Designing Experimental Investigations

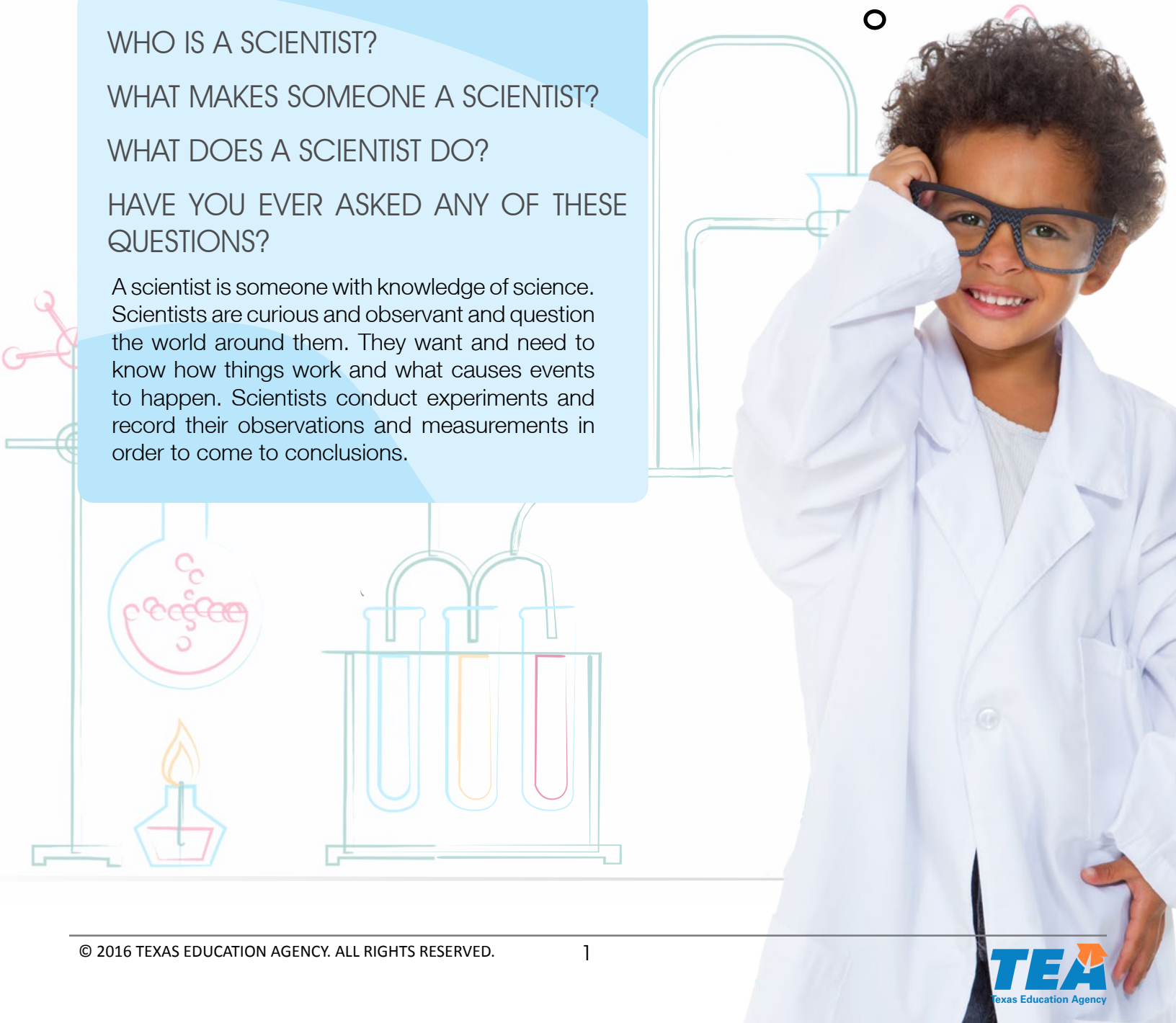
WHO IS A SCIENTIST?

WHAT MAKES SOMEONE A SCIENTIST?

WHAT DOES A SCIENTIST DO?

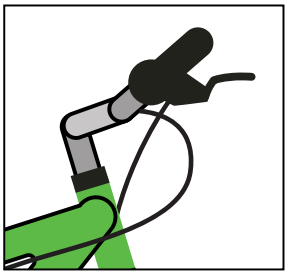
HAVE YOU EVER ASKED ANY OF THESE QUESTIONS?

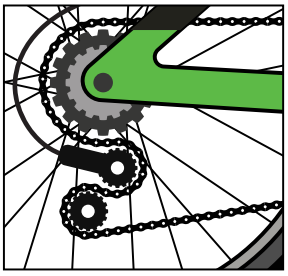
A scientist is someone with knowledge of science. Scientists are curious and observant and question the world around them. They want and need to know how things work and what causes events to happen. Scientists conduct experiments and record their observations and measurements in order to come to conclusions.

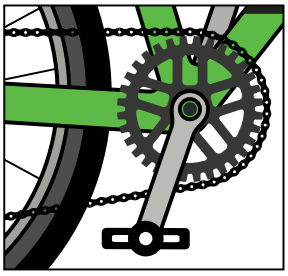


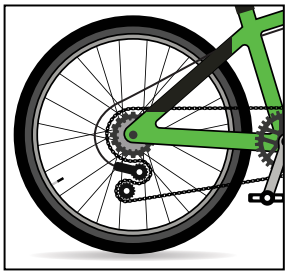
TYPES OF INVESTIGATIONS

Some investigations involve simple observations as scientists try to understand a process or behavior. For example, if a scientist wants to know how a bicycle works, she might watch someone ride a bicycle and observe how the gears, chains, wheels, handlebars, and brakes function independently or together as a system. This type of investigation is called a descriptive investigation.



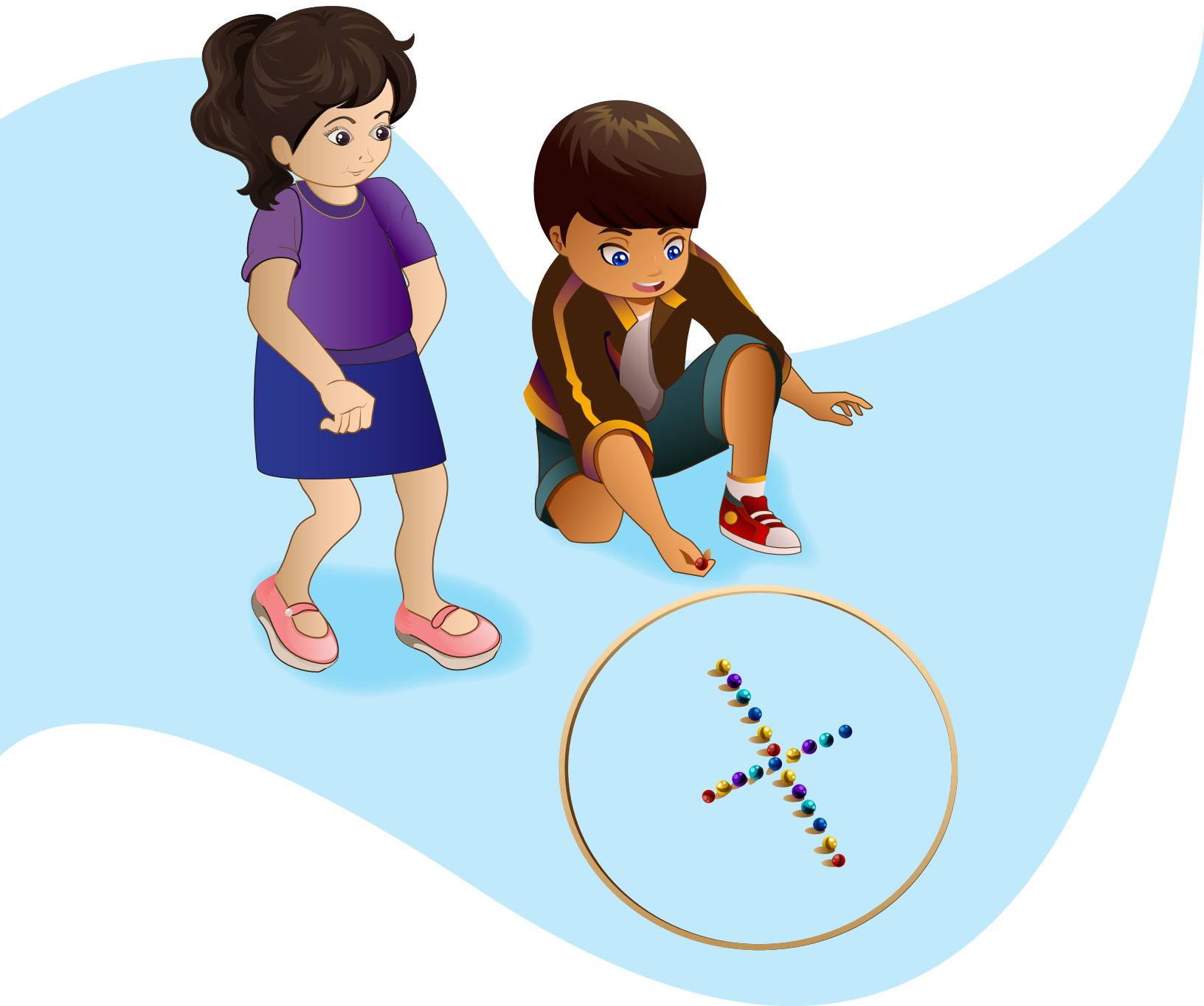






Another kind of investigation is called a *comparative investigation*. This kind of investigation involves comparing a process or behavior in two different settings. For example, a scientist may observe how a chipmunk behaves in the fall and then in the spring. The different seasons are the variable in this investigation. A scientist may predict that the chipmunk will be more active in the spring after hibernation as it searches for food and water and then be less active in the fall as it prepares to hibernate through winter.

Another kind of investigation is called an *experimental investigation*. An experimental investigation involves a test with three identified variables. Some variables stay the same throughout the experiment, one variable is manipulated by the scientist, and another variable responds to the manipulated variable. Scientists observe the relationship between the variables during the experiment. This kind of experiment can also be called a *controlled experiment*.



EXPERIMENTAL INVESTIGATIONS

An experimental investigation is a process that includes several steps or parts.

The first step in an experimental investigation is to develop a question to answer. For example, will a ball roll farther on tile or carpet? The question should be observable, measurable, and testable.

The second step in an experimental investigation is to make a hypothesis regarding what will happen in the experiment. For example, a hypothesis could be "The ball will roll farther on tile."

The third step in an experimental investigation is to identify three different variables.

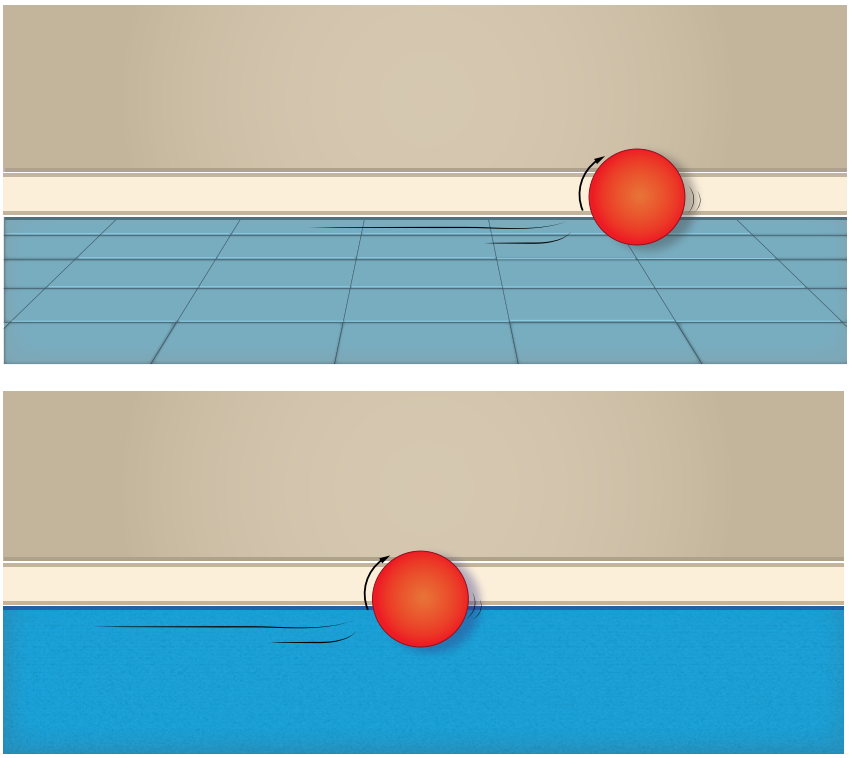
- An *independent variable* is a variable that a scientist manipulates or changes. For example, an independent variable would be the type of flooring when trying to figure out if a ball will roll farther on tile or carpet. An independent variable is also called a manipulated variable.
- A *dependent variable* is the variable that changes based on the independent variable. For example, the distance the ball rolls on different types of flooring is the dependent variable. A dependent variable is also called a responding variable. This is what the scientist measures.
- A *controlled variable* is any variable that stays the same in an experiment. The ball would be a controlled variable in an experiment involving how far a ball rolls on tile versus carpet. The only fair way to test this question would be to use the same ball on both flooring surfaces. The method of releasing the ball should also be the same. Rolling the ball or pushing the ball may result in different amounts of force being used each time, so the scientist may choose to release the ball down a ramp or launch it using a push-pull spring scale.

The fourth step in an experimental investigation is to write a procedure. A procedure is a step-by-step set of instructions that details how to do an experiment. The procedure needs to be written clearly enough that another scientist could re-create the exact experiment.

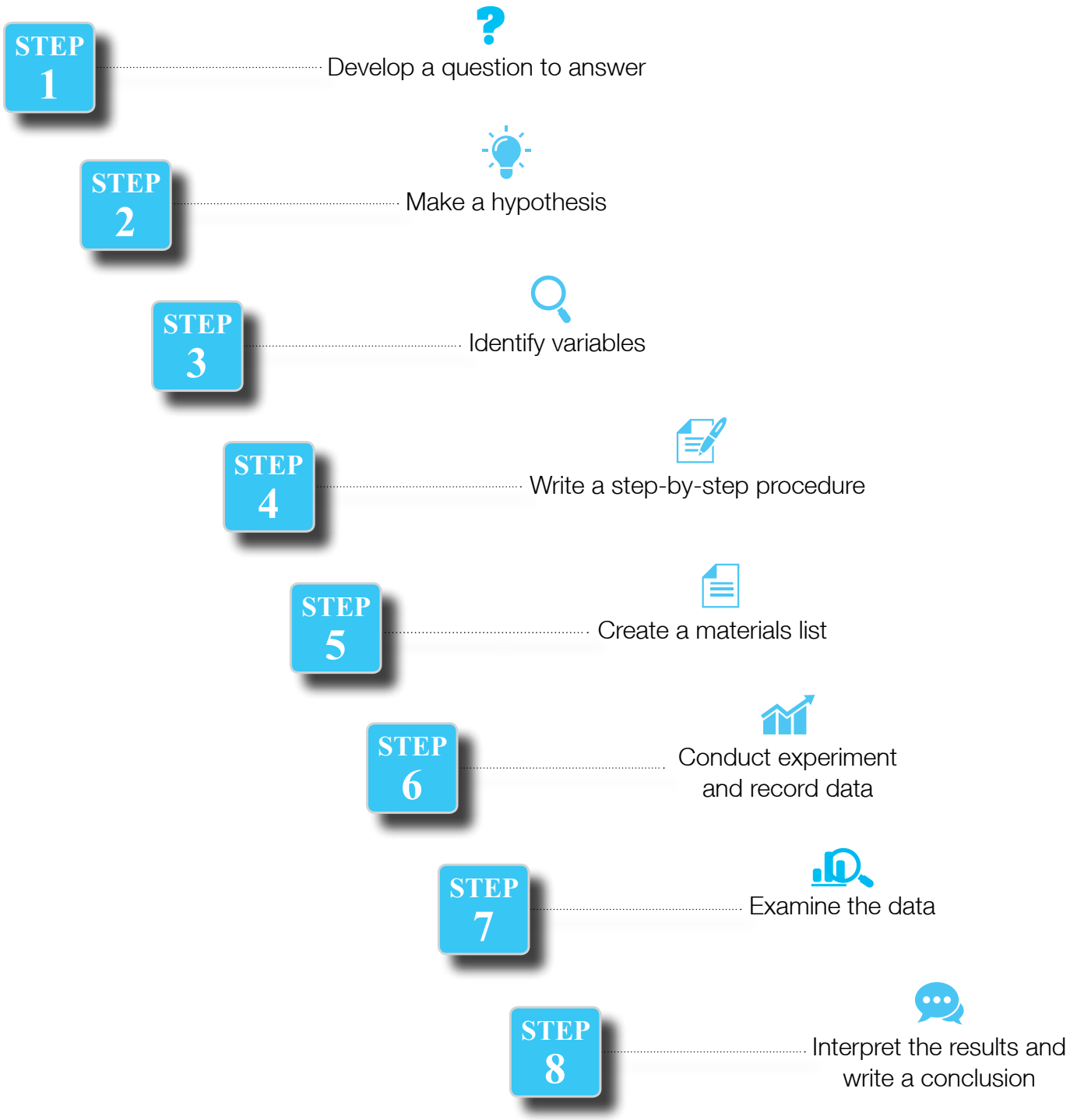
The fifth step in an experimental investigation is to create a materials list. The materials list should include everything a scientist needs to do the experiment.

The sixth step in an experimental investigation is to record data, such as observations and measurements, as a scientist does the experiment. Data can be recorded in a table or graph and may include sketches or written notes. Scientists should run multiple trials in an investigation to collect reliable data. The goal is to see if the majority of the trials have the same result. If so, the data is reliable. If the results from the trials are all different, the scientist will need to conduct more trials to see if the data support the hypothesis or not.

The seventh step in an experimental investigation is to examine the data. For example, in an experimental investigation that tests the force of friction, a ball should be released to roll on carpet multiple times and then released to roll on tile multiple times. If the ball consistently rolls a shorter distance on carpet than on tile, the data indicate that carpet has more friction. More friction causes the ball to roll a shorter distance.



The eighth, or last, step in an experimental investigation is to interpret the results and to write a conclusion that supports the hypothesis or explains why the hypothesis is incorrect.



Based on the information you have just read, are you a scientist? Have you ever conducted an investigation or experiment? If so, you are a scientist! All you need to do is ask questions, be observant, and conduct safe, supervised experiments. Make sure your teacher or an adult has approved your investigation to make sure it is safe before you conduct it. After that, get going!