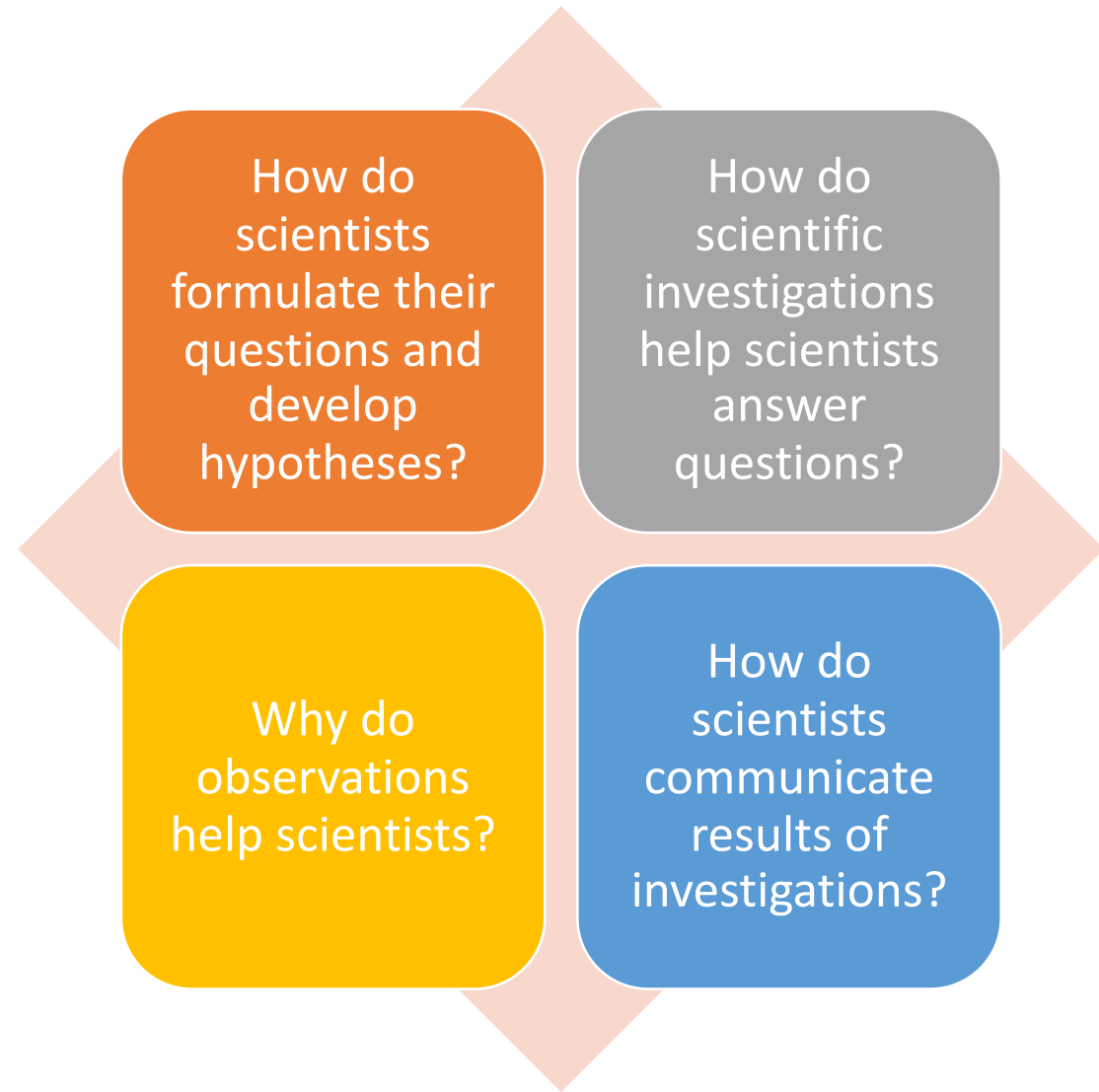


# GED Science Day 9

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# The Scientific Method: Essential Questions



# The Big Idea

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Scientists make observations, ask questions, and record data to help them formulate questions, make hypotheses, and come to conclusions in science investigations.



# Opinion vs. Hypothesis

What's the  
difference?

Can you think of  
examples of each?



# **Read: Language of Scientific Ideas: Opinions and Hypotheses**

The scientific process involves observing, describing, identifying, testing, and evaluating problems to be answered. As scientists develop ideas and test questions, there are many ways for them to express their thoughts and ideas. Two major categories of expression are: (1) opinions and (2) hypotheses. In science, these words have specific meanings that may be different than those used in day-to-day conversation. Table 1.1 summarizes these categories of scientific language questions to ask when classifying scientific language.

