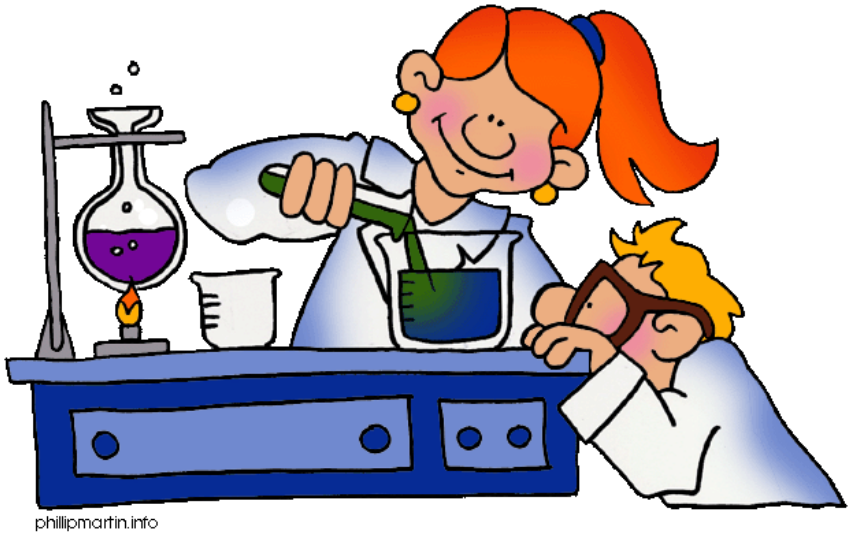
The Scientific Method

-or-

How to Write a Testable Question



Tamara Helfer, 2012 Sequoia Science Explorations

Sometimes scientists just like to explore…

Exploring or making observations often makes scientists curious about specific questions.

To answer these questions, most scientists carry out investigations using The Scientific Method.

The Scientific Method

- Ask a Question
  - *Ask a Testable Question!*
- Form a Hypothesis
- Design an Experiment to Test Your Hypothesis
  - *Independent and Dependent Variables*
  - *Controls*
- Draw Conclusions

What is a "Testable Question?"

A testable question is one that can be answered by designing and conducting an experiment.

What is a "Testable Question?"

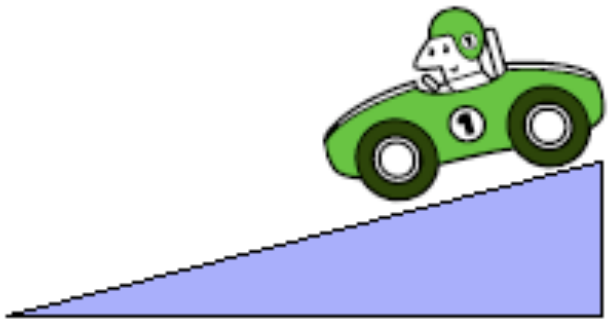
Testable questions are always about changing <u>one thing</u> to see what the effect is on <u>another thing</u>.

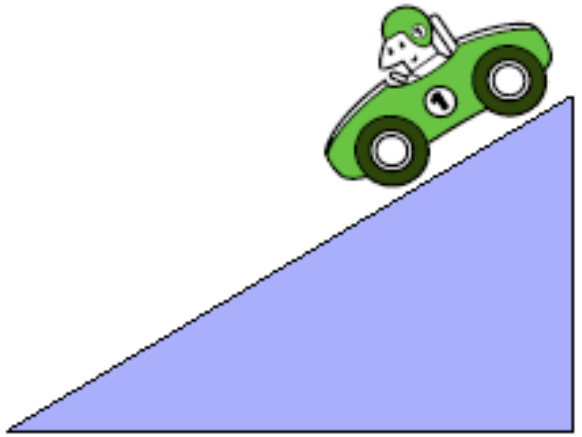
Sample Testable Question

Does changing *the height of the ramp*

affect

the speed of a car going down the ramp?





Testable Question Formats

- Does changing _____ affect _____?
- How does changing _____ affect _____?
- If I change _____, will it affect _____?

In a scientific experiment, these two blanks have special names: **variables**

What is a variable?

A variable is something that can CHANGE.

Testable Questions have two parts:

- An independent variable
- A dependent variable

What is an Independent Variable?

- The variable that will be changed by you – the scientist.

A good experiment has only one independent variable!

What is a Dependent Variable?

