

A. Strategies & Tools for Supporting the Science and Engineering Practices

Asking Questions and Defining Problems

Asking Questions Tool: Open and Closed Questions

1. What is the question you are working on?

2. What is the purpose of your question? Circle one of the reasons below or write in your reason.

Here are some reasons why people ask questions in science:

- We don't understand how the phenomenon (or a part of the phenomenon) works.*
- We have a disagreement (in our model or with someone's explanation or argument).*
- We need to test an idea we have.*
- Other reason: _____*

Close-ended and open-ended questions: Questions that can be answered with “yes” or “no” or with a single word are closed-ended questions. Asking open-ended questions gives you space to figure out more things. Scientific questions are open-ended questions.

3. Is your question close-ended or open-ended? Circle one.

- close-ended (Complete step 4.)
- open-ended (Skip to step 5.)

4. Revise your question to make it an open-ended question. Think about what you want to explain about the phenomenon.

Try using one of these question stems:

- *How does ... ?*
- *Why does ... ?*
- *What happens when ... ?*
- *What happens if ... ?*

- *What is the difference between _____ and _____?*

Write your revised question:

5. What information or data do you need to answer your question?

6. How would this information or data help you achieve the purpose you circled in step 2?

Peer or Teacher Feedback

Name: _____ Name of person giving feedback: _____

Provide feedback to another student using the table below.

Criteria	Yes or no?	Feedback and/or suggested revision
Is the question open-ended?		
Does the information or data in step 5 help answer the question?		
Does the question help the student achieve their purpose for asking		

the question?

Asking Questions Tool: Testable Questions

1. What is the original question you want to investigate?

Testable questions: Scientists develop testable questions when they want to collect evidence about a phenomenon or problem. To do this, they need to know what to observe or measure to answer their question. Here are some examples:

Question	What will be observed or measured to answer the question
<u>Where</u> does a jaguar roam in a <u>single day</u> ?	Use a GPS tracker to observe the area a jaguar travels in a 24-hour period.
How does the <u>amount of rain</u> in a forest affect <u>plant growth</u> ?	Measure the amount of plant growth over time and collect the amount of rain over time.
Is a dog's <u>speed</u> related to the <u>length</u> of its legs?	Measure the length of different dogs' legs and measure how fast they run the same 100-meter course.
<u>How many minutes per day</u> do teenagers use social media apps to communicate with their friends?	Measure the amount of time teenagers (ages 13-19) use social media apps to communicate with friends every day for a week.

2. What do you need to observe or measure to answer your question? (for example: an amount, a length, an amount of time, speed, an area)

3. What additional information do you need in your question about the phenomenon you are studying? (for example: the age of the teenagers in your study, the dog breeds you are testing, or which population of jaguars you are focusing on)

4. Revise your question to include what you wrote in steps 2 and 3.

5. Once you gather this evidence, what new thing do you think you will be able to explain about the phenomenon?

Peer or Teacher Feedback

Name: _____ Name of person giving feedback: _____

Provide feedback to another student using the table below.

Criteria	Yes or no?	Feedback and/or suggested revision
Does the question include something observable or measurable?		
Is the question specific enough that you could design an investigation to answer it?		
Does the question help figure out something new about the phenomenon?		

Asking Questions Tool: Experimental Questions

Experimental questions are one type of testable question.

1. What is the original question you want to investigate?

Experimental questions: Scientists develop experimental questions to identify what they want to test or change in an experiment. This is called the *independent variable*. They also include how they are going to measure their results, which is the *dependent variable*.

For example:

How does the amount of light a plant gets in a day affect how tall the plant grows?
(independent variable) (dependent variable)

Here are some example question frames for experimental questions:

How does _____ affect _____ ?
(independent variable) (dependent variable)

What is the effect of _____ on _____ ?
(independent variable) (dependent variable)

2. Look at your original question. What do you think will cause an effect? This is the variable you will change in your experiment (independent variable).

3. What will you measure to see if the change you made has an effect? This is the variable you will observe or measure (dependent variable).

4. Revise your question to include the variable you are changing (independent variable) and the variable you are measuring (dependent variable). Use

the questions frames above to help you revise your question.

5. If you collect this evidence in an experiment, what new thing about the phenomenon will it help you explain?

Peer or Teacher Feedback

Name: _____ Name of person giving feedback: _____

Provide feedback to another student using the table below.

Criteria	Yes or no?	Feedback and/or suggested revision
Does the question include an independent variable and a dependent variable?		
Is the question specific enough that you could design an investigation to answer it?		
Does the question help figure out something new about the phenomenon?		