Teacher's Guide

The Scientific Method

Grades 6-10

energy
weather
planets
light
stars
magnetism
explore
motion
classification
elements
genes
cells

SMTV

SUNBURST VISUAL MEDIA™

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Teacher's Guide

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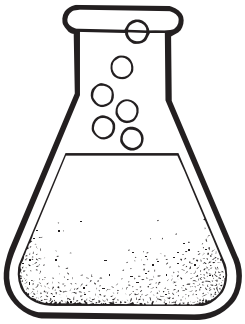

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ABOUT THIS GUIDE

Providing students with visual media is an excellent way to take them out of the classroom and into the real world. Our programs offer real-world footage, dynamic graphics, engaging dramatizations, and first-person testimonials that keep students interested and help them visualize difficult concepts. More importantly, they reinforce critical learning objectives shaped by state and national educational standards. However, the learning doesn't begin and end when the program does. You can make the learning experience even more effective by using the materials provided in this Teacher's Guide.

This guide is divided into the following sections:

- **Fast Facts** are designed to give your students a quick overview of the information presented within the video.
- **Before Viewing Activities** help identify what students already know about the subject, what they are curious about, and what they hope to learn.
- **During Viewing Activities** may be used during viewing to enhance students' understanding of the video.
- **After Viewing Activities** help students summarize and draw conclusions from the information that was presented.
- **After Viewing Quizzes** test students' retention of the information presented in the program and activity sheets.
- **Additional Resources** are designed to help you extend the information presented in the program into other areas of your curriculum.
- **Answer Keys** are provided for relevant activities or reproducible pages.
- **Script** content is provided in an unabridged version for future reference.

PROGRAM OVERVIEW

The Scientific Method program outlines step-by-step the method scientists rely on to solve problems. The scenario used to show the scientific method steps is a group of science students testing the effects of watching scary movies on heart rate.

All eight steps of the Scientific Method are discussed, including:

- Stating a problem
- Researching the problem
- Forming a hypothesis
- Writing down the procedures
- Performing an experiment to test hypothesis
- Observing and recording all results
- Interpreting data
- Stating the conclusion

Students can use this example as a model for their own experiments.

VIEWING OBJECTIVES

After viewing the program and utilizing the activities provided in the Teacher's Guide, students will be able to:

- Define vocabulary words associated with the scientific method
- List the steps of the scientific method and related details of each step
- Examine reasons for the worldwide acceptance and practice of the scientific method
- Analyze relationships associated with the scientific method
- Use the scientific method in a simple experiment
- Understand the difference between a control group and experimental group
- List variables that can be integrated in a simple experiment

THE SCIENTIFIC METHOD

Scientific Method: a problem-solving tool used by scientists to determine the validity of a hypothesis. It is an organized process for finding a solution to a question.

Scientific Method Steps

Step 1: State the problem in the form of a question

- It is extremely important to begin with a solid problem or question.
- A good question can be examined, measured and analyzed.
- Choose a problem that you do not know the answer to and a problem that you can work with.

Step 2: Research the problem

- Research is a critical part of any science project or experiment.
- Research can either make or break the project.
- When doing research, use a wide variety of resources outside of the school library.
- Research resources: books, library index, newspapers, magazines, science videos, and internet.
- Scientists rely heavily on the scientific method because there are so many variables to consider and any one of them can affect the results of the experiment.

Step 3: Form a hypothesis

- Hypothesis: an educated guess about a possible solution or answer to your problem or question
- Developing a good, solid hypothesis is the most difficult step of the scientific method.
- Your hypothesis is the center of your project.
- If the hypothesis doesn't make sense, the whole project won't make sense.
- When forming the hypothesis, stick with a simple statement, and make it precise and measurable.

Step 4: Write down the procedures that will be used to test your experiment

- Detailing the entire experiment and recording all the variables analyzed, scientists are able to track the validity of the hypothesis.
- Baseline measurement: something to measure our variables with
- Writing your procedures will:
    a) help one gather the necessary materials
    b) make sure that the experiment fits the hypothesis that is being tested
    c) help others who want to repeat the experiment

Step 5: Perform experiment to test hypothesis

- #1 rule for testing a hypothesis is to always follow the written procedures
- Control group: there are not variables being tested. Gives us a basis for comparing the experimental group.
- Variables: the factors that are being tested in the experiment. It is critical that everything in the experiment is the same each time it is tested, except for the one variable that is being tested.
- Experimental Group: The group that is being tested by changing one variable at a time.

Step 6: Observe and record all results

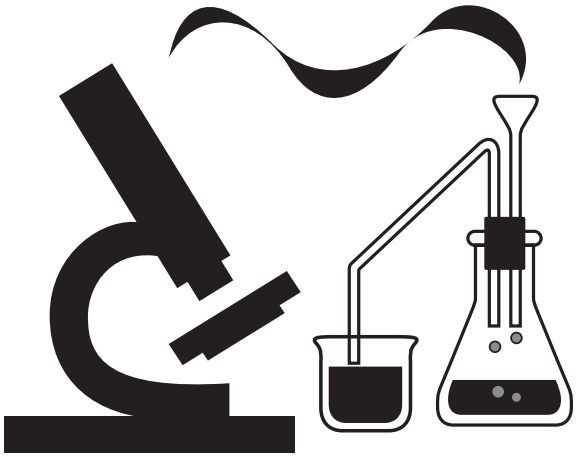
- While performing an experiment:
    a) always observe and record the data
    b) watch your experiment closely and note any reactions that occur
    c) keep results together in one journal
    d) be ethical and honest about the data from the experiment

Step 7: Interpret the data

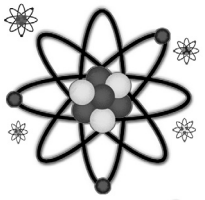
- When interpreting the data, make sure to:
    a) make tables, charts, and graphs
    b) draw pictures or take photographs to show the procedure and results
    c) write a summary

Step 8: Conclusion

- Purpose of conclusion: to communicate the result to others.
- In the conclusion make sure to answer the questions:
    a) What happened?
    b) Was it what one expected?
    c) Did the results agree with the hypothesis?
    d) Did it answer the original question?



Get the HYPE!



Fill in the chart below. In the **'H'** column, get a **"HOLD"** on all the facts you know about the scientific method. In the **'Y'** column, list at least three questions that are **"YOUR"** own about the scientific method. After viewing the program and participating in various activities, list all the **"PLACES"** where you can find information about your questions in the **'P'** column. Then, **"EVALUATE"** what you have learned about the scientific method in the **'E'** column.

H	Y	P	E
Get a **Hold** on the facts you know	**Your** questions	**Places** to learn more	**Evaluate** what you learned

Fill in the Blanks

Fill in the blanks with the appropriate words from the vocabulary list.

scientific method: a method of doing research that includes the steps of identifying a problem, gathering data, forming a hypothesis, testing a hypothesis, and drawing a conclusion

question: the inquiry or problem relating to a topic that can be answered by conducting an experiment

experiment: a test or trial performed in order to discover something

hypothesis: an educated guess or reasonable assumption

procedure: a sequence of steps involved in performing an experiment

observe: to notice what occurs during an experiment

record: to write accurate information about what occurs during an experiment

interpret: to explain or give meaning to

conclusion: the result or outcome of something

variable: something that can change or influence the results of an experiment

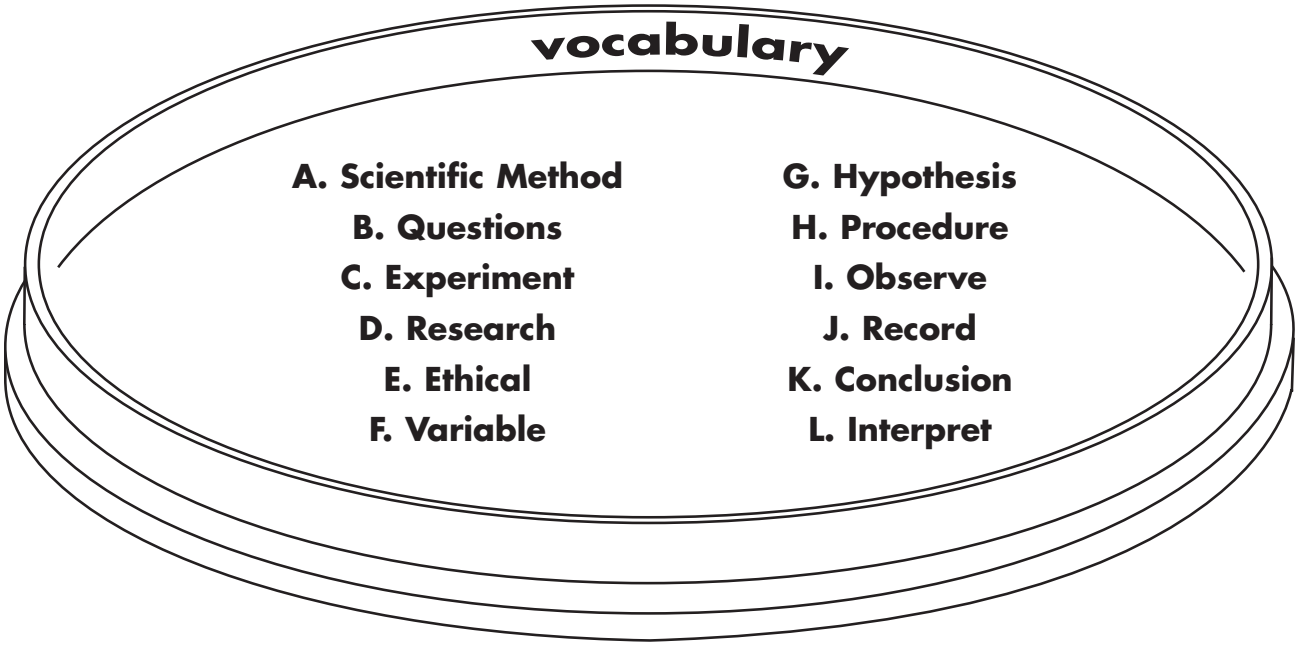
ethical: following the rules of being fair and honest

research: to conduct an investigation into current information about something

The _____ method is one way that people think about and solve questions or problems. When you begin your experiment, it is important to state a problem or _____ that you would like to find an answer to. It is important to look up or _____ up-to-date information about your topic before you conduct any experiments. A(n) _____ is a possible explanation about something. To conduct a(n) _____ is a good way to discover something new about science. Be sure to write down each step or _____ in the correct order before you start your science experiment. When you conduct an experiment and you deliberately change one thing, you are introducing a(n) _____. It is critical to watch or _____ what is happening with every step of your experiment. After you conduct your experiment, a valuable step is to write down or _____ what happened. When you explain what happened in your experiment, you _____ the results. Sharing true information about the outcome of your experiment is an example of _____ behavior. After an experiment, it is important to write down your _____ or summary of what you learned.

Vocabulary Match!

Match the vocabulary words in the petri dish to their definitions below. Write the letter in the blank space next to the definition.



1. _____ To explain or give meaning to
2. _____ Something that can change or influence the results of an experiment
3. _____ To notice what occurs during an experiment
4. _____ The inquiry or problem relating to a topic that can be answered by conducting an experiment
5. _____ A method of doing research that includes the steps of identifying a problem, gathering data, forming a hypothesis, testing a hypothesis, and drawing a conclusion
6. _____ Following the rules of being fair and honest
7. _____ An educated guess or reasonable assumption
8. _____ To conduct an investigation into current information about something
9. _____ A test or trial performed in order to discover something
10. _____ The result or outcome of something
11. _____ To write accurate information about what occurs during an experiment
12. _____ A sequence of steps involved in performing an experiment

We Need Order!

The following statements are out of order regarding the steps to follow in the scientific method. Write the number next to the statement to put them in the correct order.

Observe and record all results

Research the problem

State the problem in the form of a question

State conclusion about the problem based on the research and data collected

Form a hypothesis

Write down the procedures you will use to test your experiment

Perform experiment to test hypothesis

Interpret data

Vocabulary Scramble

Unscramble the following vocabulary words.