- The variable that is being measured in your experiment

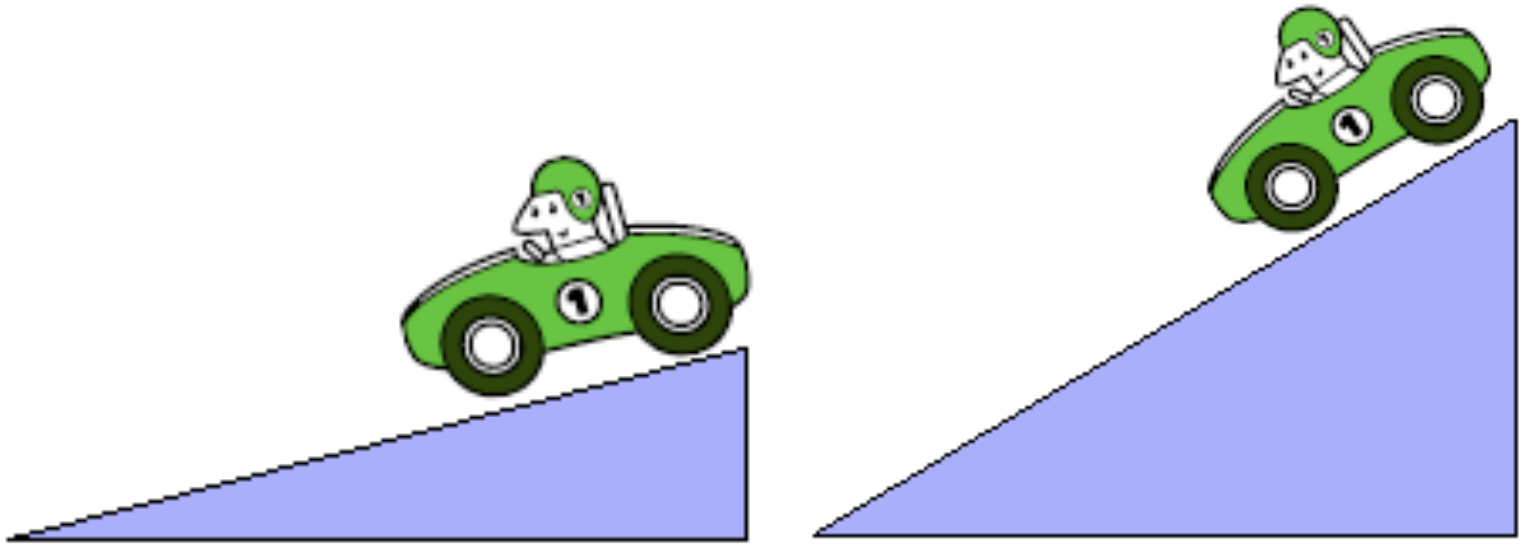
- The response to the change you make using the independent variable.

Testable Question Formats

- Does changing _____ affect _____?
- How does changing _____ affect _____?
- If I change _____ will it affect _____?

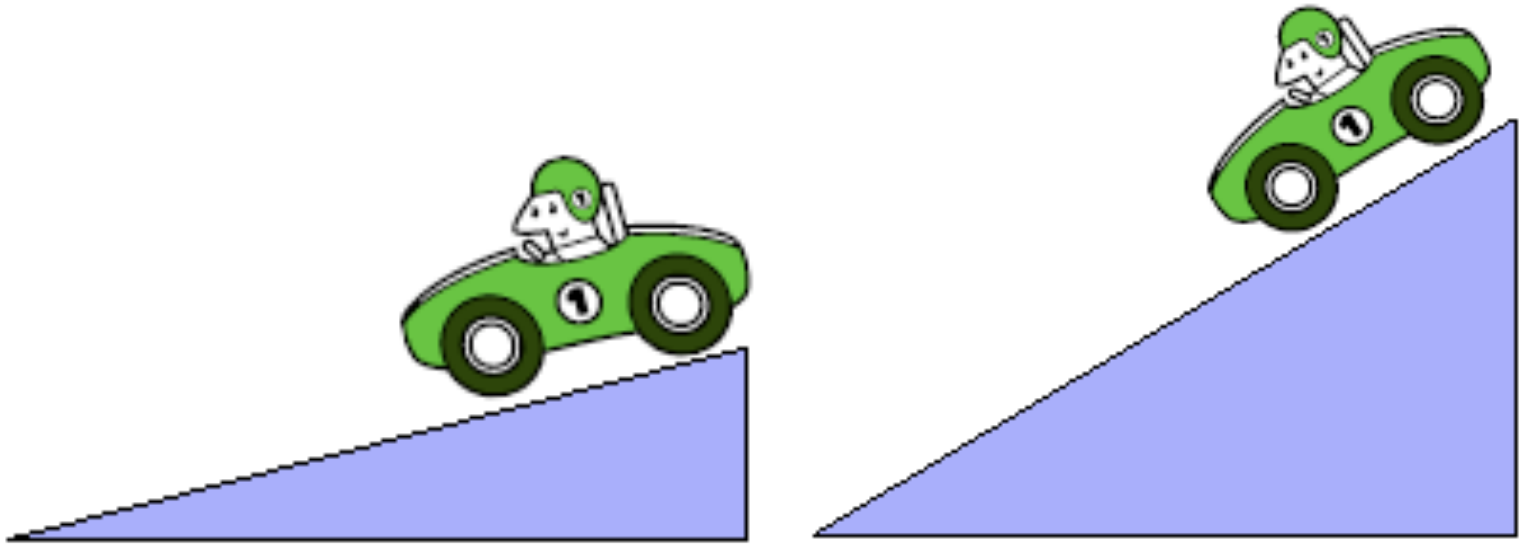
Example:

- Does changing the height of the ramp affect the speed of the car going down the ramp?



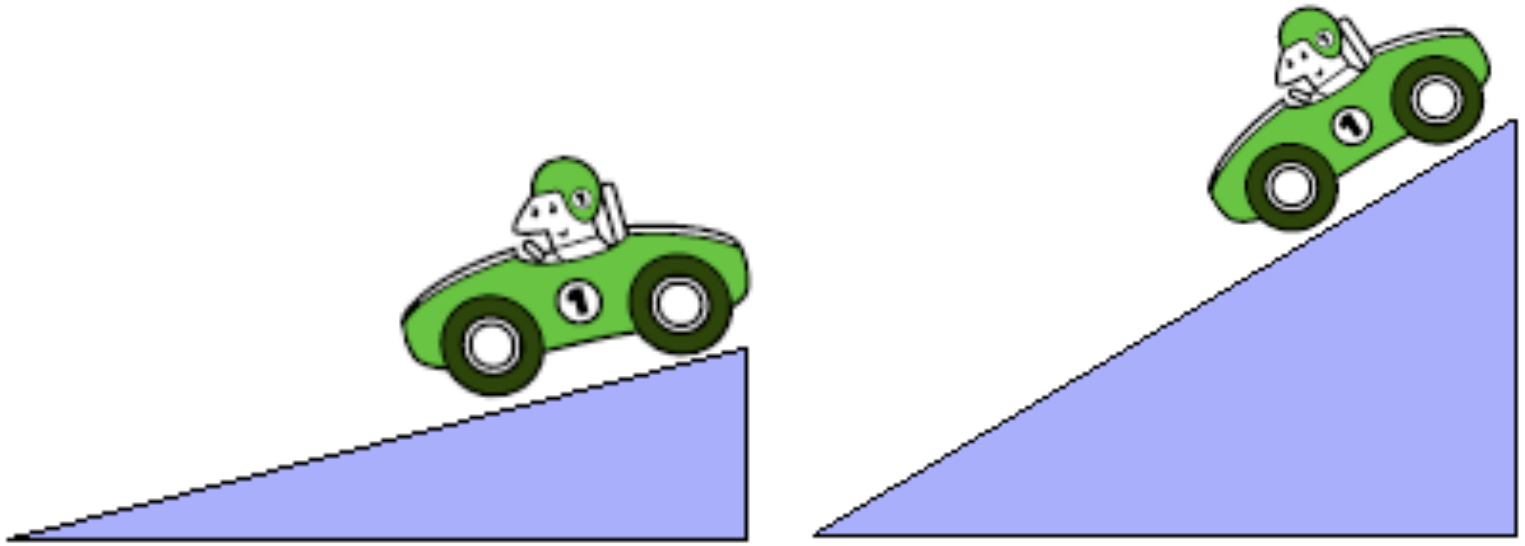
What is the independent variable?

- Does changing the height of the ramp affect the speed of the car going down the ramp?



