Questions related to the Scientific Method will test your familiarity of the steps and tools in the process of developing scientific knowledge. As the applicant, you will need to demonstrate understanding of how experiments are designed and comprehend how to critique them. In healthcare, the scientific method's steps are critical to our practice. You must understand and critique a patient's presenting condition to formulate a diagnosis of their problem. Let's get started in understanding how the Scientific Method is important on the ATI TEAS.

Scientists use a plan called the scientific method to perform experiments and discuss their results with one another. This allows experiments to be repeated to confirm results and allows those results to be communicated uniformly.
There are six steps in the scientific method that are conducted in the same order.

Step 1: Make an observation and identify the problem to be studied.

Step 2: Ask a question or questions about the problem.

Step 3: Formulate a hypothesis that attempts to answer one of the questions raised about the problem.

Step 4: Gather data and/or conduct an experiment to test the hypothesis.

Step 5: Analyze the data gathered.

Step 6: Draw a conclusion regarding whether or not the hypothesis is supported by the data.

As a scientist or researcher works through the first few steps of the scientific method to come up with the hypothesis, he or she must pay attention to the type of logical reasoning used to form the hypothesis. There are two basic types of logical reasoning: inductive and deductive.

**Inductive Reasoning**

Inductive reasoning involves drawing general conclusions based on observation of specific events.

*Example:* A coin you pull from a bag is a penny. You pull another coin from the bag and that coin is also a penny. Therefore, all the coins in the bag are pennies.

Inductive reasoning is based on observations. However, this form of reasoning has its flaws. Suppose there are other coins in the bag, but you do not have a chance to pull them out. It would be incorrect for you to conclude definitively that all the coins in the bag are pennies.

**Deductive Reasoning**

Deductive reasoning involves drawing a specific conclusion based on a general premise. When using this form of reasoning, the conclusion can only be true if the general premise is also true. However, if he or she starts out with a false premise the conclusion will also be false.

*Example 1:* All men are mortal. Harold is a man. Therefore, Harold is mortal. The conclusion is logical and true.

*Example 2:* All bald men are grandfathers. Harold is bald. Therefore, Harold is a grandfather. The conclusion is logically untrue because the original statement is false.
Science experiments are often designed with dependent and independent variables.

- **Dependent variable**: the variable being tested and measured in a scientific experiment. It is the outcome, or effect, being studied.
- **Independent variable**: the variable that is changed or controlled in a scientific experiment to test the effects on the dependent variable.

It may help to think of the two types of variables as follows: the independent variable acts on the dependent variable. The dependent variable is dependent because it is influenced by the actions of the independent variable. In contrast, the independent variable is not influenced by another source.

**Here is an example of dependent and independent variables:**

**Experiment 1**: What brand of microwave popcorn pops the most kernels and gives the most value for the money. You test different brands of popcorn to see which bag pops the most popcorn kernels.

- **Independent variable**: Brand of popcorn bags (it's the independent variable because the popcorn brand bags cannot change from one brand to another).
- **Dependent variable**: Number of kernels popped (this is the dependent variable because it's what you measure for each popcorn brand).

**Experiment 2**: What type of fertilizer helps plants grow the fastest. You test different brands of fertilizer to see which plant grows the fastest.

- **Independent variable**: Brand of fertilizer given to plant (it's the independent variable because the fertilizer brand bags cannot change from one brand to another).
- **Dependent variable**: Plant height (this is the dependent variable because it's what you measure for each fertilizer brand).
Experiments are often designed with two types of test groups: experimental groups and control groups.

- **Experimental groups or treatment groups** are the test groups that receive the particular factor being tested, such as medication or fertilizer, as discussed in our previous example. This group is receiving treatment and being tested.

- **Control groups** are groups that do not receive treatment or has a factor being tested. Control groups may never receive a factor. For example: this group would not receive any fertilizer.

Note: control groups may also give a "false" factor result, known as a placebo. For example: In pharmaceutical trials, a patient may be given a sugar pill in place of the medication being tested. Patients may experience false effects such as feeling better or worse based on false medication side effects.