**Table 1.1.** Summary of scientific language and questions to ask when classifying scientific language.

	<b>Definition</b>	<b>Questions to Ask</b>
<b>Opinion</b>	Personal belief that is not objective, tested, or testable as stated.	Is this a personal belief?  If yes: an OPINION
<b>Hypothesis</b>	A statement that is testable, offers a possible explanation, and is based on observations about the natural world.	Is this scientifically testable?  If yes: a HYPOTHESIS

A **hypothesis** is a statement that is usually based on observations or evidence.

Hypotheses must be testable, and once tested, they can be supported by evidence.

Some people refer to a hypothesis as an educated guess, but most hypotheses are more than guesses because they have reasoning behind them.

Hypotheses are sometimes expressed in three parts: if, then, and because. A hypothesis can be stated as "If we expose fish eggs to caffeine then they will hatch early because caffeine is a stimulant". In this example, the reasoning behind the hypothesis is in the "because" part of the statement. Hypotheses should be worded so that they can be tested.

In the previous example, the hypothesis could be tested by exposing fish eggs to caffeine. Hypotheses are not proven, only supported or unsupported. If the eggs do not hatch early, the hypothesis is **unsupported**. However, if the eggs do hatch early our hypothesis is **supported**.

An **opinion** is a statement describing a personal belief or thought. Opinions cannot be scientifically disproved. Opinions often contain language that describes or compares items in a way that is not measurable as written, such as "bad," "nice," or "better." For example, the statement "the favorite food of hermit crabs is fish" is an opinion. This statement is not testable because 1) it would be impossible to provide everything single food option to every single hermit crab and find out which food is their favorite, and 2) you cannot ask hermit crabs what their favorite food is.

However, a critically thinking person can modify an opinion to make it testable and then develop a hypothesis. In the previous statement, you can change the word "favorite" to "preference," limit the food choices, and identify the type of hermit crab you are interested in studying. A hypothesis would be "the hermit crab *Calcinus seurati* prefers canned tuna fish to canned clams."

This is a testable hypothesis because you can conduct an experiment to see which of these two foods *Calcinus seurati* will eat more of when given both options. The hermit crab would be said to prefer the food it consumed more of. Scientists would not use the term "favorite" because favorite implies emotion and the knowledge of choices, neither of which are appropriate to hermit crabs.



# Opinions

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## Expressing an Opinion

Sentence Stems
I think/feel...
I don't think...
In my opinion...
As far as I'm concerned...
If you ask me...
The way I see it...
From my point of view...

# Is it a hypothesis or an opinion?

1. If the oven is too hot, my cake will be dry at the end of its cooking time.
2. Moist cake is better than dry cake.

# Is it a hypothesis or an opinion?

3. Most people like moist cake more than dry cake.

4. If I bring two cakes to class, one moist and one dry, and everyone takes one piece, more than half of my classmates will choose the moist cake.

# Is it a hypothesis or an opinion?

5. If I reduce the temperature of the oven, the cake will be moister.

6. Adding more baking powder to the batter will make the cake bad.

# Is it a hypothesis or an opinion?

8. Adding more baking powder to the batter will cause the finished cake to rise more.





# Validity of a Hypothesis

**a** Some questions cannot be answered with the scientific method. This is especially true of questions that begin with “why.” Science is more about addressing questions beginning with “how.”

**b** A good hypothesis is testable and refutable. That is, it has to be subject to scrutiny. It has to be open to the question: What piece of evidence will falsify the hypothesis?

Scientific investigations often begin with an observation. Then the observation leads to a question. Not all questions can be answered by a scientific investigation. Questions that can be answered by the scientific method are those that can be answered in the form of a testable hypothesis. To formulate a testable hypothesis, scientists make an educated guess about cause-and-effect relationships. The causes and the effects are called variables; the cause is also called the independent variable, and the effect is known as the dependent variable. In a well-designed investigation, data about the independent and dependent variables are collected, recorded, and analyzed. If the hypothesis is validated by the data, the results can be used to make reliable predictions.

**c** A testable hypothesis identifies something that is measurable. For example, the amount of salt that is added to a sample of water and the temperature at which the water freezes are measurable variables.



Henry noticed that salt water freezes at a lower temperature than freshwater does. This observation led him to the question, "Does increasing the amount of salt in salt water reduce the freezing point of the water?" Which statement is a testable hypothesis that could be formulated from Henry's observation and question?

- A. Adding salt to salt water raises its freezing point.
- B. Adding salt to salt water lowers its freezing point.
- C. Adding salt to salt water has an effect on the freezing point of the water.
- D. Adding salt to salt water does not have a significant effect on the freezing point of the water.

A student in a science classroom conducts an investigation to test heat flow. She creates equal size dots of candle wax, places the dots of wax equal distances apart on a copper rod, and then inserts one end of the rod into a flame. She observes as the dots of wax melt in order from the dot closest to the heat source to the dot farthest from the heat source. Her observation supports her hypothesis.