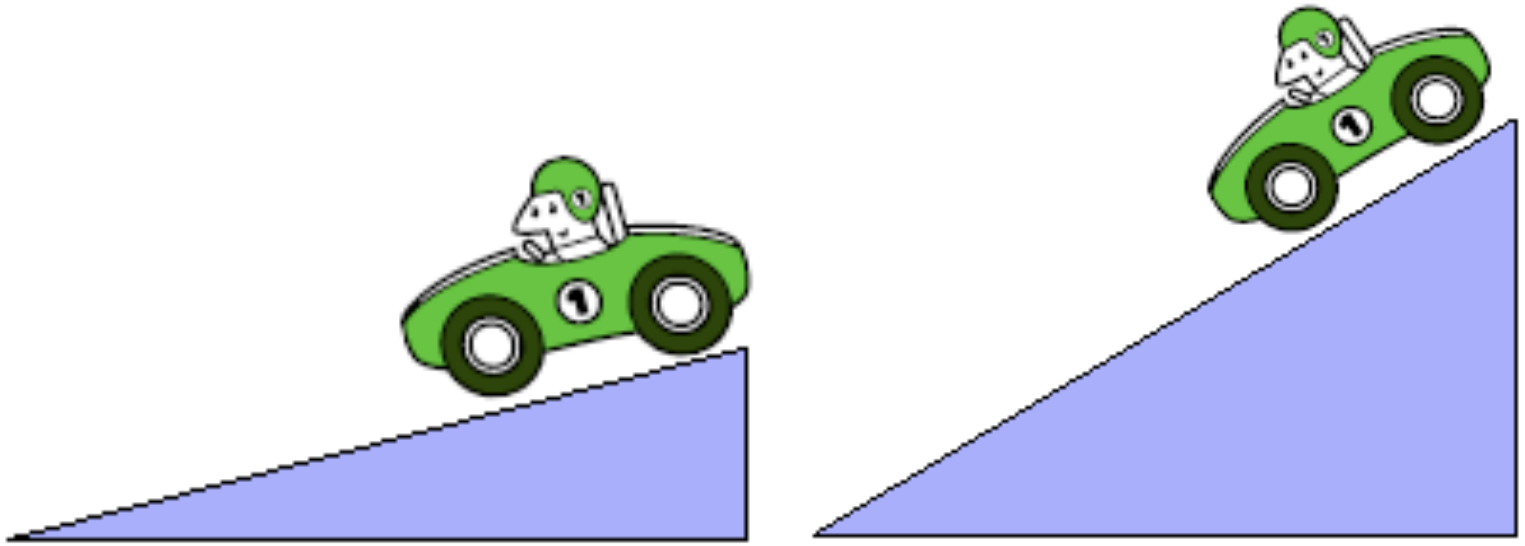
Independent Variable

- Does changing the height of the ramp affect the speed of the car going down the ramp?



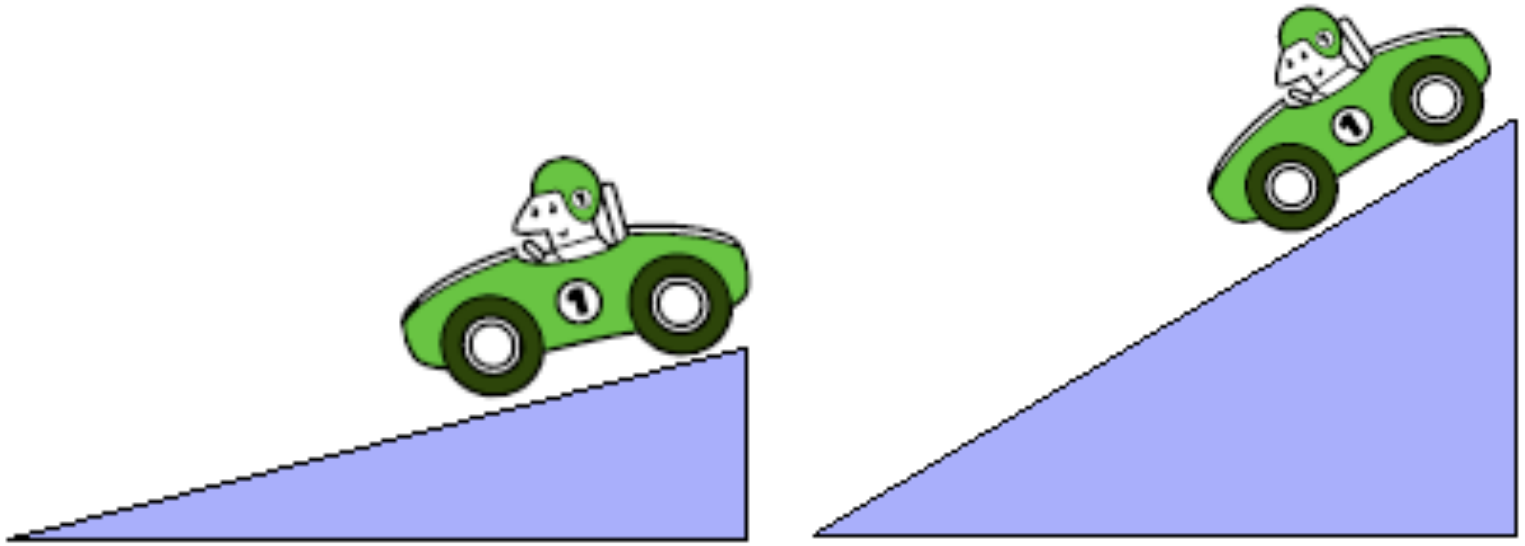
What is the dependent variable?