---

Once an experiment has been performed, the scientists or researchers must analyze the results and form conclusions. They must be careful to make conclusions that are supported by empirical evidence (data or information obtained from creating assumptions over a specific topic). Conclusions should never be drawn based on opinions or bias (favoring an idea over another).

While analyzing data, scientists and researchers look for cause-and-effect relations. The first step in this process is to look for factors that appear to be correlated. This can be established by direct correlations and inverse correlations.

---

A direct correlation/positive correlation shows that as one factor increases, the other factor also increases.

- **For example**: The more alcohol one consumes, the more urination one creates. As the alcohol consumption increases, the person’s urination frequency increases as well.

An inverse correlation/negative correlation shows that as one factor increases, the other decreases.

- **For example**: The more alcohol one consumes, the less judgment one has. As the alcohol consumption increases, the person’s judgment decreases.

---

This relationship can also be seen in positive and negative covariances as discussed in the ATI TEAS Math Review.
DIRECT AND INVERSE CORRELATIONS

In addition, correlations can sometimes be referred to as variations.

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Correlation/ Positive Variation</td>
<td>Direct Variation</td>
</tr>
<tr>
<td>Negative Correlation/ Negative Variation</td>
<td>Indirect Variation</td>
</tr>
</tbody>
</table>

Correlations can be graphed to show results of an experiment.

- The line of a line graph with a direct or positive correlation will have a positive slope (upward slanting to the right).
- The line of a graph with an inverse correlation or variation will have a negative slope (downward slanting to the right).

It is important to note that correlations do not always prove relationships. To conclude that one thing caused another thing to occur is difficult and requires more than one experiment or study. Only after multiple studies and experiments over time produce a prevalence of evidence supporting the cause can a scientist or researcher conclude that a causal relationship exists.

For example, studies have shown a relationship between alcoholism and depression. However, when conducting a study, it's important to understand that sequencing can make a big difference and can invalidate a conclusion. Does alcoholism cause depression or does depression cause alcoholism?
The ATI TEAS will expect you to know how scientific measurements are made and what laboratory tools are used to make them. Accuracy in measurement is vital to an experiment and knowing the proper tool to use is equally important.

Scientists and researchers use the metric system to measure the mass, volume, and length of objects. The metric system has base units and adds prefixes to describe increased or decreased levels of units.

### Here are the most common prefixes.

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Meaning</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kilo</td>
<td>One Thousand</td>
<td>Gram, Liter, Meter</td>
</tr>
<tr>
<td>Hecto</td>
<td>One Hundred</td>
<td></td>
</tr>
<tr>
<td>Deka</td>
<td>Ten</td>
<td></td>
</tr>
<tr>
<td>Base Unit: Gram, Liter, Meter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deci</td>
<td>One Tenth</td>
<td></td>
</tr>
<tr>
<td>Centi</td>
<td>One Hundredth</td>
<td></td>
</tr>
<tr>
<td>Milli</td>
<td>One Thousandth</td>
<td></td>
</tr>
</tbody>
</table>

In addition to the metric system, the ATI TEAS will test your knowledge of which tool is appropriate to measure an item’s mass, volume, or length.

Here are some common scientific tools and what they are used to measure.

<table>
<thead>
<tr>
<th>Tool</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermometer</td>
<td>Temperature</td>
</tr>
<tr>
<td>Graduated cylinder</td>
<td>Volume of liquid</td>
</tr>
<tr>
<td>Volumetric pipette</td>
<td>Volume of liquid</td>
</tr>
<tr>
<td>Vessel</td>
<td>Length</td>
</tr>
<tr>
<td>Triple-beam balance</td>
<td>Compare mass of an object to a known mass</td>
</tr>
<tr>
<td>Caliper</td>
<td>Thickness</td>
</tr>
<tr>
<td>Spring scale</td>
<td>Force</td>
</tr>
<tr>
<td>Stylus</td>
<td>size</td>
</tr>
</tbody>
</table>