



Experimenting and Inquiring

Students can get bogged down with multi-step processes and need help sorting out the steps to get the results they want and need. These Tip Sheets should help students visualize their thinking and learning as they progress through the experimenting and inquiring process. The steps for experimenting and inquiring are outlined in basic steps and questions. The Tip Sheets then map the students' course to help them "see" their thinking and work through the steps of experimenting by putting their thoughts together as they progress through the inquiry process. The graphic organizer helps students record and organize thoughts as they interpret findings, reformulate new hypotheses, and present alternative explanations and conclusions based on their experiences.

This thinking skill includes these resources:

Experimenting and Inquiring, Text Outline
Experimenting and Inquiring, Getting Ideas, Student Tip Sheet
Experimenting and Inquiring, Experimenting, Student Tip Sheet
Experimenting and Inquiring, Drawing Conclusions, Student Tip Sheet
Experimenting and Inquiring, Reporting Results, Student Tip Sheet
Experimenting and Inquiring, Graphic Organizer

Experimenting and Inquiring



Stage 1: Getting Ideas

1. Make observations.
 - What do I observe?
 - Why do I want to know more? What else do I want to know?
 - What do I hope to accomplish by experimenting? What is my goal? Is it to discover new aspects of the natural world? To explain phenomena? To test the conclusions of prior investigations? To test the predictions of current theories?
2. Be curious. Ask questions. Examine existing evidence.
 - What is already known? What sources of information can help me find existing evidence?
 - What does the current evidence say? What doesn't it say?
 - Did previous experiments use test and control groups? Were they similar? Too similar?
 - What are the well-known or well-used sources of information? What other sources are discounted? Why?
 - What does the existing raw data suggest?
 - What conclusions need more explanation?
3. Make predictions. Formulate hypotheses.
 - What are my predictions?
 - Are my predictions based on many observations, on few observations, or on only one observation?
 - What hypothesis will I test?

Stage 2: Experimenting

4. Plan investigations and experiments.
 - What tools will I need to conduct my experiment? (i.e., hand tools, measuring instruments, calculators, computer hardware and software)
 - What techniques will I use to perform accurate scientific investigations and communications? (i.e., measurement, formulas, charts, graphs to gather, analyze, and interpret scientific data)
5. Execute investigations and experiments to gather, analyze, and interpret data and new knowledge.
 - Have I carefully collected the data?
 - Have I carefully executed each step in my experiment?
 - Have I determined what is relevant evidence? How do I determine what is relevant and what is irrelevant?

Stage 3: Drawing Conclusions

6. Review new information and results.
 - Do I have enough information to draw conclusions?
 - What patterns do I see? Are these patterns based on evidence and logical argument?
 - What solutions would I suggest? Are these valid ways to interpret these findings?
7. Propose answers and explanations. Make more predictions and observations about results.
Draw conclusions.
 - Are my explanations and conclusions based on my findings?
 - Are there alternative explanations and conclusions to this experiment?
 - Do I detect any bias in results such as observations affected by strong beliefs of what I felt should have happened, or results I previously deemed as irrelevant now provide new insight?

Experimenting and Inquiring

Tip Sheet

8. Check your logic and process. Critique your own explanations and procedures.
 - As I critique the procedure, did I review my procedure for deliberate steps, carefully collect data, use impartial reporting methods for my data, and note relevant and irrelevant evidence?
 - As I critique the explanations, did I check for faulty reasoning and logic, and carefully examine the use of evidence?
 - As I critique the conclusions, am I consistent with experimental and observational evidence, accurate with the conclusion about the system being studied, and logical with the conclusion?

Stage 4: Reporting Results

9. Communicate the results to others.
 - Have I clearly organized, displayed, and analyzed the data for others?
 - Have I clearly and accurately presented the results?
 - Have I graciously invited and received critical response from others?
10. Repeat the process based on new knowledge to test the validity of the conclusion, refine results, or test a new hypothesis.
 - Do I wish to reformulate a new hypothesis for study after my old hypothesis has been tested or eliminated?
 - Have I established reasons for future investigations such as investigating new ideas and phenomena, generating new methods or procedures, developing new technologies to improve the collection of data, or determining new investigations of alternative explanations?

Experimenting and Inquiring

Stage 1: Getting Ideas

Step #1
Make observation.

- What do I observe?
- Why do I want to know more?
- What else do I want to know?

What do I hope to accomplish by experimenting?
- To discover new aspects of the natural world?
- To explain phenomena?
- To test the conclusions of prior investigations?
- To test the predictions of current theories?

Step #2
Be curious.
Ask questions.
Examine existing evidence.

What are the well-known or well-used sources of information? What other sources are discounted? Why?

What does the current evidence say? What doesn't it say?

What does the existing raw data say?

What is already known? What source of information can help me find existing evidence?

Did previous experiments use test and control groups? Were they similar? Too similar?

What conclusions need more explanation?

Step #3
Make predictions.
Formulate hypotheses.

What are my predictions?

Are my predictions based on many observations, on few observations, or on only one observation?

