Name _____ Date _____ Class _____

Notes

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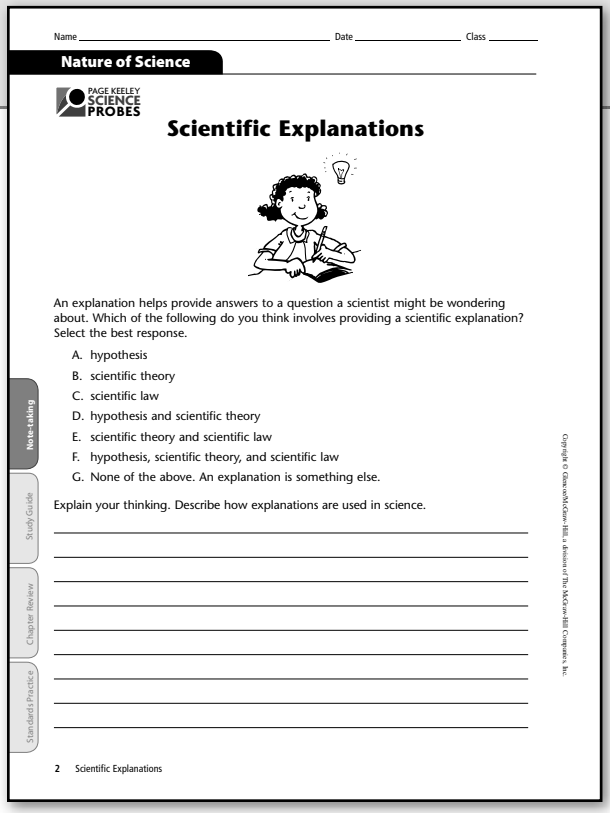
Name _____ Date _____ Class _____

Nature of Science

PAGE KEELEY SCIENCE PROBES

Scientific Explanations

An explanation helps provide answers to a question a scientist might be wondering about. Which of the following do you think involves providing a scientific explanation? Select the best response.

A. hypothesis
B. scientific theory
C. scientific law
D. hypothesis and scientific theory
E. scientific theory and scientific law
F. hypothesis, scientific theory, and scientific law
G. None of the above. An explanation is something else.

Explain your thinking. Describe how explanations are used in science.

Note-taking | Study Guide | Chapter Review | Standards Practice

2 Scientific Explanations

PAGE KEELEY SCIENCE PROBES

Teacher Notes

The best answer is D. hypothesis and scientific theory. While a hypothesis and a scientific theory are different, they both involve explanations. A hypothesis is a possible explanation about an observation that can be tested. A scientific theory is a well-tested explanation that stands the test of time until a better explanation replaces or revises it.

The big idea is that scientific explanations are used by scientists to support their thinking about observations, based on evidence and sound reasoning. Some students will not choose A, B, or D because of misunderstandings about the nature of science. They may think hypotheses are guesses (this comes from calling a hypothesis an "educated guess") and that theories are simply "hunches." Students who choose C may think that a scientific law is the accepted explanation. However, scientific laws only describe patterns or events. They do not explain them.

Students' answer choices and their description of explanations will alert teachers to the need to make sure instruction builds a bridge between the students' initial ideas about the nature of science and the scientific understanding of the way science works.

Name _____ Date _____ Class _____

Note-taking Nature of Science

How can science provide answers to your questions about the world around you?

Before You Read

Before you read the chapter, think about what you know about how science provides answers to questions about the world. Record your ideas in the first column. Pair with a partner, and discuss his or her thoughts. Write those ideas in the second column. Then record what you both would like to share with the class in the third column.

Think	Pair	Share

Chapter Vocabulary

Lesson 1	Lesson 2	Lesson 3
NEW observation hypothesis prediction inference technology scientific theory scientific law critical thinking **ACADEMIC** ethics	**NEW** description explanation International System of Units (SI) accuracy precision significant digits	**NEW** variable dependent variable independent variable constants

A Lesson Content Vocabulary page for each lesson is provided in the Chapter Resources Files.

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Note-taking
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Lesson 1 Understanding Science

7.NS.1, 7.NS.8, 7.NS.11, 7.DP.1, 7.DP.3, 7.DP.4, 7.DP.5, 7.DP.6, 7.DP.7, 7.DP.10, 7.DP.11

Skim or scan *the heading, boldfaced words, and pictures in the lesson. Identify or predict three facts you will learn from the lesson. Discuss your thoughts with a classmate.*

Main Idea

What is science?

I found this on page NOS 4.

Branches of Science

I found this on page NOS 5.

Scientific Inquiry

I found this on page NOS 6.

I found this on page NOS 7.

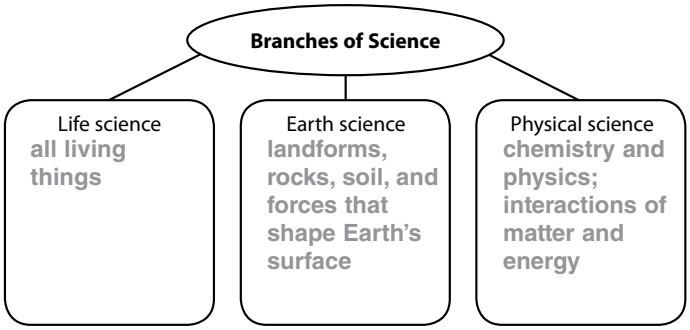
I found this on page NOS 7.