Ethical	**Record**	**Procedure**
Variable	**Experiment**	**Observe**
Hypothesis	**Conclusion**	**Research**
Question	**Scientific Method**	**Interpret**

OPESYIHTHS

DTTMOHIIICESNFEC

REAECHSR

ETHLCIA

SNUNCCOIOL

NIPEEMXETR

DRECREPUO

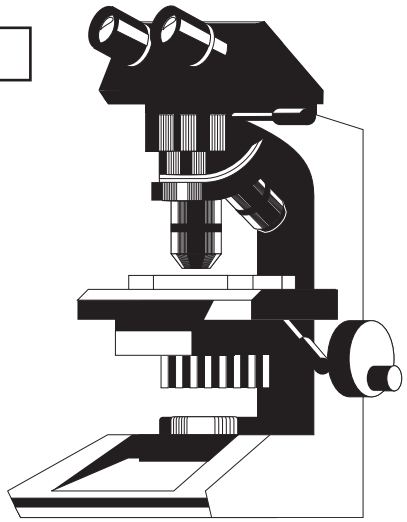
PTRRNTEIE

ARLBEVIA

VEBOESR

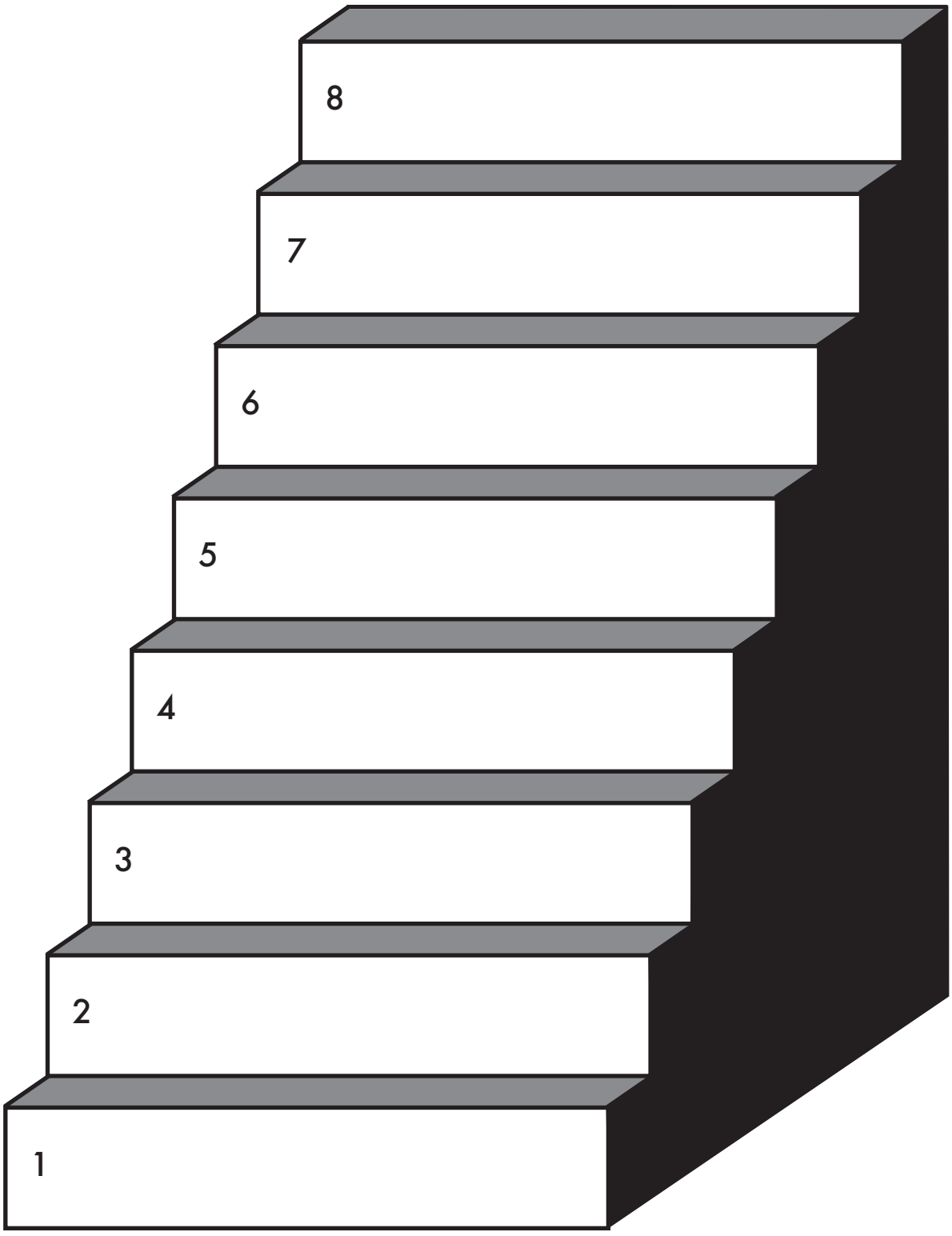
EDCRRO

TEOISQUN



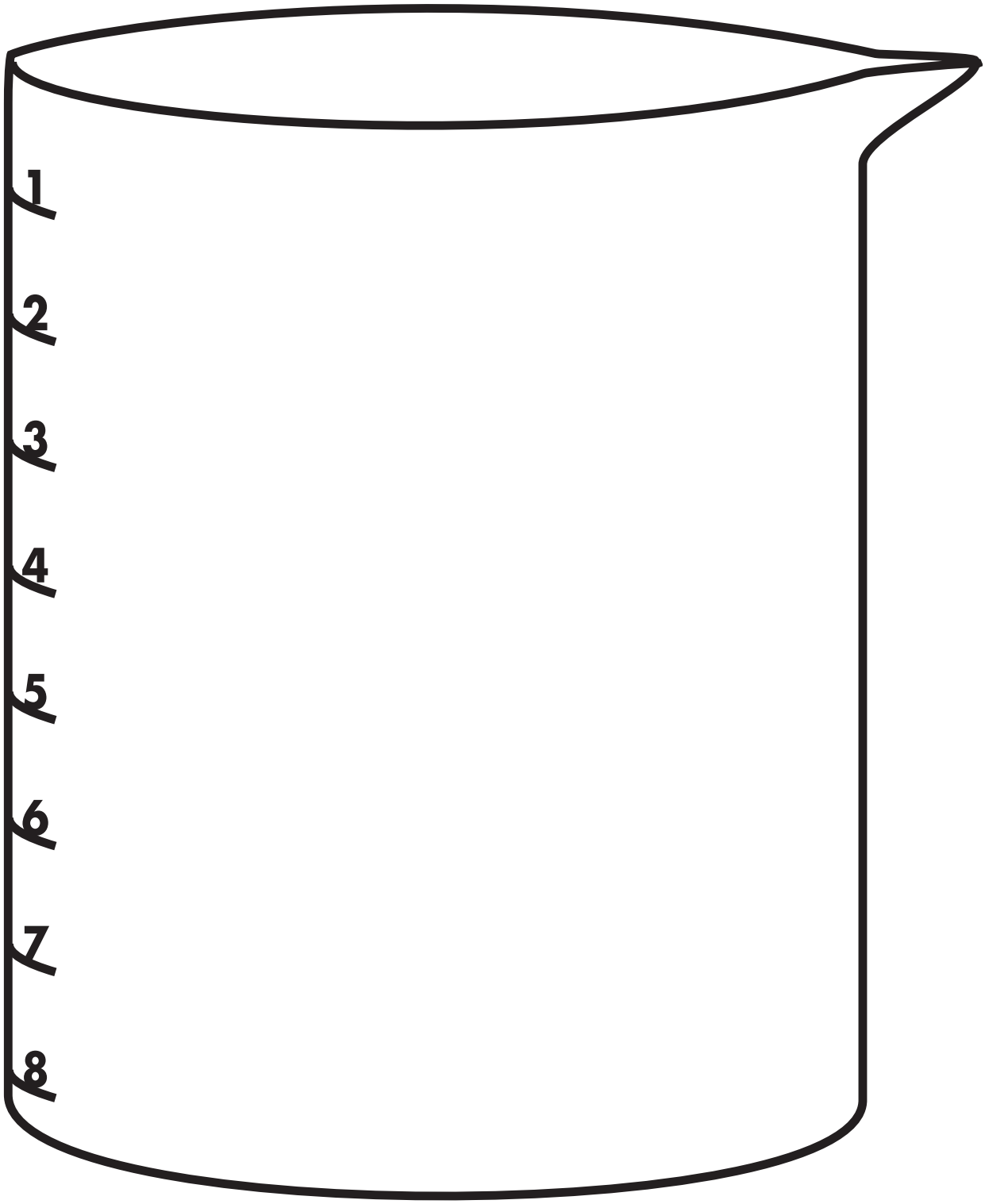
The Steps!

While viewing the program, list the 8 steps of the scientific method in order.



Steps & Facts

Write the scientific method steps in order and at least one fact about each step as you view the program.



Name _____

Mr. Curry's Class Uses the Scientific Method

While viewing the program, state what the students in Mr. Curry's class decide to use for their steps in the scientific method. In steps 1 and 3, state exactly what their final version was. In the other steps, state what their plan of action was for each step and include as much information as possible.

1. State the problem in the form of a question. →	
2. Research the problem. (Where did they find their information?) →	
3. Form a hypothesis. →	
4. Write down the procedure for testing your experiment. →	
Variable in experiment →	
Control Group (What will they be doing?) →	
Experimental Group (What will they be doing?) →	
5. Perform experiment to test hypothesis. →	
6. Observe and record all results. →	
7. Interpret the data. →	
8. State conclusion about the problem based on research and data collected. →	

Just the Facts Please!

Teacher Note: This worksheet can be used solely as a note-taking device by using the **"FACT"** only column, or it can be used in its entirety as a follow up activity after viewing the program.

Directions: This chart is designed to help you record important information while viewing the program. Record the facts in the **"FACT"** column and any questions or topics you do not understand in the **"QUESTIONS"** column. In the **"COMMENTS"** column, state how you feel about that fact or question.

FACTS	QUESTIONS	COMMENTS

Scientist's Notepad

Below are various questions to answer while viewing the program. State your answers in the scientist's notepad

1. What makes up a good hypothesis?

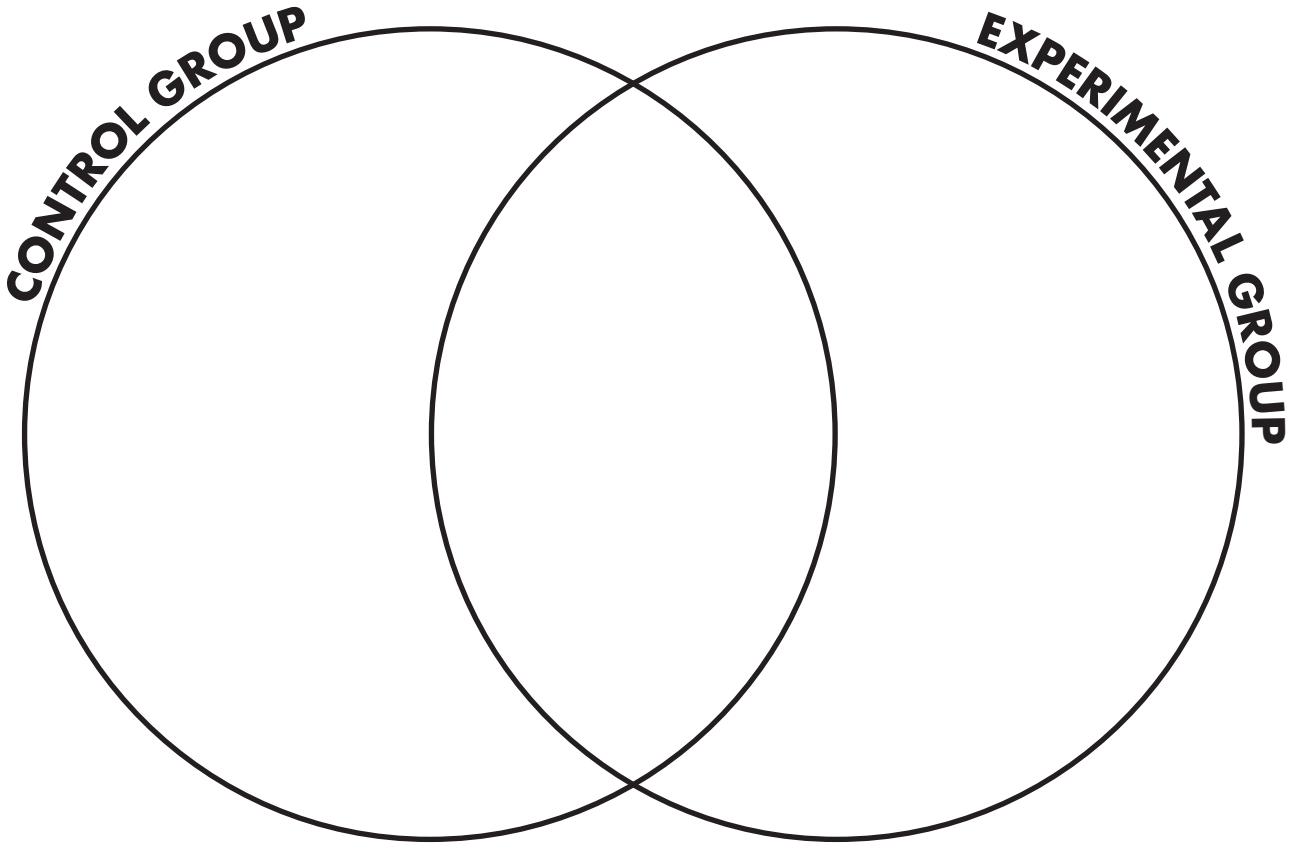
2. Why is it important to have a base line measurement?