- Does changing the height of the ramp affect the speed of the car going down the ramp?



Dependent Variable

- Does changing the height of the ramp affect the speed of the car going down the ramp?

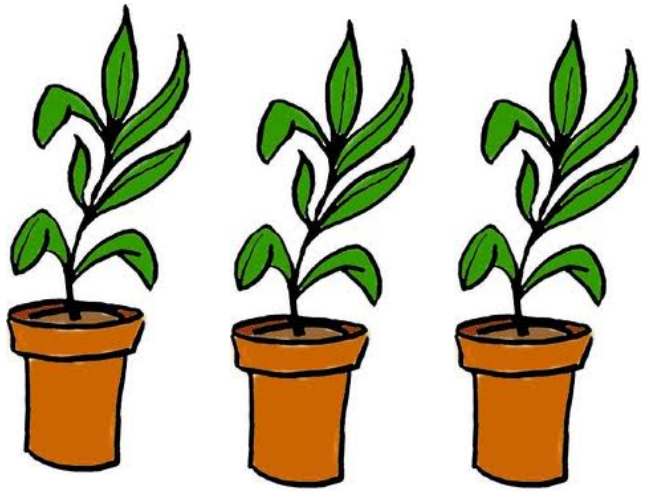


Another Testable Question

- Does changing the amount of light affect the growth rate of plants?

Identify the INDEPENDENT variable

Identify the DEPENDENT variable



Another Testable Question

- Does the temperature of water affect the time it takes a sugar cube to dissolve?

Identify the INDEPENDENT variable

Identify the DEPENDENT variable




Review: Testable Questions

Testable Questions need 2 parts:

(1) _____ variable

(2) _____ variable

Review: Testable Questions

Testable Questions need 2 parts:

(1) Independent variable

(2) Dependent variable

Is this a Testable Question?

What makes plants grow best?

How to Turn a General Question into a Testable Question

First, read the question carefully.

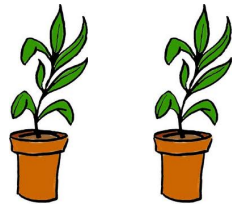
What makes plants grow best?

How to Turn a General Question into a Testable Question

Next, think of a cause and an effect related to your question.

What makes plants grow best?

In this case, the idea is that you can change something to affect something about how a plant grows.



What are examples of things you can change?

What makes plants grow best?

What are examples of things you can change?

What makes plants grow best?

Examples:
-Amount of water
-Amount of light
-Soil type

What specific effects can you look for?

What makes plants grow best?

What specific effects can you look for?

What makes plants grow best?

Examples:
-Height of plant
-Speed of growth

Finally, plug the cause and the effect into the format…

"What is the effect of _____ on _____?"

The cause goes in the first blank, and the effect goes in the second blank.

So a testable question looks like this:

"What is the effect of soil type on plant height?"

Controls

Controls are all the factors in your experiment that you want to remain constant.

"What is the effect of soil type on plant height?"

Controls for the plant experiment:

- type of plant
- growing conditions (sunlight, temperature, etc.)
- amount of water
- type of container

Here's another example... Is it Testable?

How does a paper airplane fly?

Let's Make the Question Testable!

- Decide what you are going to change (independent variable)

Let's Make the Question Testable!

- Decide what you are going to change (independent variable)

For example:

- Size of the plane
- Style of the plane
- Type of paper

Let's Make the Question Testable!

- Decide what you are going to measure (dependent variable)

Let's Make the Question Testable!

- Decide what you are going to measure (dependent variable)

For example:

- Distance the plane will fly
- Length of time the plane stays in the air

Make the Question Testable

- Now select <u>one</u> independent variable and <u>one</u> dependent variable

- Put them together to create the testable question:

"How does the type of paper affect the distance a paper airplane flies?"

What are the controls?

"How does the type of paper affect the distance a paper airplane flies?"

Controls:

- Style of airplane
- Flying conditions (wind)
- How you throw the airplane

Final Thoughts

- Keep your experiment simple and clear
- Check out the library or our web links for ideas
- Don't wait! Some projects take time to do.