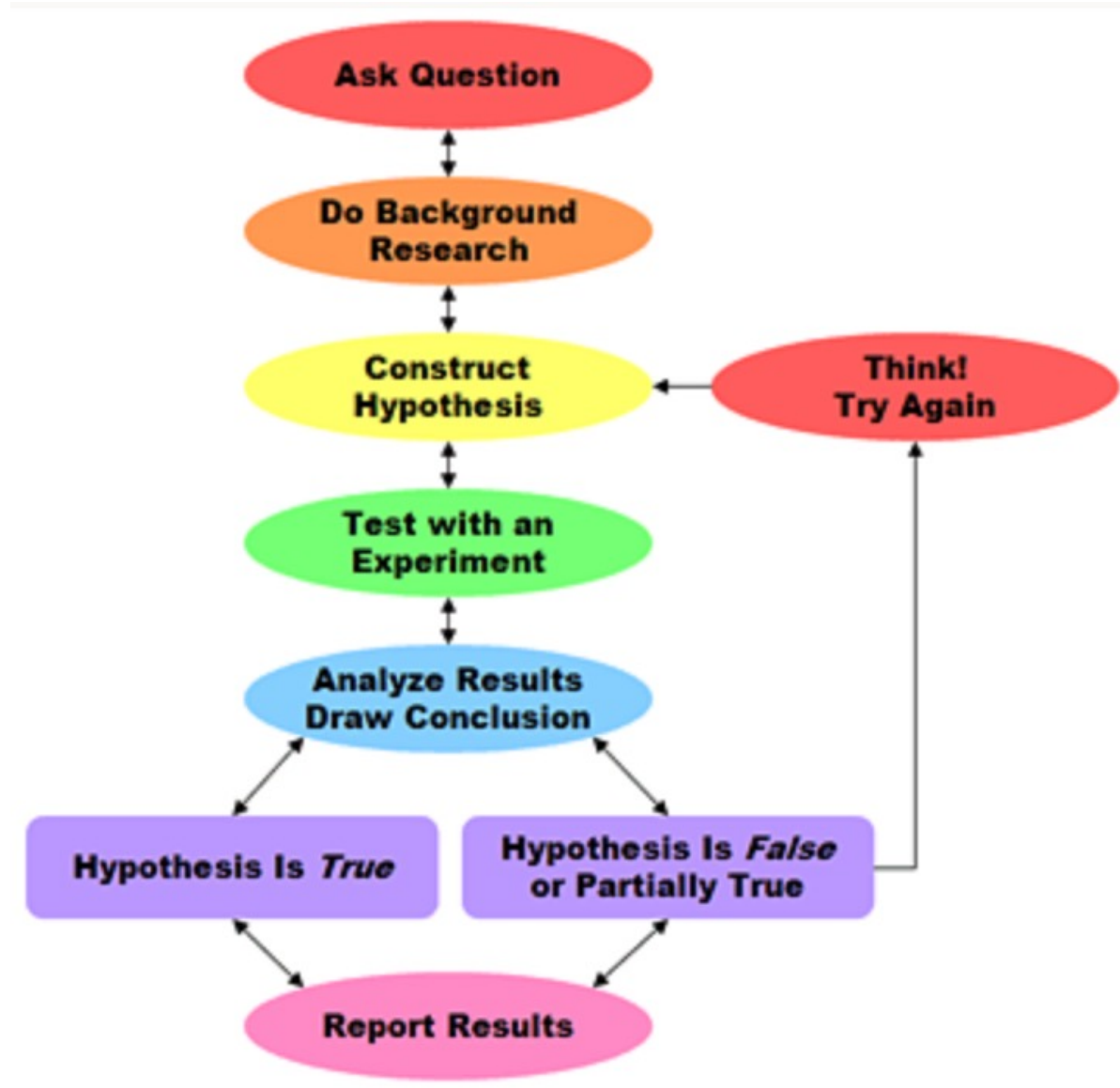
7. What hypothesis is the student **most likely** testing?
- A. Heat flows from warmer parts of a solid to cooler parts of a solid.
  - B. Heat flows from warmer parts of a metal object to cooler parts of a metal object.
  - C. Copper is a better conductor of heat than other metals.
  - D. Bringing about heat transfer by radiation is an effective method for melting objects.



Another student attempts to repeat the investigation. He also uses wax from a candle and a copper rod, but he observes that one dot of wax appears to begin to melt before a dot of wax that is closer to the flame. What is a likely source of error in his investigation?

- A. The flame produces higher heat later in the investigation.
- B. The copper rod is longer than that used in the first investigation.
- C. The two dots are different types of wax.
- D. The dots are not equal in size.

# Scientific Method Flow Chart



# Homework!

## Active Assignments



Week 9

To begin, select an activity from All Activities

[Select New Activity](#) 



**All Activities**

Completion: 0/5 (0%)



No Due Date