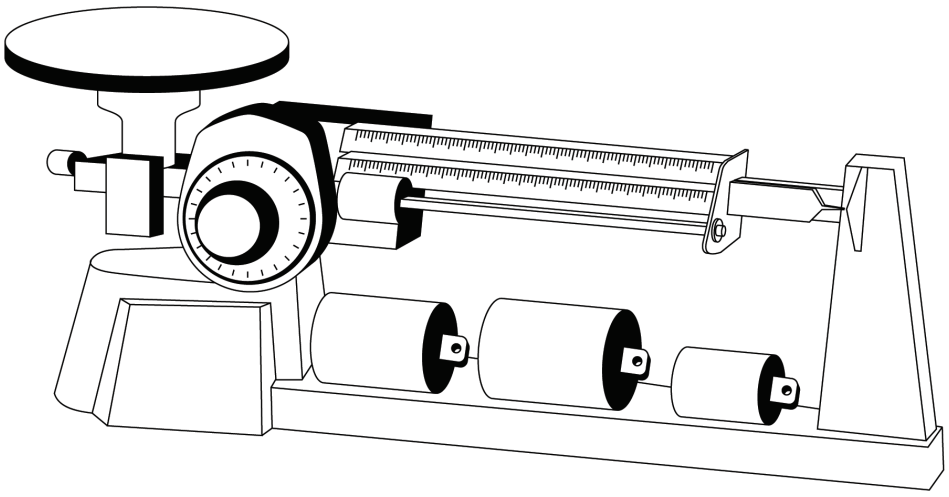
3. Why is is so important to be ethical in conducting the scientific method process?

4. Why is it so important to write one's procedures down first before conducting the experiment?

Compare and Contrast Groups

Using the Venn diagram below, compare and contrast a control group and an experimental group.





Vocabulary Cryptogram

Below is a Cryptogram. It contains a message from the program *The Scientific Method*. Solve this puzzle by substituting letters for the numbers. For a head start, the "E" and "A" have been given to you. "E" = 7. "A" = 9. Substitute "E" any time you see the number 7. Substitute "A" any time you see the number 9. Not all letters will be used. *Hint: Look to see where "scientific" will fit.*

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
9	■			7					■							■							■		■

			E										E				A								
2	11	24	7	23	10	24	17	24	11		1	23	25	19	26	7	16	4	7		9	23	16		

	E							A		E				E			E								
14	7	10	22	25	16	2		9	15	7		10	22	7		15	7	2	13	26	10				

			A								E														
25	17		12	9	15	24	25	13	2		10	5	8	7	2		25	17							

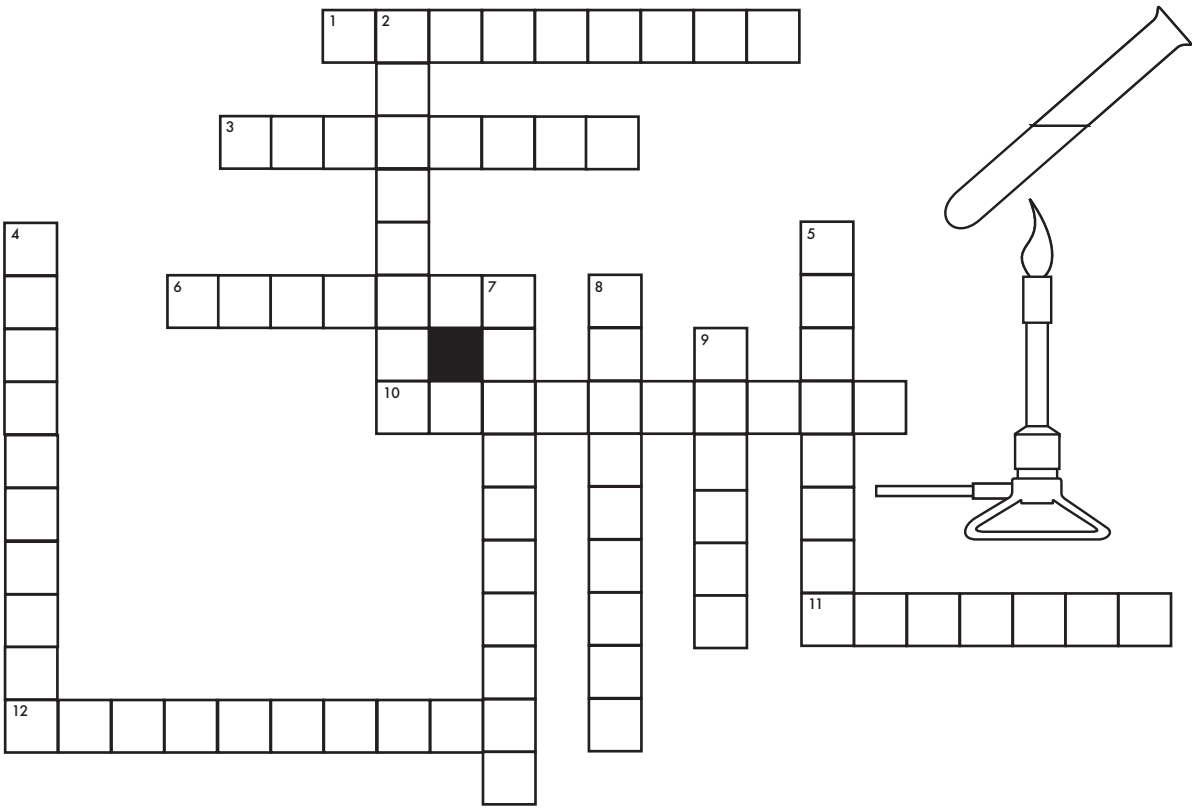
			E					A								A									
24	23	12	7	2	10	24	4	9	10	24	25	23	2		9	23	16								

								A																	
11	25	14	14	13	23	24	25	23	10	24	25	23													

A							E																		
9	14	25	23	4		2	11	24	7	23	10	24	2	10	2										

Vocabulary Crossword

Use the clues at the bottom of the page to fill in the crossword puzzle.



Across

1. A sequence of steps involved in performing an experiment
3. The inquiry or problem relating to a topic that can be answered by conducting an experiment
6. To notice what occurs during an experiment
10. An educated guess or reasonable assumption
11. Following the rules of being fair and honest
12. The result or outcome of something

Down

2. To conduct an investigation into current information about something
4. A method of doing research that includes the steps of identifying a problem, gathering data, forming a hypothesis, testing a hypothesis, and drawing a conclusion
5. Something that can change or influence the results of an experiment
7. A test or trial performed in order to discover something
8. To explain or give meaning to
9. To write accurate information abut what occurs during and experiment

Vocabulary Quiz

Write the vocabulary word next to its definition.

scientific method	interpret
hypothesis	experiment
ethical	conclusion
observe	procedure
question	
variable	

1. _____: to explain or give meaning to

2. _____: the inquiry or problem relating to a topic that can be answered by conducting an experiment

3. _____: following the rules of being fair and honest

4. _____: the result or outcome of something

5. _____: to notice what occurs during an experiment

6. _____: a method of doing research that includes the steps of identifying a problem, gathering data, forming a hypothesis, testing a hypothesis, and drawing a conclusion

7. _____: a test or trial performed in order to discover something

8. _____: something that can change or influences the results of an experiment

9. _____: a sequence of steps involved in performing an experiment

10. _____: an educated guess about a possible solution or answer to your problem or question

Scientific Method Quiz

Write the letter of the best answer in the space provided, fill in the blank with the best answer, or write "true" or "false" for each statement.

1. _____ What is the first step in the Scientific Method?
   a. Form a hypothesis
   b. Research the problem
   c. State the problem in the form of a question
   d. Interpret data

2. _____ When choosing a problem, you should _____.
   a. choose a problem you don't know the answer to
   b. choose a problem you can work with
   c. choose a problem you know the answer to
   d. A and B
   e. B and C

3. _____ What are some resources one can use to research their problem?
   a. World Wide Web
   b. Books
   c. Newspapers
   d. All of the above

4. _____ is something to measure "variables" against.
   a. outcomes
   b. control group
   c. base line measurement
   d. data

5. _____ To conduct a(n) _____ is a good way to discover something new about science.
   a. control group
   b. experimental group
   c. hypothesis
   d. experiment

Scientific Method Quiz (cont.)

6. List the 8 steps in the Scientific Method

    1.

    2.

    3.

    4.

    5.

    6.

    7.

    8.

7. When developing a question, what 3 things should you be able to do?

    1.

    2.

    3.

8. In the conclusion, list the questions that should be answered.

    1.

    2.

    3.

    4.

9. _____ True or False? The Scientific Method is an organized process for finding the answer to a question.

10. _____ True or False? Developing a good, solid hypothesis is the easiest step of the scientific method.

11. _____ True or False? When you explain what happened in your experiment, you record the results.

Scientific Method Quiz (cont.)

12. _____ True or False? Sharing true information about the outcome of your experiment is not an example of ethical behavior.

13. _____ True or False? Something that can change or influence the results of an experiment is a variable.

14. _____ True or False? Experimental group is the group that is being tested by changing one variable at a time.

15. _____ True or False? Detailing the entire experiment and recording all the variables analyzed, scientists are able to track the validity of the hypothesis.

Interdisciplinary Ideas

Reading and Writing:

Read and Discuss:

Have students choose a book from the suggested reading list or website from the scientific method website list. Form groups of three or four based on choice. Students should make a list of the major points outlined in the book or website. Then discuss their findings. Share with other groups how it supports their learning about the scientific method.

Writing:

Have students discuss why it is important to be honest and ethical when recording and observing an experiment. have them explain what could be done if they knew of an experiment that was not being recorded ethically. Why would one try to match the hypothesis? What would this unethical behavior do to future experiments?

Writing:

Give students a scenario in which they will need to write down the procedures that would be necessary to conduct the scenario. You provide the Scientific Method steps one through three.

Writing:

Have students create poems form the vocabulary words to remember them better. Share the poems to create a study guide for the entire class.

Example:

Very important part of experimental group
Always change only one variable in each experiment
Record any variables
Interpret the data recorded from the variable
Accurate information on the variable is a must
Be ethical and honest when using a variable
List observations from variable
Experiments are where a variable is needed

Arts and Technology:

Arts:

Any visual aids necessary for documentation and interpretation of the data could be shown in an artistic form. Sometimes drawings and pictures are better at explaining things than words. By collaborating with the art teacher, you will be able to help students enhance and clarify their projects.

Interdisciplinary Ideas

Arts and Technology (cont.):

Arts:
If using the scientific method for a science fair project, many different artistic mediums could be used depending upon the project.

Technology:
Use a software program to graph, chart, and make tables of interpreted data. Also, one could use drawings and pictures to enhance either project.

Technology:
After researching a project using the scientific method, have students create a slide show or video tape of their findings. Include graphs, charts, etc in presentation.

Math and Science:

Math:
Have students interpret data obtained using the scientific method. Use graphs, charts, and tables.

Math:
Collect students' complete projects and write word problems based on the data collected. Share with students.
Example: Mr. Curry's students viewed his explanation of the variables lesson. He possessed 10 various items. All items fell due to the laws of gravity, except for one. What percentage of the objects did not fall?

Science:
Experiments using the scientific method:

Introduction to the Scientific Method
This is a basic experiment to introduce students to the scientific method approach. This may be used at any grade level.
http://www.iit.edu/~smile/bi9208.html

The Scientific Method – "The Big Ahah"
For intermediate and upper students. Students use the scientific method and understand the importance of it. Has students think through their experiment before actually conducting it. good prep work for a science fair project.
http://www.iit.edu/~smile/chi9608.html

Interdisciplinary Ideas

Math and Science (cont.):

Science:

Exercises demonstrating the scientific method:

Using the Scientific Method

Simple exercise where students put the concepts of the scientific method into action. Has section for students to ponder use in the real world. For any grade level.
http://www.teachers.net/lessons/posts/199.html

Scientific Method

Another simple exercise that shows students how the process of science works. Students form hypotheses based on facts and reevaluate the hypotheses based on a new fact.
http://www.teachers.net/lessons/posts/1561,html

Projects:

Group Project:

Have students form groups and go through the scientific method step by step as outlined in the program. Group size should be three to four students. Have them come up with a problem they would like to know the answer to. Use a rubric to help students stay on track.

Current Events:

Have students look through a current newspaper and choose an article with a topic in which the scientific method could be applied. Have them document the eight steps of the scientific method based on the article. The article is to obtain a question to start them on a "mock" scientific method process. The article does not necessarily need to contain procedures or observations. The students should be able to "fictionalize" the procedures as they see fit. The article search is to have the students become familiar with current events while applying the scientific method on a real topic.

Interdisciplinary Ideas

Projects (cont.):

Science Fair Project:

Many projects that students do for a school science fair use the scientific method. Have students design a science fair project using the scientific method. Their demonstration/presentation will be in a logical order and they will know how to reproduce the experiment or state what their data said when they interpreted it. By using the scientific method steps, they will better understand their project and this will show in their presentation if asked other questions.

Interdisciplinary Ideas

Brainstorming and Question Forming Template

1. Have group list ideas on possible topics where they see a problem.

2. Choose a topic for the group.

3. List possible questions about the topic.

4. Check the question:
   Can you analyze it? _____
   Can you interpret it? _____
   Can you work with it? _____

Suggested Reading List

Carey, Stephen S. *A beginner's guide to scientific method*. Wadsworth Publishing, 2004.
Provides a brief introduction to the basics of good scientific research. Good as a supplement to other books and classroom instruction. Helpful if students has some knowledge of the scientific method. Has end of chapter exercises to reinforce concepts.

Kneidel, Sally. *Creepy Crawlies and the Scientific Method: More than 100 Hands-On Science Experiments for Children*. Fulcrum Publishing, 1993.
This books is for anyone interested in the scientific method and how to conduct experiments using it. Appropriate for K-12 with some revisions based on your learners. Many of the experiments deal with insects. Easy to obtain supplies and has resource list. Very clear directions to perform experiments.

Kramer, Stephen. *How to Think Like a Scientist: Answering Questions by the Scientific Method*. Harper Collins Publishers, 1987.
In a story format. Shows one how to think using the scientific method. Poses questions about hypothetical situations. Would be good for the student who is needing a basic understanding of what the method is used for.

McGowen, Tom. *The beginnings of science*. Twenty-First Century Books, 1998.
Card catalog description: Discusses the roots of science as developed by primitive people, Greek thinkers, Muslim scholars, and those responsible for the birth of the scientific method in Europe.

Internet Sites

Below are a list of sites that you may use to find more information about the scientific method. Due to routine web maintenance, not all of the links will be accurate at the time of access. If the link is not available, try to conduct a search on that topic from the main site or using a search engine.

Intel ISEF: The Scientific Method

This site is a review of the scientific method. It will help students who need guidance in the development of their project using the scientific method by asking key questions.
http://www.sciserv.org/isef/students/scientific_method.asp

Science Fair handbook

Outlines the procedures in clear terms how to use the scientific method. Has it applying to students doing projects for a science fair. Gives hints of do's and don'ts
http://school.aol.discovery.com/aol/?http://school.discovery.com/sciencefaircentral/scifairstudio/handbook/scientificmethod.html

The Scientific Method

This Web site is a multimedia instructional design site intended to teach students the scientific method. The students are able to easily progress through the entire lesson with minimal confusion. The lesson uses text, graphics, videos, mnemonics, an example, and simple explanations to demonstrate the scientific method.
http://www.pages.drexel.edu/~bcb25/scimeth/

The Scientific Method of problem solving

Basic steps are outlined and expanded upon. Links are noted and the site is easy to navigate. Has logic problems.
http://www.howe.k12.ok.us/~jimaskew/pmethod.htm

Scifair.org: The Scientific Method

Basic information relating to the scientific method. Gives directions for the steps involved in the process. Has links to project ideas and project hints if competing in science fairs.
http://www.scifair.org/articles/sm.shtml

sci.skeptic FAQ Scientific Method

Answers questions about the scientific method. Very basic, but interesting.
http://home.xnet.com/~blatura/skep_1.html

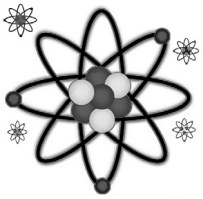
Steps in the Scientific Methods

Internet Sites

Visual diagram of the steps involved in the scientific method. Great for learners who are visual.
http://www.ldolphin.org/SciMeth2.html

ANSWER KEY

Get the HYPE!



Fill in the chart below. In the **'H'** column, get a **"HOLD"** on all the facts you know about the scientific method. In the **'Y'** column, list at least three questions that are **"YOUR"** own about the scientific method. After viewing the program and participating in various activities, list all the **"PLACES"** where you can find information about your questions in the **'P'** column. Then, **"EVALUATE"** what you have learned about the scientific method in the **'E'** column.

H	Y	P	E
Get a **Hold** on the facts you know	**Your** questions	**Places** to learn more	**Evaluate** what you learned

Answers will vary according to the individual student's prior knowledge of the subject.

Places category may include the library, the Internet, and professionals.

Fill in the Blanks

Fill in the blanks with the appropriate words from the vocabulary list.

scientific method: a method of doing research that includes the steps of identifying a problem, gathering data, forming a hypothesis, testing a hypothesis, and drawing a conclusion
question: the inquiry or problem relating to a topic that can be answered by conducting an experiment
experiment: a test or trial performed in order to discover something
hypothesis: an educated guess or reasonable assumption
procedure: a sequence of steps involved in performing an experiment
observe: to notice what occurs during an experiment
record: to write accurate information about what occurs during an experiment
interpret: to explain or give meaning to
conclusion: the result or outcome of something
variable: something that can change or influence the results of an experiment
ethical: following the rules of being fair and honest
research: to conduct an investigation into current information about something

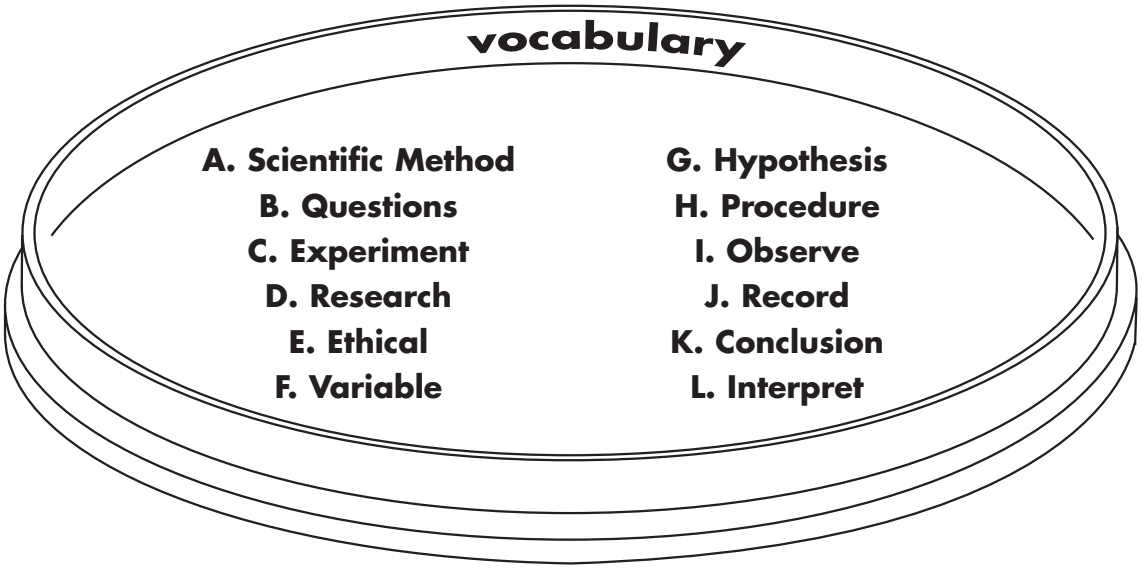
The **scientific** method is one way that people think about and solve questions or problems. When you begin your experiment, it is important to state a problem or **question** that you would like to find an answer to. It is important to look up or **research** up-to-date information about your topic before you conduct any experiments. A(n) **hypothesis** is a possible explanation about something. To conduct a(n) **experiment** is a good way to discover something new about science. Be sure to write down each step or **procedure** in the correct order before you start your science experiment. When you conduct an experiment and you deliberately change one thing, you are introducing a(n) **variable**. It is critical to watch or **observe** what is happening with every step of your experiment. After you conduct your experiment, a valuable step is to write down or **record** what happened. When you explain what happened in your experiment, you **interpret** the results. Sharing true information about the outcome of your experiment is an example of **ethical** behavior. After an experiment, it is important to write down your **conclusion** or summary of what you learned.

ANSWER KEY

ANSWER KEY

Vocabulary Match!

Match the vocabulary words in the petri dish to their definitions below. Write the letter in the blank space next to the definition.



1. __L__ explain or give meaning to
2. __F__ Something that can change or influence the results of an experiment
3. __I__ To notice what occurs during an experiment
4. __B__ The inquiry or problem relating to a topic that can be answered by conducting an experiment
5. __A__ A method of doing research that includes the steps of identifying a problem, gathering data, forming a hypothesis, testing a hypothesis, and drawing a conclusion
6. __E__ Following the rules of being fair and honest
7. __G__ An educated guess or reasonable assumption
8. __D__ To conduct an investigation into current information about something
9. __C__ A test or trial performed in order to discover something
10. __K__ The result or outcome of something
11. __J__ To write accurate information about what occurs during an experiment
12. __H__ A sequence of steps involved in performing an experiment

We Need Order!

The following statements are out of order regarding the steps to follow in the scientific method. Write the number next to the statement to put them in the correct order.

6	Observe and record all results
2	Research the problem
1	State the problem in the form of a question
8	State conclusion about the problem based on the research and data collected
3	Form a hypothesis
4	Write down the procedures you will use to test your experiment
5	Perform experiment to test hypothesis
7	Interpret data

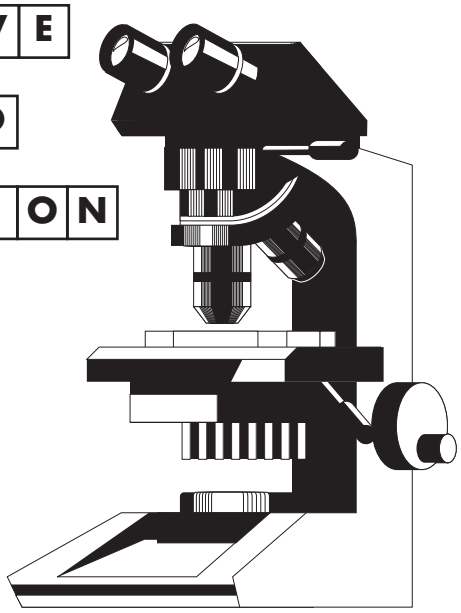
ANSWER KEY

ANSWER KEY

Vocabulary Scramble

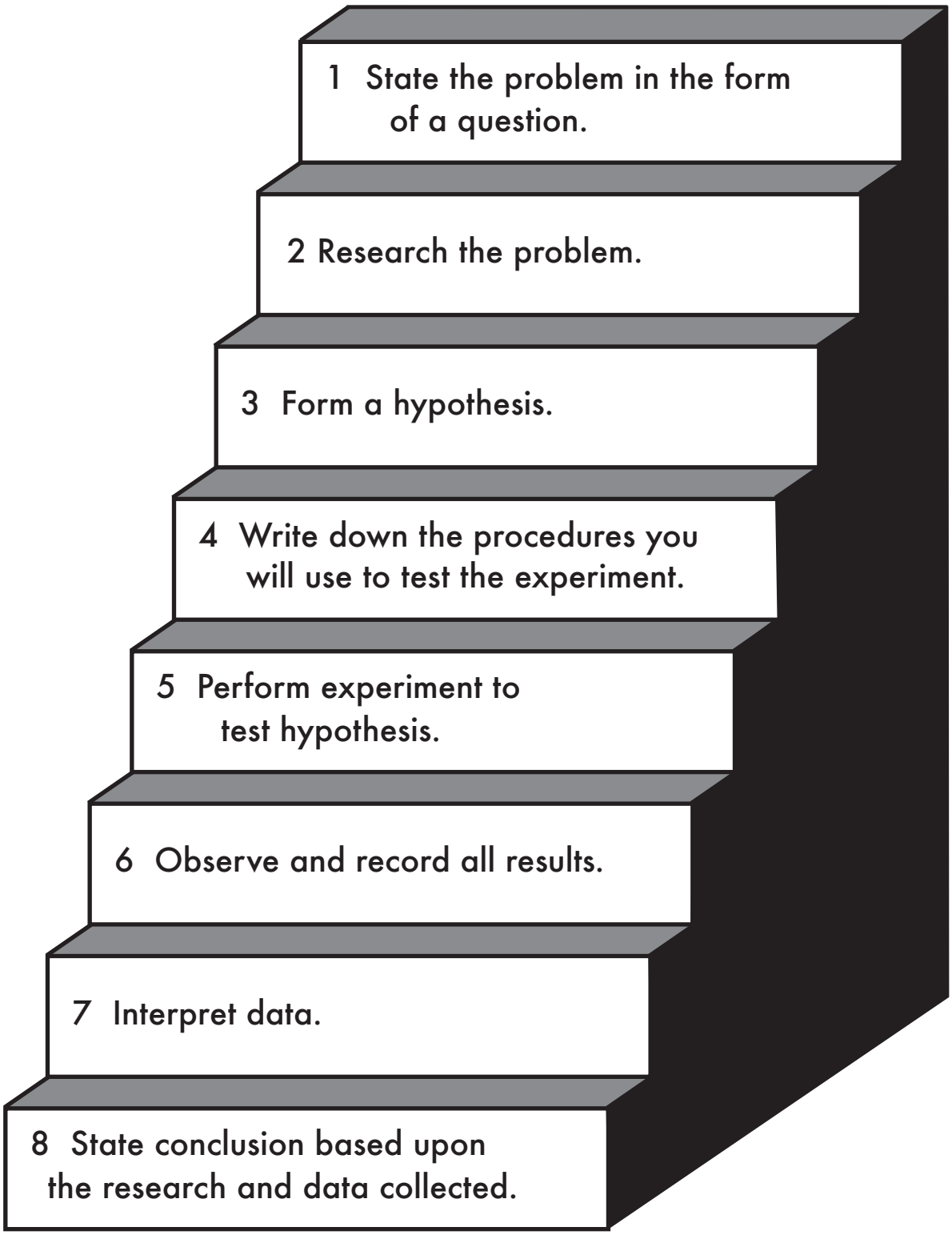
Unscramble the following vocabulary words.

OPESYIHTHS	HYPOTHESIS
DTTMOHIIICESNFEC	SCIENTIFIC METHOD
REAECHSR	RESEARCH
ETHLCIA	ETHICAL
SNUNCCOIOL	CONCLUSION
NIPEEMXETR	EXPERIMENT
DRECREPUO	PROCEDURE
PTRRNTEIE	INTERPRET
ARLBEVIA	VARIABLE
VEBOESR	OBSERVE
EDCRRO	RECORD
TEOISQUN	QUESTION



The Steps!

While viewing the program, list the 8 steps of the scientific method in order.

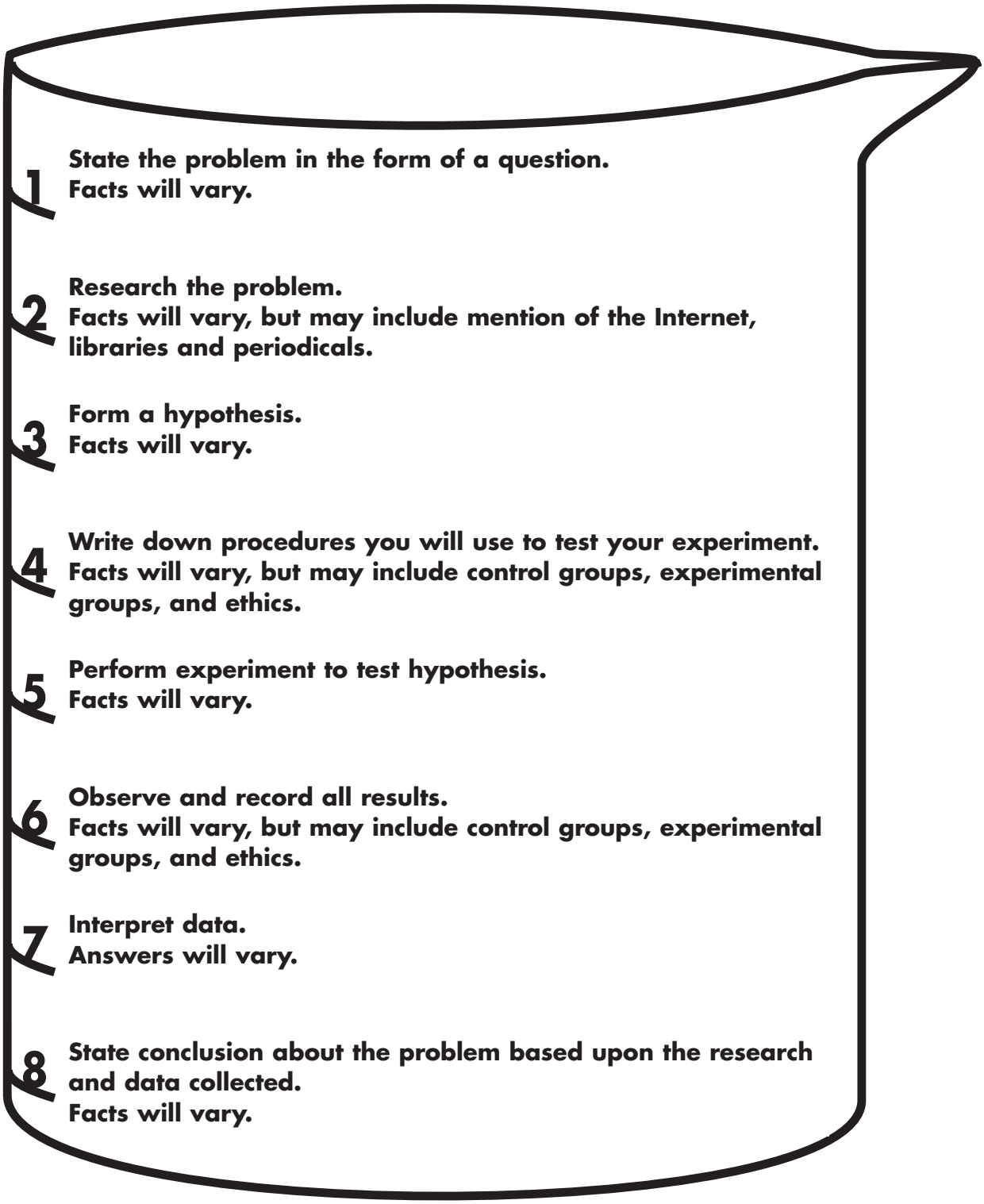


ANSWER KEY

ANSWER KEY

Steps & Facts

Write the scientific method steps in order and at least one fact about each step as you view the DVD/video.



1. **State the problem in the form of a question.**
   Facts will vary.

2. **Research the problem.**
   Facts will vary, but may include mention of the Internet, libraries and periodicals.

3. **Form a hypothesis.**
   Facts will vary.

4. **Write down procedures you will use to test your experiment.**
   Facts will vary, but may include control groups, experimental groups, and ethics.

5. **Perform experiment to test hypothesis.**
   Facts will vary.

6. **Observe and record all results.**
   Facts will vary, but may include control groups, experimental groups, and ethics.

7. **Interpret data.**
   Answers will vary.

8. **State conclusion about the problem based upon the research and data collected.**
   Facts will vary.

Mr. Curry's Class Uses the Scientific Method

While viewing the program, state what the students in Mr. Curry's class decide to use for their steps in the scientific method. In steps 1 and 3, state exactly what their final version was. In the other steps, state what their plan of action was for each step and include as much information as possible.

1. State the problem in the form of a question.	**What happens to a person's hear rate when he or she watches a scary movie?**
2. Research the problem. (Where did they find their information?)	**Books on human body systems, Internet information about heart rates, called Dr. Stephens about normal heart rate, magazine article for experiment.**
3. Form a hypothesis.	**If a person's normal resting heartbeat is approximately 70 beats per minute, then the heartbeat will increase above that level when a person watchs a scary movie.**
4. Write down the procedure for testing your experiment.	**Found information in a magazine article and set up testing stations for experiment. One student wrote up the procedures. Formed control group and experimental group.**
Variable in experiment	**Different movies.**
Control Group (What will they be doing?)	**Students are sitting quietly and are not watching movies.**
Experimental Group (What will they be doing?)	**Students are watching movies.**
5. Perform experiment to test hypothesis.	**Have volunteer students helping them with the experiment. Perform experiments according to written procedures.**
6. Observe and record all results.	**Scary movie: student's heart rates increased in experimental group Boring movie: students' heart rates have gone down; almost asleep More movies shown Took pictures of experiment.**
7. Interpret the data.	**The students are going to graph data and write a summary.**
8. State conclusion about the problem based on research and data collected.	**In each case, the heart rat increased while the subjects were watching the scary movies. The hypothesis is true. Data supports the hypothesis.**

ANSWER KEY

ANSWER KEY

Just the Facts Please!

Teacher Note: This worksheet can be used solely as a note-taking device by using the **"FACT"** only column, or it can be used in its entirety as a follow up activity after viewing the program.

Directions: This chart is designed to help you record important information while viewing the program. Record the facts in the **"FACT"** column and any questions or topics you do not understand in the **"QUESTIONS"** column. In the **"COMMENTS"** column, state how you feel about that fact or question.

FACTS	QUESTIONS	COMMENTS
Answers will vary between students, but may include the eight steps of the scientific method, places to do research, variables, and control and experimental groups.		

Scientist's Notepad

Below are various questions to answer while viewing the program. State your answers in the scientist's notepad

1. What makes up a good hypothesis?

A good hypothesis:

- **Stick with a simple statement**
- **Make it precise and measureable**
- **Use words like "if" and "then"**
- **Must make sense for project to make sense**

2. Why is it important to have a base line measurement?

It is necessary to have something to measure the variables against.

3. Why is is so important to be ethical in conducting the scientific method process?

Many scientists rely heavily on the scientific method. There are so many variables to consider and any one of them can affect the results of an experiment. You must record the results and observations ethically because your results may affect other people's findings It is okay if your data does not prove your hypothesis – just state this! You might have made a new scientific discovery.

4. Why is it so important to write one's procedures down first, before conducting the experiment?

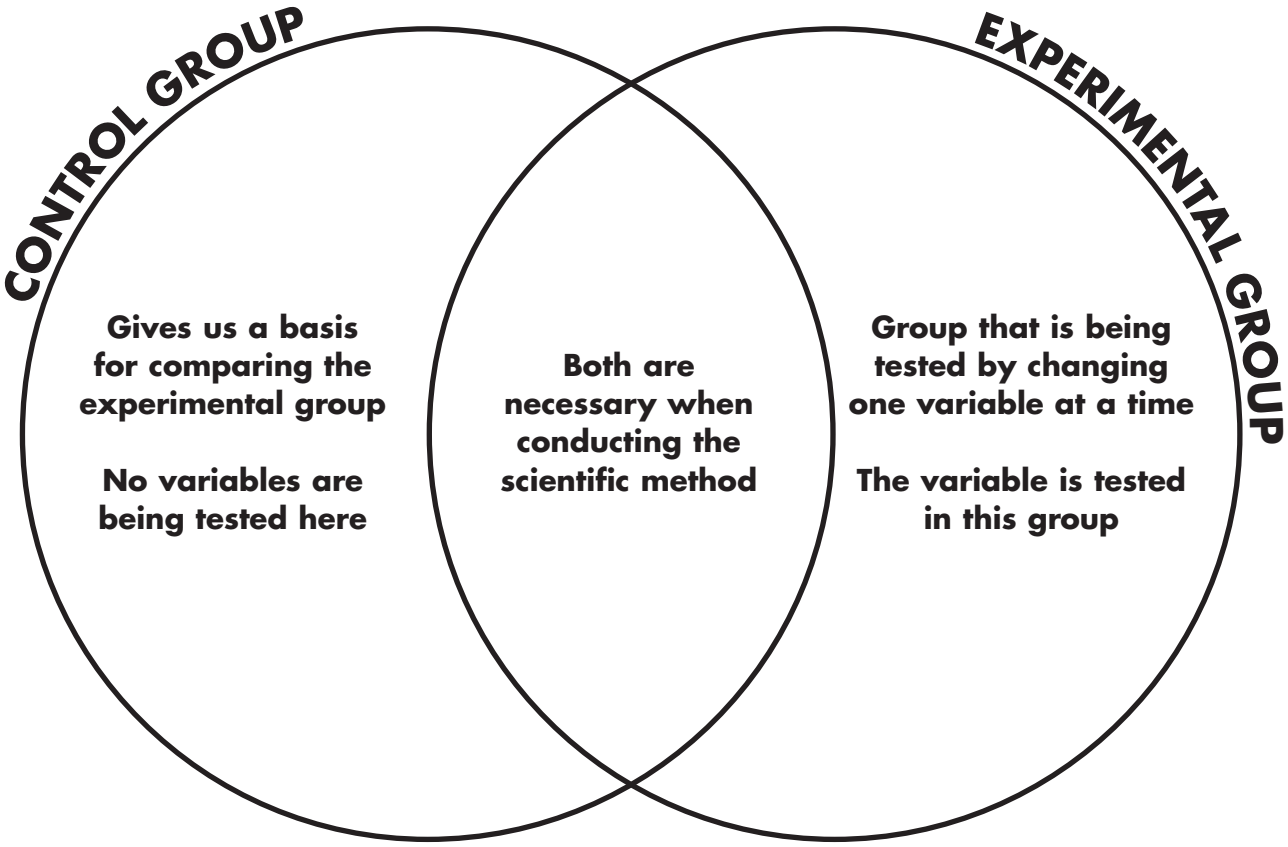
- **Helps you gather the neccessary materials**
- **Ensures that your experiment fits the hypothesis that you are testing**
- **It will help others who want to repeat your experiment**

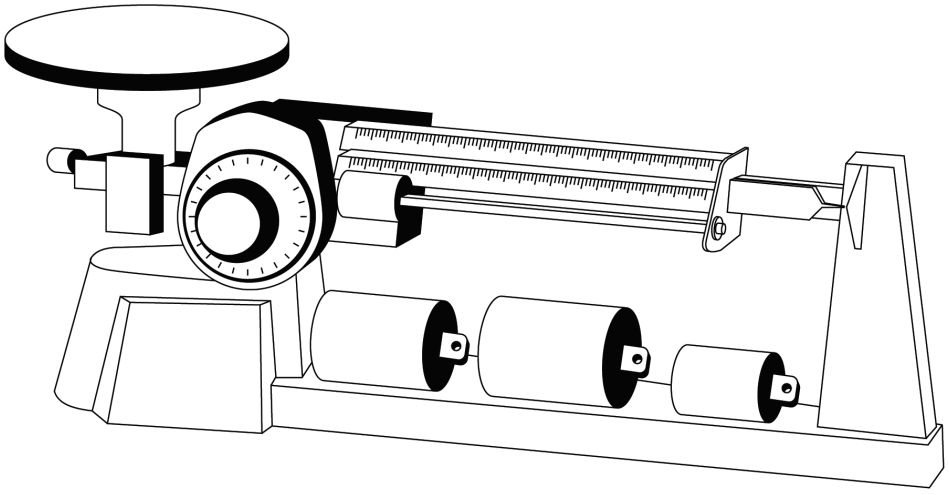
ANSWER KEY

ANSWER KEY

Compare and Contrast Groups

Using the Venn diagram below, compare and contrast the control group and the experimental group.





Vocabulary Cryptogram

Below is a Cryptogram. It contains a message from the program *The Scientific Method*. Solve this puzzle by substituting letters for the numbers. For a head start, the "E" and "A" have been given to you. "E" = 7. "A" = 9. Substitute "E" any time you see the number 7. Substitute "A" any time you see the number 9. Not all letters will be used. *Hint: Look to see where "scientific" will fit.*

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
9		11	16	7	17	4	22	24		1	26	14	23	25	8		15	2	10	13	12	19		5	

S C I E N T I F I C K N O W L E D G E A N D
2 11 24 7 23 10 24 17 24 11 1 23 25 19 26 7 16 4 7 9 23 16

M E T H O D S A R E T H E R E S U L T
14 7 10 22 25 16 2 9 15 7 10 22 7 15 7 2 13 26 10

O F V A R I O U S T Y P E S O F
25 17 12 9 15 24 25 13 2 10 5 8 7 2 25 17

I N V E S T I G A T I O N S A N D
24 23 12 7 2 10 24 4 9 10 24 25 23 2 9 23 16

C O M M U N I C A T I O N
11 25 14 14 13 23 24 25 23 10 24 25 23

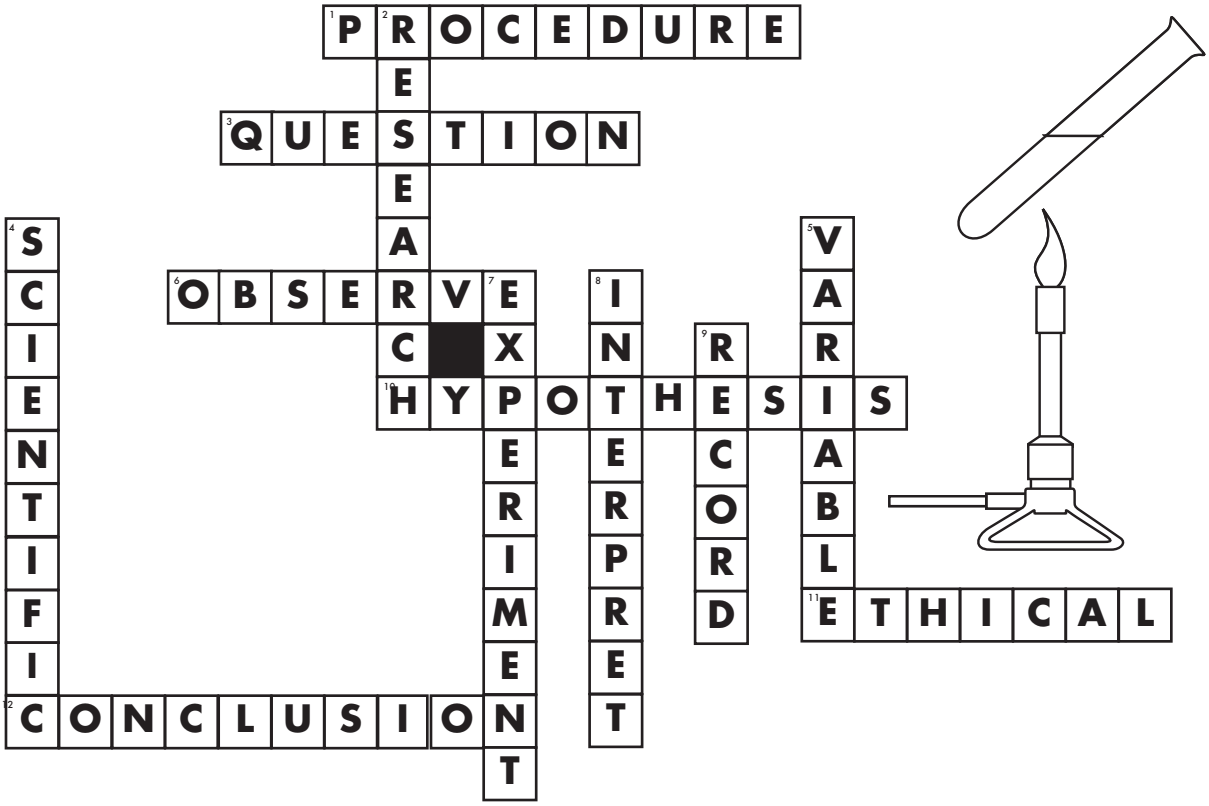
A M O N G S C I E N T I S T S
9 14 25 23 4 2 11 24 7 23 10 24 2 10 2

ANSWER KEY

ANSWER KEY

Vocabulary Crossword

Use the clues below to fill in the crossword puzzle.



Across

1. A sequence of steps involved in performing an experiment
3. The inquiry or problem relating to a topic that can be answered by conducting an experiment
6. To notice what occurs during an experiment
10. An educated guess or reasonable assumption
11. Following the rules of being fair and honest
12. The result or outcome of something

Down

2. To conduct an investigation into current information about something
4. A method of doing research that includes the steps of identifying a problem, gathering data, forming a hypothesis, testing a hypothesis, and drawing a conclusion.
5. Something that can change or influence the results of an experiment
7. A test or trial performed in order to discover something
8. To explain or give meaning to
9. To write accurate information abut what occurs during and experiment

Vocabulary Quiz

Write the vocabulary word next to its definition.

scientific method	interpret
hypothesis	experiment
ethical	conclusion
observe	procedure
question	
variable	

1. **INTERPRET**: to explain or give meaning to

2. **QUESTION**: the inquiry or problem relating to a topic that can be answered by conducting an experiment

3. **ETHICAL**: following the rules of being fair and honest

4. **CONCLUSION**: the result or outcome of something

5. **OBSERVE**: to notice what occurs during an experiment

6. **SCIENTIFIC METHOD**: a method of doing research that includes the steps of identifying a problem, gathering data, forming a hypothesis, testing a hypothesis, and drawing a conclusion

7. **EXPERIMENT**: a test or trial performed in order to discover something

8. **VARIABLE**: something that can change or influences the results of an experiment

9. **PROCEDURE**: a sequence of steps involved in performing an experiment

10. **HYPOTHESIS**: an educated guess about a possible solution or answer to your problem or question

ANSWER KEY

Scientific Method Quiz

Write the letter of the best answer in the space provided, fill in the blank with the best anwer, or write "true" or "false" for each statement.

1. **C** What is the first step in the Scientific Method?
   a. Form a hypothesis
   b. Research the problem
   c. State the problem in the form of a question
   d. Interpret data

2. **D** When choosing a problem, you should _____.
   a. choose a problem you don't know the answer to
   b. choose a problem you can work with
   c. choose a problem you know the answer to
   d. A and B
   e. B and C

3. **D** What are some resources one can use to research their problem?
   a. World Wide Web
   b. Books
   c. Newspapers
   d. All of the above

4. **C** _____ is something to measure "variables" against.
   a. outcomes
   b. control group
   c. base line measurement
   d. data

5. **D** To conduct a(n) _____ is a good way to discover something new about science.
   a. control group
   b. experimental group
   c. hypothesis
   d. experiment

Scientific Method Quiz (cont.)

6. List the 8 steps in the Scientific Method

    1. **State the problem in the form of a question**
    2. **Research the problem**
    3. **Form a hypothesis**
    4. **Write down the procedures you will use to test your experiment**
    5. **Perform experiment to test hypothesis**
    6. **Observe and record all results**
    7. **Interpret data**
    8. **State conclusion about the problem based on research and collected data**

7. When developing a question, what 3 things should you be able to do?

    1. **examine**
    2. **measure**
    3. **analyze**

8. In the conclusion, list the questions that one should make sure they answer

    1. **What happened?**
    2. **Was it what you expected?**
    3. **Did your results agree iwth the hypothesis?**
    4. **Did it answer the original question?**

9. **TRUE** True or False? The Scientific Method is an organized process for finding the answer to a question.

10. **FALSE** True or False? Developing a good, solid hypothesis is the easiest step of the scientific method.

11. **FALSE** True or False? When you explain what happened in your experiment, you record the results.

ANSWER KEY

ANSWER KEY

Scientific Method Quiz (cont.)

12. **FALSE** True or False? Sharing true information about the outcome of your experiment is not an example of ethical behavior.

13. **TRUE** True or False? Something that can change or influence the results of an experiment is a variable.

14. **TRUE** True or False? Experimental group is the group that is being tested by changing one variable at a time.

15. **TRUE** True or False? Detailing the entire experiment and recording all the variables analyzed, scientists are able to track the validity of the hypothesis.

Script

Cast

Mr. Curry .....Science Teacher
Tracy.....Science Student
Jill .....Science Student
David .....Science Student
Mike Malone.....Science Student
Football Player #1 .....Test Subject
Football Player #2 .....Test Subject
Football Player #3 .....Test Subject
Cheerleader #1 .....Test Subject
Cheerleader #2 .....Test Subject
Cheerleader #3 .....Test Subject
Documentary Narrator .....Off-screen voice

Scene One - Introduction

(Bell rings)

TRACY
What's Mr. Curry up to?

JILL
I don't know what's that machine anyways?

DAVID
It's some kind of old movie projector it looks like 8mm.

MIKE MALONE
Don't tell me we're going to watch a film, oh brother you think he's even heard about videos yet?

MR. CURRY
Mr. Malone of course I'm well aware of videos it just happens that this film I have for us today covers the specific material we're all about to study. As you appear to know so much about teaching perhaps you'd like to share with the rest of us what you already know so much about – the scientific method.

Script

MIKE MALONE
The scientific method, uh let's see. When scientists want to make something like Frankenstein's monster or something, well they have a special way of doing it called the scientific method, you know the hip bone's connected to the thigh bone, the thigh bone's connected to your shin bone and your shin bone's connected to your knee bone.

MR. CURRY
Very amusing Mr. Malone perhaps you can share the rest of your anecdote with me after class. For now I want everybody to pay careful attention to this little film.

FILM MR. CURRY
The Scientific Method. The scientific method is a problem-solving tool used by scientists to determine the validity of hypotheses. Simply put, it is a series of steps by which scientists test whether a scientific question is valid or invalid. In this film we will show you how you can use the scientific method as a problem solving tool and the correct steps you need to follow when using the scientific method.

TRACY
Is that Mr. Curry?

JILL
I don't know it sure looks like him, but with a lot more hair.

FILM MR. CURRY
As we have seen the scientific method is simply an organized process for finding a solution to a question – it is basic problem solving!

TRACY
I didn't know he was an actor.

MIKE MALONE
You call that acting?

MR. CURRY
Mr. Malone pay attention and take careful notes there will be a test on this.

Script

FILM MR. CURRY
There are eight steps that should be followed when using the scientific method. The first step is to state the problem in the form of a question. After stating the problem as a question, the next step is to research the problem. Based upon your research, you will then form a hypothesis for step three; form a hypothesis.

TRACY
Hippopotamus? Is that what he said? Form a hippopotamus?

FILM MR. CURRY
No a hypothesis! A hypothesis is an educated guess about a possible solution or answer to your problem or question.

JILL
Are you getting all this?

TRACY
I'm trying to but it's a little weird the way the guy in the film is acting.

MIKE MALONE
I still say it's a stretch to call that acting.

MR. CURRY
Perhaps now we can continue, after forming the hypothesis, step four is to write down the procedures that you will use to test your experiment. And based upon your procedures, you will perform your experiment to test your hypothesis in step five. Are you sure you're getting all this? Hmm? How about you Mr. Malone?

MIKE MALONE
What? Who? Me?

MR. CURRY
Yes you, of course you. Are you getting all this?

MIKE MALONE
Yeah, yeah I'm writing it all down see step 1, 2, 3, 4, and 5 I got it.

DAVID
Me too.

Script

JILL
Yeah I got it all.

TRACY
This is too weird.

MR. CURRY
Good, let's continue just three more steps. While conducting your experiment, you will observe and record all of your results in step six. Your results will also be used in step seven when you interpret your data. And finally, the last step, step eight, is to state your conclusion about the problem based upon the research you did and the data you collected.

Script

Scene Two - Step One: Question

MR. CURRY
I believe that the scientific method is one of the most important things
I'll teach you all year and if it takes getting a little scare into you to get you interested well then so be it. You do like scary movies don't you?

TRACY
Well yeah of course I mean scary movies are awesome.

MIKE MALONE
Yeah scary movies and the scientific method it sounds great.

MR. CURRY
Well Mr. Malone perhaps you've come up with the perfect assignment for yourself and your group. Why don't you all take some time to work together using the information that you already have and your textbooks to discover how the scientific method can be used to investigate scary movies. I have a feeling you'll do just fine. You just have to start thinking like scientists. Now you guys start working on it together I've got to get back to the lab.

TRACY
Is he kidding? This is way too complicated. Why do we even need to know this stuff anyway?

MIKE MALONE
Well, it says here that the scientific method is used everyday by scientists all around the world and without it technology just wouldn't get any better.

TRACY
But, I'm not a scientist – I want to be an actress after I graduate!

JILL
You heard Mr. Curry. For this project we all have to be scientists – whether we like it or not!

DAVID
Yeah. All we have to do is think like scientists and figure out how a scientist would look at a scary movie.

TRACY
Think like a scientist? I wouldn't even know where to start?

Script

MIKE MALONE
At the beginning, of course. What did Mr. Curry's movie say was the first step to the scientific method?

TRACY
Oh, wait! I know that! I was scribbling notes like crazy. The first step is to state the problem, right?

JILL
Hmm, so what is a problem associated with scary movies?

TRACY
Well, there are always people running and screaming – oh, and they're always running in the wrong direction. Instead of running away from danger they're always running into it. I never could understand that and you know—

DAVID
No, not that kind of problem!

TRACY
Well, what do you mean? The only other problem I can think of is that scary movies almost always give me a heart attack!

JILL
Exactly!

TRACY
What? You mean the problem could be that scary movies always give me a heart attack?

DAVID
Well sort of... Well don't you see that's the way a scientist would look at it? They would ask...what do scary movies do to us physically?

TRACY
(confused)
What do they do? Well, they usually make my heart start beating really fast because I get so scared! *(now catching on)* Oh, I get it. You mean the problem could be that scary movies increase the heart rate of the viewers. Right?

Script

DAVID
Yes, that's exactly what I mean. But remember, when you identify a problem, you need to state that problem in the form of a question.

JILL
So the first step is to state the problem in the form of a question. In this case it would be: "What happens to a person's heart rate when he or she watches a scary movie?" Right?

MIKE MALONE
Works for me.

(projector turns on)

MIKE MALONE
Did you do that?

DAVID
Me? I've been sitting right here.

JILL
It must be Mr. Curry up to his old tricks.

TRACY
But Mr. Curry isn't even in the room.

MR. CURRY
When applying the scientific method, it is very important that you begin with a solid problem or question. Without one your project won't go very far. For example, the question "Do scary movies frighten people?" is not specific enough. It would be very difficult to prove it true or false without solid measurable data to examine.

JILL
So, now what?

DAVID
Well, the number of heartbeats can be examined, measured, and analyzed...so I guess we're on the right track. The textbook also says that it is important to choose a problem that you do not know the answer to and a problem that you can work with.

JILL
I'm talking about the projector. What are we going to do with a projector that turns off and on by itself?

Script

DAVID
Oh that I think its better if we just stick to the assignment and try not to think about the projector.

MIKE MALONE
I think I'm with David.

TRACY
Yeah Jill some of these things are a little too weird to worry about.

DAVID
Let's look at the problem we chose. What happens to a person's heart rate when he or she watches a scary movie? Jill, is this a question we definitely know the answer to?

JILL
Well yeah I think so?

DAVID
You do? Without a doubt?

JILL
Well, it was a guess...I guess.

DAVID
Good. In that case, we're OK. The book says: "Choose something that you do not know the answer to."

MIKE MALONE
The movie guy said we should choose a problem or a question that we can work with...are we going to find information about scary movies and heartbeats?

ALL
Sure.

DAVID
Great! Well that takes care of Step One. Only...seven more to go! Oh well this is kind of fun and at least this thing isn't rolling by itself again. *(projector turns on)* Uh oh I spoke too soon.

Script

Scene Three - Step Two: Research

MR. CURRY
Research is a critical part of any science project or experiment. Your research can either make or break your project. *(sound of glass crashing in the background)* If you gather enough information to support your problem, your project could be a winner; but if you don't gather enough information, your project could be...well let's just say ... you probably won't get the grade you want. So when you're doing your research, remember to use a wide variety of resources outside of your school library.

TRACY
Research the problem? How are we supposed to do that?

JILL
Well, what are some things we should know before we begin our scary movie experiment?

MIKE MALONE
Well, we need to pick out some scary movies to watch. Let's go to the video store and watch some over at my place. I'll call my mom to make sure it's OK. I mean its homework after all.

JILL
Hold on there, Mike. This isn't about a particular movie we have other more important things to figure out like how are we supposed to know if a person's heart rate increases if we don't know what a normal heart rate is supposed to be.

MIKE MALONE
Yeah, I guess you have a point. So, what do we do?

DAVID
Looks like we'll have some research to do. We can hit the library and find some books on human body systems...

JILL
We can also check the library indexes, newspapers, magazines, check out a science video...

MR. CURRY
And Don't forget the World Wide Web.

Script

Scene Four - Step Three: Hypothesis

TRACY
Mr. Curry, where did you come from?

MR. CURRY
From the door of course what did you think I'd come in through the window or something?

MIKE MALONE
Mr. Curry, I think we came up with a way to use the scientific method to test scary movies.

MR. CURRY
Terrific.

DAVID
We thought that our Step One Question could be "What happens to a person's heart rate when he or she watches a scary movie?"

MR. CURRY
Very good. Now that's a question can be examined, measured, and analyzed. I assume you don't know the answer to that question?

JILL
But, in a way, we kind of do. I mean, can't we assume that because it feels like our heart is beating more after a scary movie that it is beating faster?

MR. CURRY
Not until you've examined it using the scientific method. You can't be sure that other variables didn't affect the outcomes until you test them.

JILL
Now you're talking too much like a scientist. What do you mean by variables and outcomes?

MR. CURRY
Well, let me grab my bag of tricks and I'll show you what I mean. Ok. I'm going to show you a bunch of objects and I want you to tell me what you think is going to happen when I drop them. Like this for example. *(He holds up a ball.)* What do you think will happen if I drop this?

Script

JILL
Are you serious?

MR. CURRY
Yes, of course. What will happen if I drop it?

JILL
It will fall.

MR. CURRY
So your hypothesis is...If I drop the ball then it will fall.
(He drops the ball and it bounces back) So far so good. Now, what if I drop it from here? *(He picks up the ball and holds it up higher)*

TRACY
It will still fall.

MR. CURRY
So you say even if I change the variable of height, the ball will still fall.

ALL
Yeah.

MR. CURRY
Very good. *(He drops the ball and it bounces back)* Did the variable of height change anything?

DAVID
It bounced more.

MR. CURRY
Hmm...more height more bounce. Now this could change our hypothesis... "If a ball is dropped from increasingly greater heights then it will bounce more." Now what if I drop a different ball. *(grabs new ball)* What do you suppose would happen if I drop this ball?

ALL
It would fall.

MR. CURRY
Well let's see. *(He drops the ball and it shatters)* It did fall, but it didn't bounce. Another different variable another different result. But still when I drop things, they fall, right?

Script

ALL
Yep!

MR. CURRY
Now what about if I drop these? *(holds up cymbals)* what's going to happen? (*he drops them it makes a loud crash)* Wow. It's looking like everything that I drop falls to the ground. What about if I drop this?
(He holds up balloon) What's going to happen?

ALL
Then it falls.

MR. CURRY
It will fall right? *(He drops the balloon – it floats up to the ceiling)* Hmm... Let me try that again *(He pulls out an identical balloon)* What's going to happen if I drop this?

ALL
Then it floats? *(He drops the balloon. It sinks to the ground)*

JILL
That other balloon was a helium balloon.

MR. CURRY
A-ha. A new variable. Looks like we're going to have to do some research. We cannot just assume that "the ball will fall." Our hypothesis has to be based on some research. If I had given you the balloon to check before I had let it drop you would have noticed the variable of helium and changed your assumptions. This is why scientists rely so heavily on the scientific method. There are so many variables to consider and any one of them can affect the results of your experiment. You may think that scary movies cause your heart to beat faster, but until you do some research, set up a controlled experiment, and record your results, you can't know for sure.

TRACY
So you expect us to test the whole thing?

MR. CURRY
It could be worth some serious extra credit points. Besides, I'm not sure anything like this has ever really been done before. It could become a landmark experiment that other scientists draw from in the future.

Script

DAVID
Really?

MR. CURRY
Well, that is one of the main points of using the scientific method. By detailing the entire experiment and recording all the variables analyzed, scientists are able to track the validity of the hypothesis. Some of the most exciting discoveries are those that prove other hypotheses wrong. It's like the helium balloon; all of a sudden, everything has changed. From "Gravity makes everything fall" we move to "Gravity makes things that are heavier than air fall." Who knows, one day we may find a new variable that changes everything again.

DAVID
So our experiment could lead to a new scientific discovery.

MR. CURRY
It's possible. If you follow the method and carefully note your variables and results.

DAVID
Cool.

MR. CURRY
(the bell rings) You guys have a good weekend and I'll see you on Monday. *(MR. CURRY exits scene)*

TRACY
Let's get together in the library after school today you guys and figure out how to do this...

(STUDENTS start walking towards the door.)

MR. CURRY
Probably the most difficult step of the scientific method is developing a good, solid hypothesis. The hypothesis is the center of your project. Chances are if your hypothesis doesn't make sense, your whole project won't make sense. So when you form your hypothesis, use words like "if" and "then," stick with a simple statement, and make it precise and measurable.

(later that day at the library)

Script

TRACY
Look at all the information that I got!

JILL
Cool! It looks like you did pretty well.

DAVID
I found some really cool stuff on the internet about heart rates and exercise.

MIKE MALONE
I found a magazine article on "psychological testing." It has all this stuff on test groups – kind of like the "variables" thing Mr. Curry was talking about.

TRACY
I called my doctor, Dr. Stevens, and he told me that the normal heart rate for a person at rest is about seventy beats per minute.

JILL
Cool, I didn't know that. Hmm let's see. *(Checking her pulse)* One... two... three.... .

TRACY
You know, I'm sure our heart beats faster when we are scared. Just like it beats faster when we've been exercising. Like me, I've been running around finding things and I bet that my heart is beating a mile a minute.

JILL
You just said the magic word.

TRACY
What?

JILL
Bet. A bet is nothing more than a hypothesis.

TRACY
Are you sure you don't mean hippopotamus?

JILL
Yes, I'm sure. Now remember a hypothesis is an educated guess about the possible solution or answer to the problem.

Script

TRACY
So our problem is "What happens to a person when he or she watches a scary movie?" So our hypothesis could be: "If a person watches a scary movie, then he or she could have a heart attack."

JILL
No, let's not get that extreme! But in a sense you're on theright track. Let's get back to the problem. How does watching scary movies affect a persons heart rate? Now, how can we turn that question into a statement that answers the question?

MIKE MALONE
Maybe the hypothesis could be " If a person watches a scary movie, his or her heart rate will increase."

DAVID
The textbook says it's important to be precise.

TRACY
(confused)
Precise? What do you mean?

JILL
You said earlier that your doctor told you that a normal heart beats 70 times per minute. We can use this as our base line measurement. Something to measure our variables against.

TRACY
I think I've got the hypothesis! How's this? If a person's normal resting heartbeat is approximately 70 beats per minute, then the heartbeat will increase above that level when a person watches a scary movie.

JILL
(excited)
By Jove...I think she's got it.

DAVID
Ex-tra cred-it here we come! *(Singing to tune of "California here we come!")*

Script

Scene Five - Step Four: Procedure

TRACY
Ok, so now we have our hypothesis! We're getting close to the really cool part! Now all we have to do is write down the procedures for testing our hypothesis.

MIKE MALONE
You really ought to be in movies, you know. You're always so dramatic.

TRACY
Did you hear what I said? We have to WRITE DOWN OUR PROCEDURES!

MIKE MALONE
I know, I know... Step four to the scientific method. No big deal. It's not like we have to write a 10 page essay or anything and in fact, I've got an idea that will help solve everything.

JILL
You do?

MIKE MALONE
Yeah, I do and if you can get some of your friends from the cheerleading squad and some of the guys from the football team to help us out tomorrow after the game, I will be glad to write out all the procedures.

JILL
Well...sure we can get some people to help out. But what for?

MIKE MALONE
You'll see. Just bring them to the lab tomorrow. I'm going to OK it with Mr. Curry. Man, I can smell the extra credit!

Script

MR. CURRY

So you've developed a solid hypothesis and you think you're ready to do your experiment. Before you just jump in, remember that you have to write out the procedures for your experiment before you actually do it. That way you'll know what materials you need and you can make sure that your experiment fits the hypothesis that you're testing. You will save yourself a lot of time and keep organized during the whole process. Writing down your procedures is important because other people can use them to repeat your experiment – it also helps your teacher better understand how you did your experiment. So remember, writing your procedures will help you gather the necessary materials, make sure that your experiment fits the hypothesis that you're testing, and it will help others who want to repeat your experiment.

Script

Scene Six - Step Five: Test Your Hypothesis

(the next day in the lab)

DAVID
Hey Mike, what's up? What is all this?

MIKE MALONE
Well I followed some stuff I read in that magazine article and I've set up some testing stations for our experiment.

JILL
Hey guys! The game's over and I have some people stopping by to help us test our hypothesis. Is everything ready?

TRACY
Did you write down the procedures like you promised Mike?

MIKE MALONE
I did. It's all set.

FOOTBALL PLAYER #1
Hey is this where we're supposed to be for the experiment?

MIKE MALONE
Oh yes it is. Come on in.

FOOTBALL PLAYER #2
So how is this going to work?

MIKE MALONE
David put this on so I can show everyone. *(Mike sits David down and attaches the monitor. It begins to beep quite quickly)* It's very simple. All we do is sit people down and make sure they're relaxed. Relax, David.

DAVID
I'm trying.

MIKE MALONE
Okay, three of you will go with Jill and Tracy.. You will be the experimental group.

CHEERLEADER #1
I don't think I like the sound of that.

Script

MIKE MALONE
Don't worry its all part of the project. First, we'll record all of your heart rates at rest. Then, the experimental group will watch a few scenes from the scary movies that I've picked out. *(He holds up some videotapes.)*

FOOTBALL PLAYER #3
All right! We get to watch some scary movies! I love scary movies!

JILL
Okay well let's get started.

DAVID
Ok. I think I'm relaxed now. This thing isn't too bad after all.

MIKE MALONE
See, you're measuring at 70 beats a minute.

FOOTBALL PLAYER#1
I'll try that thing.

MIKE MALONE
Ok, guys. Please attach your heart rate monitors and watch the video.

Script

Scene Seven - Variables, Control Groups and Experimental Groups

VIDEO MIKE MALONE
As you can see, experiments can be a lot of fun. The written procedures we are following help us make things flow smoothly. Which is exactly why rule number one for testing a hypothesis is to always follow the written procedures. Based upon these written procedures, we will form a control group and an experimental group. A control group gives us a basis for comparing the experimental group. In a control group, there are no variables being tested.

FOOTBALL PLAYER #1
Variables? What are variables?

VIDEO MIKE MALONE
Variables are the factors that are being tested in this experiment. It is critical that everything in the experiment is the same each time it is tested except for the one variable you are testing. This is where the experimental group will come into play.

FOOTBALL PLAYER #1
Are we the experimental group?

VIDEO MIKE MALONE
The experimental group is the group that is being tested by changing one variable at a time. In this experiment, we have two groups of students. The first group has been given a number one. You are the control group. In this group, no variables are being tested and as you can see, these students are not watching any movies and are just sitting quietly. But if you look at the second group of students, you will notice that they are watching a scary movie and the activity of this group is much different than that of the control group. This is the experimental group.

CHEERLEADER #2
So let me get this straight we are the control group and, we're the group that doesn't have any variables and they are the experimental group and they're the group that the variables are being tested on. Is that right?

VIDEO MIKE MALONE
Very good.

CHEERLEADER #3
But wait!! What is the variable in this experiment?

Script

VIDEO MIKE MALONE
Well, in this case it would be the scary movies. Since we are trying to prove that scary movies increase a person's heart rate, we will have to use different movies in the experiment to prove this to be true.

JILL
So how do you think it's going so far?

TRACY
Really good. During the first scary movie, that I showed the experimental group everyone's heart rates increased.

JILL
Good, but what movie are we showing now?

TRACY
Well now I'm showing a pretty boring movie...

DOCUMENTARY NARRATOR
(Voice off-screen)
There are many, many, many trees in the forest and we will now list all of them...

TRACY
And as you can see, the heart rates have gone way down and everyone is almost asleep.

JILL
That's perfect!! That can help us show that our hypothesis is true. We're almost done.

TRACY
Yeah, a few more movies and we'll have all the data that we need. Then we'll be finished.

JILL
Great. We're in the home stretch now.

Script

Scene Eight - Step Six: Recording Data

VIDEO MIKE MALONE
Here are some handy hints when performing your experiment. Always observe and record the data. Watch your experiment closely and note any reactions that occur. Always keep your results together in one journal. This will make it lot easier to keep your information organized. And remember, when dealing with the data from your experiment, be honest. Don't make up results from your experiment that you didn't get. Don't make your data fit your hypothesis. If your data doesn't prove your hypothesis to be true, then simply state that in your conclusion. Always be ethical and honest. And who knows? By being honest in your experiment, you may make a new scientific discovery. Just think, you could be the next Albert Einstein or Isaac Newton! So remember, when you're observing and recording the data from your experiment, make sure to watch your experiment closely and note any reactions that occur, keep all of your results in one journal, and be honest.

CHEERLEADER #3
Hey this scientific method is cool.

CHEERLEADER #2
Yeah we need to talk to Mr. Curry about doing something like this in our class.

Script

Scene Nine - Step Seven: Interpreting Data

MIKE MALONE
Well everybody that concludes our research.

JILL
Thanks for helping us out with our experiment you guys were great I think we got all the information that we need.

TRACY
This experiment was a lot of fun, but now comes the yucky part.

MIKE MALONE
The yucky part? What's that?

TRACY
Well, we have to figure out what to do with all of the data that we just got.

MIKE MALONE
Well, actually since we did a good job recording the data, interpreting it will be a breeze.

DAVID
Interpreting it? Oh, no this is already sounding hard!

JILL
Oh, it's not that bad. Let's take a look at the results. *(pause – picking up one of the journals)* The first thing we need to do is organize the results on graphs, charts, and tables.

DAVID
Graphs, charts, and tables? I know you don't mean the four-legged kind.

MIKE MALONE
Definitely not! By using graphs, charts, and tables, we can show results from the experiment. This will make it easier for our audience to understand the results and for us to write the summary.

DAVID
OK, so I can make some graphs, charts, and tables to organize the data, but then we're suppose to write what?

Script

JILL
We have to write a summary. All we have to do in the summary is write about what we discovered from the results of our experiment

DAVID
Do you mean that everyone fell asleep during the boring movies, but that everyone was screaming their heads off during the scary ones?

MIKE MALONE
Not quite. I mean what happened to their heart rates when they watched the movies.

TRACY
Oh! Well during the scary movies, their heart rates all increased and during the boring movies, their heart rates didn't increase. *(pause)* In fact, their heart rates were almost the same as when we measured them at rest before we began the experiment.

JILL
Great. I'll put all that down in the summary.

DAVID
Yeah, I get it now. This is going to be so cool.

TRACY
Oh, and guess what I did? *(She holds up pictures of the experiment and shows them to everyone)* I took pictures of the experiment.

MIKE MALONE, **DAVID**, **JILL**
Good job!! That's great Tracy!

MIKE MALONE
These pictures will be great. Good drawings or pictures that show your results or procedures can definitely make a project better.

TRACY
Do you really think so?

MIKE MALONE
Yeah, sometimes drawings and pictures can explain things better than words. Let's all take this home and finish it up for class on Monday.

Script

MR. CURRY
Interpreting data can sometimes be a difficult task. That's why pictures, drawings, graphs, charts, and tables of your results and procedures are an asset to your project. Not only will they enhance your project, they can also help clarify your written summary. And remember, your written summary does not have to be complicated - your written summary should be just that – a summary of your procedures, results, and of course your discoveries. It will make it easier for you to write your conclusion in step eight. So remember, when you are interpreting the data from your experiment, make sure to make tables, charts, and graphs, draw pictures, or take photographs to show your procedures and results, and write a summary.

Script

Scene Ten - Step Eight: Conclusion

(lab Monday)
(bell rings)

JILL
Wow Tracy! That table looks great!

TRACY
Thanks! You know, you were right. This table was easy to make and it really helped me organize the results.

JILL
Good. I wrote up the summary now we can just add it to the rest of the project.

MIKE MALONE
Did we state a conclusion yet?

TRACY
CONCLUSION? I thought the summary was the conclusion.

MIKE MALONE
Not quite. Our summary does what it was supposed to do – it summarizes the procedures, the results, and discoveries.

DAVID
Yeah, but what are we supposed to say in the conclusion? Like "In conclusion, scary movies freak people out?"

MIKE MALONE
No. Not quite. All we have to do in our conclusion is state if the results support our hypothesis.

JILL
So we have to decide based on our results if our hypothesis is true or false?

DAVID
Exactly. Let's re-read our hypothesis and look at our results. Then we can determine if the results of our summary support our hypothesis.

Script

TRACY
Well the hypothesis is: If a person's normal resting heart beat is approximately 70 beats per minute, then the heart beat will increase above that level when a person watches a scary movie.

DAVID
Now let's look at our results and see what conclusions we can draw.

TRACY
Well, in each case, the heart rate increased while the subjects were watching the scary movies.

DAVID
You know what that means?

JILL
That the hypothesis is true (she gets excited) Mike, Tracy, can you believe it? The hypothesis is true!

MIKE MALONE
All right. That wasn't so bad! Now all we have to do is write the conclusion out.

TRACY
Cool! Let's do it.

MR. CURRY
Stating a conclusion doesn't have to be hard. In fact your conclusion should just describe what your data tells you about your hypothesis. If the data supports your hypothesis, state it clearly. If it does not support it, decide how you might change your hypothesis based on your results or what you might do to experiment further. Whether your hypothesis is proven to be false or true, remember, the purpose of your conclusion is to communicate your results with others. To do this effectively, make sure to answer questions in your conclusion like: What happened? Was it what you expected? Did your results agree with the hypothesis? Did it answer the original question? By answering these questions in your conclusion, you will clearly communicate your discoveries with your audience.

Script

Scene Eleven - Wrap-Up

TRACY
This is really good.

MIKE MALONE
Oh my gosh! Guess what you guys?

JILL
What?

DAVID
I think we're finished!

ALL
Yes. All right! Wow! Right on!

MR. CURRY
Now that's what I like to see, students excited about science class.

TRACY
We did it Mr. Curry we finished the assignment.

MR. CURRY
You guys are great.

JILL
Thanks Mr. Curry. Actually it was a lot of fun.

DAVID
And better yet the experiment worked.

MR. CURRY
Yes you definitely used the scientific method to prove your hypothesis. I'm really impressed guys. So do you think this will help you?

ALL
Definitely.

MR. CURRY
Remember the scientific method is simply a problem-solving tool you can use to help yourself in science class...and everyday life.

Script

TRACY
So um Mr. Curry are you going to tell us how you did that little trick with the projector.

MR. CURRY
What trick?

JILL
You know turning the projector off and on by itself?

MR. CURRY
I didn't do any trick with the projector.

(projector turns on)

DAVID
You're telling us you did not just turn that on?

MR. CURRY
That's exactly what I'm telling you.

MR. CURRY
Pretty scary huh?

(everyone screams and runs out of classroom)

MR. CURRY
So long everyone. Well, my work is done here. Great work buddy, we did it again.

Notes