The Scientific Method

Name:____

Unit 1: The Scientific Method

- Step 1: State the Question (Write a question that asks what you want to know)
- Step 2: Collect Information (Information may come from a previous experience or from research)
- Step 3: Form a Hypothesis (Make an educated guess about what the answer to the question will be. The hypothesis should be based on the information collected in Step 2.)
- Step 4: Test a Hypothesis (Perform the experiment and observe the results.)
- Step 5: Record and Study Data (The results of an experiment can be recorded in many different ways. Tables are useful for recording data in an organizes way. Graphs can be used to compare results.
- Step 6: Write a Conclusion (Write a statement that compares the hypothesis to the data and answers the question. It will either prove or disprove the hypothesis. Results that do not support the hypothesis may lead to a new or revised hypothesis and a new experiment.)

Scientific or Not?

A Is the ocean the same depth everywhere?	K What kinds of organisms live in different parts of the ocean?
B What does an anglerfish eat?	L How fast does the wind blow in a tornado?
C What causes tornados to form?	M How can organisms be classified?
D How much does an anglerfish weigh?	N How long is an anglerfish?
E What is the temperature of the ocean at different depths?	O Will lemon juice, salt, or sugar on apples keep them from turning brown?
F What type of structure will remain standing in an earthquake?	P How do galaxies collide?
G What did the people who became ill at a picnic eat and drink?	Q What do birds with different kinds of beaks eat?
H What causes dogs to bark?	R Is a dog the best pet?
I Is the anglerfish the prettiest fish?	S Is an earthquake scary?
J Which galaxies are the most beautiful?	T What is the best tasting apple?

OBSERVATION

INFERENCE

PROBLEM

RESULT

HYPOTHESIS

CONCLUSION

Name	
Date:	

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ORDER OF EVENTS

	Unscramble the letters to identify which step of the scientific method each statement represents. Then number the statements in chronological order, 1-7.
	We bought a block of unsliced cheese on the same day, and it isn't moldy at all. ITVBARNOESO
	I think that sliced cheese gets moldy faster because people touch it more. PSHEYTSHIO
······	After five days, both sets of cheese that I touched are moldy. Both sets of cheese that I left alone have no mold. SRUETL
	I keep four separate sets of cheese in the refrigerator: five slices that I touch once a day; five slices that I leave untouched; five cubes of unsliced cheese that I touch once a day; and five cubes that I leave untouched. MRETEPXNIE
(********)	Why is the sliced cheese in the fridge all moldy? BEMOPLR
	I was right: Touching is the critical factor in making cheese mold. LNCSUOICNO
********	There must be something about sliced cheese that makes it more likely to mold. ECRFENINE

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Name	Date	Her 1

Words to Know

Write the word next to the description it matches.

observa	tion	hypothesis	
1		nething you find out ngs using your senses	about objects, events, or living
2		tatement of what you entific investigation	ı think will happen during a

Explain

Tell if each statement is true or false. Explain your choice.

3. A scientist's opinion is a valid source of information to use in a scientific investigation.

	This statement is	because		
ŧ.	Scientists make observations	very carefully.	÷	14 m
	This statement is	because		

Apply Concepts

What resources should the sc are some examples of reliable		water pollution?	Who
are semie examples of reliable	0 100001003.		
	4.1		

5. Suppose a scientist wants to begin an investigation on water pollution.



Name:	
Date:	

SCIENCE > SCIENTIFIC INQUIRY > SCIENTIFIC METHOD

FLOW CHART

Most of us use a loose form of the scientific method to solve everyday problems. For each of the problems and observations below, develop a hypothesis to explain what's happening. Then describe how you might test your theory with a simple experiment.

	T	T	
PROBLEM >	OBSERVATION >	HYPOTHESIS >	EXPERIMENT
Your cat rejects a can of tuna cat	She ate the can of chicken flavored		
food.	food you fed her last night, and the beef food from the		
	night before.		
Your bedroom air conditioner blows	Your bedroom gets lots of direct		
very cold air at night, but only cool air during the	sunlight all day long.		
day.	ž		
You're talking on your cell phone in	Just before the reception clears		
your bedroom, when suddenly the	up, you hear the microwave beep in		
reception goes bad for a minute.	the kitchen.		
			•••••

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ि क्रिक्रि Explor e) It!	Materials
Which towel absorbs	the most water?	graduated cylinder
Pour 100 mL of water into a Wad up one Brand A towel. cup and remove it. Measure in the cup.	Dip it completely into the and record the water left	plastic cup
2. Repeat twice using the same brand of towel.	Trial Water Left in Cup (mL) Brand Brand Brand Brand Brand	3 sheets each of 3 different brands of paper towel
3. Repeat Steps 1 and 2 with each of the other brands.	A B C	water
each of the other brands.	2	A
Explain Your Results 4. Draw a Conclusion Which towel absorbed the m	Total ost?	
		For each trial, dip you towel the same way.
5. How did carrying out repeate your conclusions?	ed trials help you trust	•
hat other conclusion can you mo	ake about Brand B?	

174.7s

Do the Inquiry Investigation This is the hands-on experimental part of the investigation. This part of the inquiry investigation involves using materials to make a model, gathering data to create a graph, or performing an experiment to prove a hypothesis. What You Did 1. State exactly what you did in each step of the investigation.	nc
Draw sketches of the models and materials in the box below.	
3. Record all data you collected in the "Data Record" section on the next page.	
Step 1:	
Step 2:	
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Step 5.	_
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Step 6:	_
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Drawing Conclusions	
Did you prove your hypothesis? Explain.	
	a)
What went wrong?	:
What would you do differently another time? Why?	
·	
What did you learn from this investigation?	
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1. Put 2	2 slices of bread on a	os bread freshes plate. Observe with er I slice with waxed p	a 4 slices vaper.	of bread plastic braxed paper plate hand le
		er bag. Put another slic		
3. Wait	5 days. Observe the	slices. Record your ob	de la companya de la	art.
	Waxed Paper	Bread Observ	Paper Bag	Uncovered Slice
Day 5				
Explai		pare the freshness of the	·	
Explai	erpret Data Comp	pare the freshness of the	·	
Explai 4. Inte 5. Infe	erpret Data Comp		ep bread fresh longe	
Explai 4. Inte 5. Infe	erpret Data Comp	combine methods to kee	ep bread fresh longe	
Explai 4. Inte 5. Infe	erpret Data Comp	combine methods to kee	ep bread fresh longe	

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Directed Inquiry Investigate It!



How does a banana slice change over time?

4. Observe the slices when you place them in the cup and each hour for 3 hours. Record your observations in the chart.

Changes to Banana Slices Over Time				
Time	Observations			
	Whole Slice	Cut-Up Slice	Mashed Slice	
When placed in cup			2	
After 1 hour			8	
After 2 hours				
After 3 hours				

Analyze and Conclude

5. Communicate	Examine your data. Identify a simple pattern you observed.
6. Make an inferen	ce to explain about the pattern you identified.
7. How can investiga	ting cut bananas help scientists learn about other fruits?
	v

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Step 2:
Step 3:
Step 4:

Step 5: _____

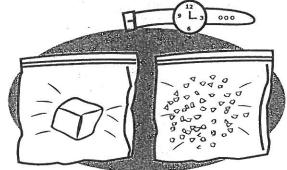
Step 6: _____

Drawing Conclusions	
Did you prove your hypothesis? Explain.	
What went wrong?	
What would you do differently another time? Why?	
What did you learn from this investigation?	·
·	

Name			
Halling			

Date

On the Surface



How does changing the surface area of an ice cube affect the rate at which it melts?

- 1 Place an ice cube in each sandwich bag and zip each bag tightly closed.
- 2 Take the hammer or rolling pin and gently break up the ice in one of the bags so that it is now in many small pieces. Be careful not to tear the bag! By crushing the ice, what did you do to the overall surface area of the cube?



- 6 Examine the ice in each bag. Which ice will melt faster? Why? Record your prediction and reasoning:
- 4 Place the two bags side-by-side on a table in a warm room. Keep a close watch on the ice in the two bags. Every minute or so lift the bags to see how much of the ice has melted. Which bag of ice melted first?
- **6** How did your observations compare with your prediction? Explain why you think you got the results that you did:

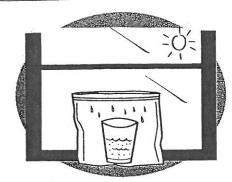
Think About It: How might you melt ice covering a sidewalk or street faster without using heat or chemicals?

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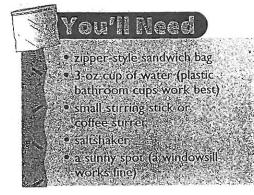
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Hold the Salt

How can the sun be used to purify water?



• Add 2 or 3 good shakes of salt to the water in the small cup and stir it until the salt dissolves completely. Look at the salty water in the cup. How does it look compared to freshwater? Dip a finger into the cup of water and touch it to the tip of your tongue. How does the water in the cup taste? Record your observations:



- Without spilling any water, carefully place the cup inside the sandwich bag and zip the bag closed. Place the sandwich bag with the cup in a sunny spot for at least 15 minutes. Predict: What do you think will happen to the water in the cup when it sits in the sun? Write your prediction here:
- After 15 minutes have passed, observe the plastic bag. Do you see any changes? What do you see? What do you think may have caused it? Write your ideas below:
- ② Carefully open the sandwich bag and remove the cup without spilling any water. Take your finger and rub it on the inside of the bag. Touch your finger to the tip of your tongue. How does the water in the bag taste compared to the water in the cup?
- **6** Based on your experiment, explain how the sun's energy worked to purify the water. How might a device like this be used to make ocean water drinkable?

Think About It: How does this activity simulate the way the water cycle works in nature?

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What You Did	
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Draw sketches of the models and materials in the box below.	

3. R	ecord all data you collected in the "Data Record" section on the next page.
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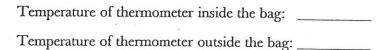
Drawing Conclusions	
Did you prove your hypothesis? Explain.	
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What went wrong?	×
What would you do differently another time? Why?	
What did you learn from this investigation?	

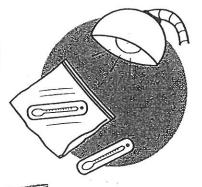
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The Heat Is On

How does a greenhouse work?

- 1 Find a sunny spot on a table or windowsill, or set up an incandescent lamp on a table.
- 2 Place one thermometer inside a sandwich bag and zip it closed. Make sure that there is some air inside the bag when you do this. Keep the other thermometer out. Read the temperature on each thermometer. They should be the same temperature (or very close). Record the temperature of the two thermometers below:







- zipper-style sandwich bag
- 2 small identical thermometers
- watch or clock
- a sunny spot or incandescent lamp

3	Place the two thermometers side-by-side in the sunny spot or under the lamp. If you are using a lamp, make sure both thermometers are the same distance from the bulb. What do you think will happen to the temperature on the thermometers after 10 minutes? Write your prediction here:
A	After 10 minutes, read the temperatures on the two thermometers. Record them below:
	Temperature of thermometer inside the bag:
0	Temperature of thermometer outside the bag:
5	Is there a difference in temperature between the two thermometers? Why do you think that is?
2	
9	Explain how this activity is a good model for the way a greenhouse works.

Think About It: How does this experiment explain why a car parked in the sun in the winter feels hotter on the inside than on the outside?

Name		
Date	Savor the Fla	vor!
Item to be tested: piece of		de °°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°
 Steps: Write the name of y Tell what you know Then make a hypot Start chewing your to rate the gum's flavor. Repeat Step 3 for a the flavor each min Compare your resu 	your gum above. Write your question below about the flavors of different kinds of gum. thesis about your group's results. gum. After one minute, use the flavor scale avor. Then list words that describe the a total of six minutes, rating and describing	
Testable Question	about Which guill's haver laste the longest	Flavor Scale Flavor Scale (packed with flavor)
What I Know		
My Hypothesis Pata and Observations		- 5 (has some flavor)
Flavor Rank I minute Flavor Rank	Flavor Rank 2 minutes Flavor Rank Flavor Rank Flavor Rank Flavor Rank Flavor Rank	O (has no flavor)
Conclusion	5 minutes 6 minute	es



Date:	
Name:	
Class:	

1	What's the	difference	between a	hypothesis	and a theory?	j
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1	What's the difference between a hypothesis and a theory?
A	word for "guess"
B	Hypotheses can't be proven; theories can
C	Theories have been confirmed through tests; hypotheses haven't
D	Theories contain many hypotheses; a hypothesis only contains one theory
2	Place the following steps in sequence: A) Recognizing a problem; B) Testing a hypothesis; C) Drawing inferences
A	A, C, B
B	A, B, C
C	B, C, A
D	C, B, A
3	In the phrase, "The scientific method is an analytic process for determining why things happen," what's the best
A	synonym for "analytic"? Probable
B	Amazing
C	Incoherent
D	Logical
4	What must you do before you make a hypothesis?
A	Run an experiment
B	Make observations
C	Form a theory
D	Draw conclusions
5	If you were running an experiment to determine the temperature at which beans sprout the fastest, what would be the variable?
A	The number of beans you plant
В	The height of the sprouts you grow
C	The amount of water you give the beans
D	The temperature at which each bean is kept

	Name:
	Class:
6	You should run an experiment several times to make sur
A	your results are consistent. In the preceding phrase, wh does "consistent" mean? Obvious
В	Perfect
C	Unchanging
D	Testable
7	What might cause a theory to change over time?
A	New laws passed by the government
В	New but untestable ideas
C	Changes in public opinion
D	The discovery of new evidence
8 A	Evolution is one example of a theory. From what you kno about the scientific method, what can you conclude abou this biological theory? It's been tested many times
В	Scientists don't need to test it anymore
C	No one is allowed to test whether it's true or not
D	There is very little evidence to support it
9	Which of the following is a testable hypothesis?
A	Roses are more beautiful than violets
B	A plant needs at least five hours of sunlight per day to grov
C	Ice cream is delicious
D	Humans will someday land on Mars
10	What happens if you test a hypothesis multiple times and the data doesn't support your prediction?
A	Change the data to support your prediction
B	Run the experiment again until you get the results you're looking for
C	Conclude that your hypothesis cannot be proven

Re-think your hypothesis

*

The Spaghetti and Marshmallow Tower Challenge

Science and Engineering Practices
Asking Questions and Defining Problems

Ask questions that can be investigated and predict reasonable outcome based on patterns such as cause and effect relationships. (4-PS3-3)

<u>Objective</u>: To build the tallest marshmallow and spaghetti tower within 30 minutes. The tallest tip will be the marshmallow that is furthest off the ground

Process:

- You will create or be assigned a team; 3 to 4 people to each team.
- You will be given 50 pieces of spaghetti and 25 minimarshmallows.
- You will have 5 minutes to plan your approach using the inquiry worksheets.
- You will have 30 minutes to build your structure.
- Spaghetti and marshmallows may be altered, but the marshmallows must remain dry. In addition, you are not to eat any of the materials.
- After 30 minutes, the teacher will wait an additional minute before measuring the height of the tower. The additional minute is to ensure the stability of the structure.

Learning Goals:

Students will work on...

- Determining variables and controlling them
- Team work
- Time management
- Creative problem solving
- Engineering for structural strength
- Perseverance and idea adaptation

4	the steps in your investigation be		
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6.	*		
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cientists need to conat they think an incake a mind map wire quiry investigation. Step 1 Step 4 Anticipating Properties to doing any incounter in doing the	nvert the pictures in their mind in quiry investigation is going to loo th sketches showing what you the Step 2 Step 5 Step 5 blems nvestigation need to look ahead	Step 3 Step 6	ep to step f your

Planning the Investigation

This is the	the Inquiry Investigation nee hands-on experimental part of the inquiry investigat nee hands-on experimental part of the investigat using materials to make a model, gathering data to create a graph, or performing an ent to prove a hypothesis.	ion
1. S 2. D 3. R	tate exactly what you did in each step of the investigation. raw sketches of the models and materials in the box below. ecord all data you collected in the "Data Record" section on the next page.	
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Drawing Conclusions)
Did you prove your hypothesis? Explain.		
What went wrong?	2	
	2	
What would you do differently another time? Why?		
What did you learn from this investigation?		
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> Journal Entry					
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Include any illustrations, picture, or models that you wish on the back of this page.

Science Journal

Inquiry Assessment Rubric

Final Grade: 4 3 2 1

Comments:

4 Points — Advanced/Above Grade Level Expectations

The inquiry choice and investigation demonstrate original and creative thinking.

The brainstorming for the inquiry topic indicates a diverse range of potential topics of varying value.

The investigation demonstrates detailed planning.

The inquiry investigation is rigorously and completely done.

Some kind of data from the investigation is carefully recorded.

Carefully reasoned conclusions are drawn.

The inquiry investigation worksheet is carefully completed.

3 Points — Proficient/At Grade Level Expectations

The inquiry choice and investigation demonstrate some original and creative thinking.

The brainstorming for the inquiry topic indicates several potential topics of varying value.

The investigation demonstrates fairly detailed planning.

The inquiry investigation is completed.

Some kind of data from the investigation is recorded.

Some conclusions are drawn.

The inquiry investigation worksheet is generally complete.

2 Points — Basic/Below Grade Level Expectations

The inquiry choice and investigation demonstrate some thought.

The brainstorming for the inquiry topic indicates only two or three potential topics of varying value.

The investigation demonstrates some planning.

The inquiry investigation is largely complete.

The data from the investigation is unclear or limited.

One conclusion is made or attempted.

The inquiry investigation worksheet is only partially complete.

1 Point — Below Basic/Far Below Grade Level Expectations

The inquiry choice and investigation demonstrate little thought.

The brainstorming for the inquiry topic indicates few potential topics.

The investigation demonstrates little or no planning.

The inquiry investigation is largely incomplete.

The data from the investigation is unclear and not useful.

No conclusion is made or attempted.

The inquiry investigation worksheet has little or no information.