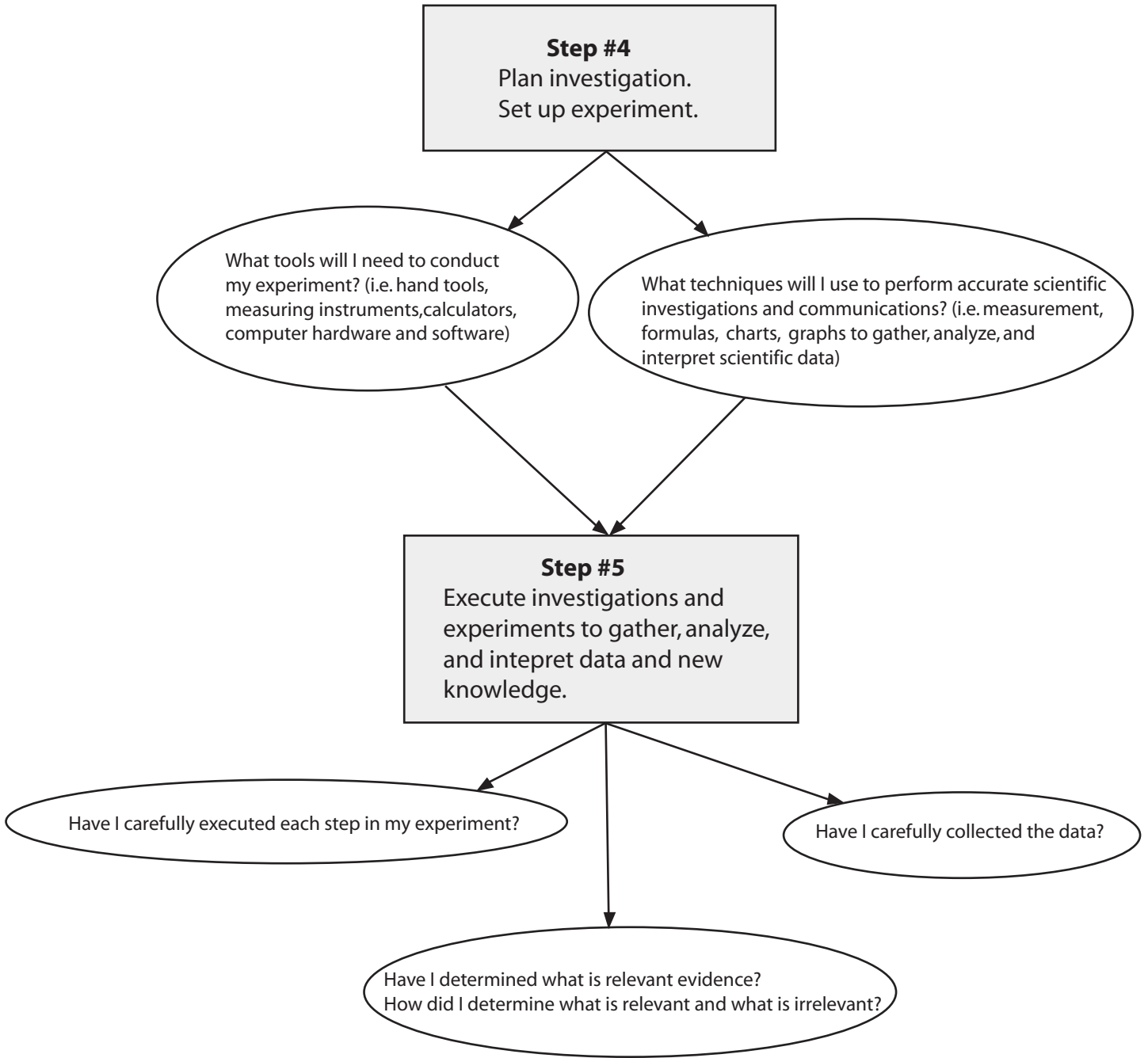
What hypothesis will I test?



I'm ready to experiment.

Experimenting and Inquiring

 Stage 2: Experimenting



I'm ready to draw conclusions.

Experimenting and Inquiring

Stage 3: Drawing Conclusions

Step #6

Review new information and results.

Do I have enough information to draw conclusions?

What patterns do I see?
Are these patterns based on
evidence and logical argument?

What solutions would I suggest?
Are these valid ways to interpret these findings?

Step #7

Propose answers and explanations.
Make more predictions and observations
about results and draw conclusions.

Are there alternative explanations and
conclusions to this experiment?

Are my explanations and
conclusions based on my findings?

Do I detect any bias in results such as observations affected by strong
beliefs of what I felt should have happened, or results I previously
thought were irrelevant now provide new insight?

Step #8

Check logic and process.
Critique explanations and procedures.

As I critique the procedure, did I
review my procedure for deliberate steps,
carefully collect data, use impartial reporting
methods for my data, and note relevant
and irrelevant evidence?

As I critique the explanations, did I check for
faulty reasoning and logic, and carefully examine
the use of evidence?

As I critique the conclusions, am I consistent
with experimental and observational evidence,
accurate with the conclusion about the system
being studied, and logical with the conclusion?



I'm ready to tell others.

Experimenting and Inquiring

Stage 4: Reporting Results

Step #9
Communicate the results to others.

Have I clearly organized, displayed, and analyzed the data for others?

Have I clearly and accurately presented the results?

Have I graciously invited and received critical responses from others?

Step #10
Repeat the process based on new knowledge to test the validity of the conclusion, refine results, or test a new hypothesis.

Have I established reasons for future investigation such as:

- investigating new ideas and phenomena,
- generating new methods or procedures,
- developing new technologies to improve the collection of data,
- determining new investigations of alternative explanations?

Do I wish to reformulate a new hypothesis for study after my old hypothesis has been tested or eliminated?



I'm ready to begin again.



Explore More: Experimenting and Inquiring

 Graphic Organizer

NAME: _____ DATE: _____

DIRECTIONS: Use the space below to record information and thoughts about your experiment. Keep in mind that the information you record will begin with general ideas but end with specific conclusions. You will have several ideas, predictions, results, and conclusions—and perhaps a few surprises!

My observations and ideas:

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My predictions and why I think this:

.....
My hypothesis:

.....
My experiment (step-by-step):

.....
My results:

.....
My conclusions: