4 – page 2 of 4

PROCEDURE

The procedure is the practical part of the scientific method—it's the steps you take to test your hypothesis.

The purpose of science is to discover things about the world with accuracy, truth, and objectivity. Scientists

- test ideas
- weigh evidence carefully
- come to conclusions cautiously
- make conclusions based on facts.

An important part of the scientist's process of discovery is the procedure followed. A procedure is like a recipe—it's a list of steps. The steps you plan to take to test your hypothesis must be clearly written out so that anyone could repeat what you have done. Your procedure

- gives step-by-step directions on what to do
- lists all the materials and equipment you use
- provides any instructions you need to build or use equipment.

EXPERIMENT AND FIELD WORK

Scientists test their hypotheses either through experiment or field work.

EXPERIMENT

Experimental observations are made in a controlled *environment* that you create. How? You make a simpler, smaller-scale version of the part of the real world you want to study. You focus your attention on just a few things, instead of on everything that can happen.

In an experiment, a scientist tries to look at how just one thing affects a subject. The tricky part is creating an environment in which only that one thing changes. That is why you often see scientists using test tubes, petri dishes, and other small, enclosed settings for their experiment. It is much easier to control things in such environments.

FIELD WORK

In field work, a scientist goes into an uncontrolled environment, a specific place in the world, and records exactly what is observed there at the time. Because you are studying a unique situation every time, field work is almost always new and original.

The tricky part with field work is that while you are recording your observations, you must make sure that you yourself are not interfering with your subject simply by being there. For instance, you cannot count birds in a tree if you scare any (or all!) away while you try to count them.

VARIABLES, CONTROLS, GROUPS, AND TRIALS

Scientists are like detectives—they try to solve mysteries. Experiments are part of a scientist's detective kit. When you want to prove a theory true or false, create an experiment that will test one thing you can observe.

You have an idea—that if you set up a controlled situation and purposely change only one thing, this alteration will cause something else to happen. The thing you purposely change is called the *changing variable*. If your change causes something else to happen, this "something else" is called the *responding variable*, because it is responding to the change.

You must plan your procedure carefully to be sure that you change only one thing in your experimental group.

Suppose you want to know what would happen if you played music for an experimental group of plants. You will play music, your changing variable, and watch for any signs of a responding variable, which you expect to be bigger or faster growth.

But how will you know if any growth is a change? How will you know what is bigger and faster growth? You need a way to compare the rate of growth. You need to have



Unit 3.1 Handout 4 – page 3 of 4

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something to compare your experimental plants to—something to show what normal growth is. So you need a *control group*. You need to raise some other plants in exactly the same way as you raise your experimental group, except that they will not experience the changing variable. You will treat them exactly the same as you do the experimental group, but you will not play music for them.

Your experimental group—Give these plants x amount of food, y amount of water, and play music for them.

Your control group—Use the same kind and age and size of plants, give them the same amounts of food and water, but do not expose them to any music.

You can measure the growth of the plants that you expose to music against the growth of the plants that you don't.

Still, you need to consider some other things. Can you think of anything that could affect the plants? How about diseases or pests? Could some of the plants have been healthier than others before you even started the experiment? That is possible, even though you looked them over carefully before you began. To ensure that any recorded change is from your changing variable, and only from your changing variable, you should test in groups of at least 25 subjects. For example, if you tested only one or two plants and they both died, you could not be sure that their death resulted from your experiment, or if they were weak before being part of the experiment and were about to die anyway. But if you tested a group of 25 subjects and only two died, you could more confidently conclude that those two plants had been weak or ill before the experiment began.

To be reasonably sure that nothing happens randomly (by chance), you also should run at least three *trials*—do your experiment three times. For example, if you ran your experiment once and correctly used a group of at least 25 subjects, but they all died, you could not be sure their deaths were the result of your experiment. Perhaps they had all been weak or ill before they were affected by your experiment. If you have at least three trials, and the results are similar each time, you can feel more confident that your results are accurate. If one of the trials gives results that are inconsistent with the others, you can suspect a problem with the odd trial.

 Record your reading time below. Then look up your reading speed on the Words-per-Minute table on page 72.

Reading Time

Reading Speed

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Lesson 3.1: Scientific Method 1

Unit 3.1 Handout 4 – page 4 of 4

Comprehension

Put an \mathbf{x} in the box next to the correct answer for each question or statement. Do not look back at the selection.

- 1. You begin to be a scientist when you
 - □ a. ask questions about things you wonder about.
 - b. find answers to questions you wonder about.
 - □ c. do experiments to prove why something happens.

2, When doing a science project following the scientific method, you should first

- □ a. write a report describing how you will follow the scientific method.
- \Box b. do an experiment or field work.
- \Box c. state your hypothesis.

3. What is a hypothesis?

- □ a. the steps you take to do an experiment or field work
- b. a comparison of the actual results of an experiment with your expectations
- □ c. a question and your own informed guess at an answer
- 4. How many parts are there to the scientific method?
 - \Box a. three
 - □ b. four
 - \Box c. five
- 5. The author compares the procedure used in the scientific method to a
 - □ a. report.
 - □ b. recipe.
 - C. guidebook.
- 6. In testing your hypothesis with a procedure, you should do
 - \Box a. an experiment.
 - \Box b. field work.
 - \Box c. either of the above

7. When should you use a controlled environment?

- □ a. when doing an experimental observation
- \Box b. when doing field work
- \Box c. before stating your hypothesis
- 8. Which of the following statements is true of both an experimental observation and field work?
 - a. It is almost always new and original because you are studying a unique situation every time.
 - b. You focus your attention on just a few things, instead of on everything that can happen.
 - c. Careful observations and measurements are recorded.
- 9. In a controlled experiment, when one change causes something else to change, the "something else" that changes is called the
 - \Box a. changing variable.
 - \Box b. constant variable.
 - \Box c. responding variable.
- 10. How many times should you do an experiment (run trials) to be reasonably sure that nothing in the experiment happens by chance?
 - 🗆 a. two
 - □ b. three
 - \Box c. four

Use the answer key provided by your teacher to check your work.

_____Number of correct answers Enter your Reading Speed and your Comprehension Score on the Progress Graph on page 73.



Unit 3.1 Handout 4 - ANSWER KEY

Comprehension

- 1. **A**
- 2. **C**
- 3. **C**
- 4. B (according to this reading, other readings state there are 6 steps)
- 5. **B**
- 6. **C**
- 7. **A**
- 8. **C**
- 9. **C**
- 10. **B**