Details

Identify *three behaviors that scientists might use in exploring questions and in solving problems.*

1. reasoning
2. skepticism
3. creativity

Differentiate *3 main branches of science. Describe what scientists study in each area.*



Define *terms applied to scientific inquiry.*

Observation the act of watching something and recording what occurs	Hypothesis a possible explanation about an observation that can be tested by scientific investigations
Prediction a statement about what will happen next in a sequence of events	Inference a logical conclusion based on available information or evidence

Practice *stating a research* hypothesis. *Write a research* hypothesis *that might form the basis of an investigation.*

Accept all reasonable responses. Answer should follow the format "if…and…then…."

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Lesson 1 | Understanding Science (continued)

Main Idea

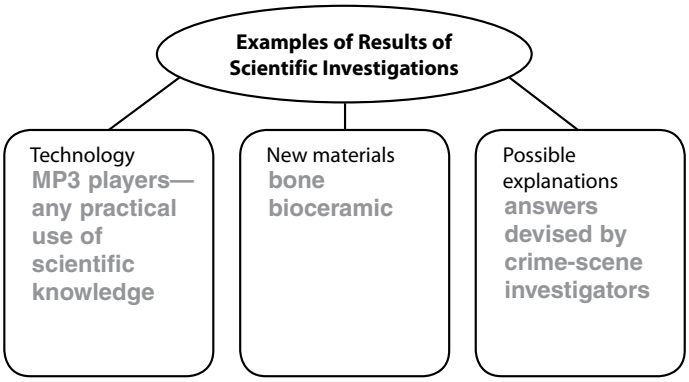
Results of Scientific Inquiry

I found this on page NOS 8 .

Examples are sample answers. Students might select others.

Details

Categorize *outcomes of scientific inquiry. Give an example of each type of result.*



Scientific Theory and Scientific Laws

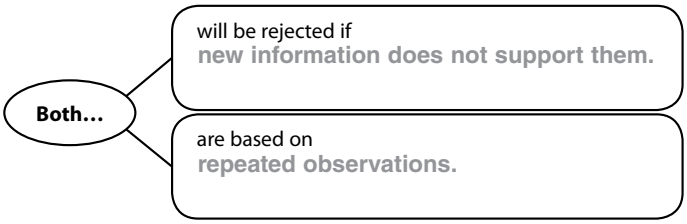
I found this on page NOS 9 .

Contrast *a* scientific theory *with a* scientific law.

Scientific Theory	Scientific Law
Description: an explanation of observations or events based on knowledge gained from many observations and investigations	Description: describes a pattern or an event in nature that is always true
Example: cell theory	Example: law of conservation of mass

I found this on page NOS 9 .

Relate *two ways in which a* scientific theory *and a* scientific law *are similar.*



Scientific Explanations 5

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Lesson 1 | Understanding Science (continued)

Main Idea

Details

I found this on page NOS 10 .

Assess *two situations in which it is important to question scientific issues in the media.*

1. claims that are based on vague statements
2. statements made by nonexperts

I found this on page NOS 10 .

Identify *the process of comparing what you already know with new information.*

critical thinking

I found this on page NOS 10 .

Explain *how these three factors can help prevent bias in a scientific investigation.*

Sampling	Blind Study	Repetition
A sample must be a random representation of the whole to avoid bias.	To avoid bias, the subject, the investigator, or both are unaware of which item they are testing.	An unbiased investigation should yield the same result when repeated.

I found this on page NOS 11 .

Point out *the importance of safety and ethics when conducting scientific investigations.*

Safety
Experiments should be conducted using safe lab practices and proper safety equipment.

Ethics
Animals should be treated properly; people should know about the risks of participating in research.

Analyze It Suppose you see two news stories on TV about a scientific topic, but the experts say different things about the data and what it means. How do you decide which is correct?

Accept all reasonable responses. Sample answer: I would do more research to find out how the two experts conducted their investigations, whether they used proper processes of scientific inquiry, and whether they show signs of bias in their conclusions or their attempts to persuade others.

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Lesson 2 Measurement and Scientific Tools

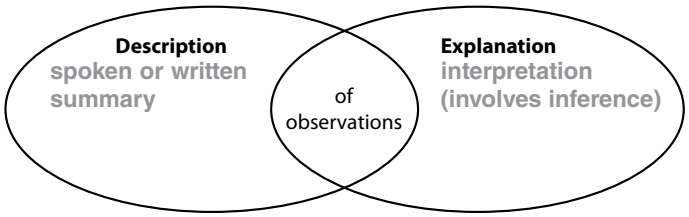
7.NS.3, 7.NS.5, 7.NS.7, 7.NS.8
Skim or scan *the heading, boldfaced words, and pictures in the lesson. Identify or predict three facts you will learn from the lesson. Discuss your thoughts with a classmate.*

Main Idea

Description and Explanation
I found this on page NOS 12 .

Details

Relate *the terms* description *and* explanation *to observations.*



The International System of Units
I found this on page NOS 13 .

Students may also write fraction answers in decimal form.

Interpret *the mathematical meaning of prefixes used in the* International System of Units (SI).

Prefix	Meaning	Prefix	Meaning
Mega	1,000,000	Micro	1/1,000,000
Kilo	1,000	Milli	1/1,000
Hecto	100	Centi	1/100
Deka	10	Deci	1/10

I found this on page NOS 13 .

Identify *the* SI *units for different measurements.*

Quantity Measured	Unit
Length	meter
Mass	kilogram
Time	second
Electric current	ampere
Temperature	Kelvin
Substance amount	mole
Light intensity	candela

I found this on page NOS 13 .

Express *each measurement in the proper* SI *unit.*

One thousand of the base unit in length: kilometer

One millionth of the base unit in mass: microgram

One thousandth of the base unit in time: millisecond

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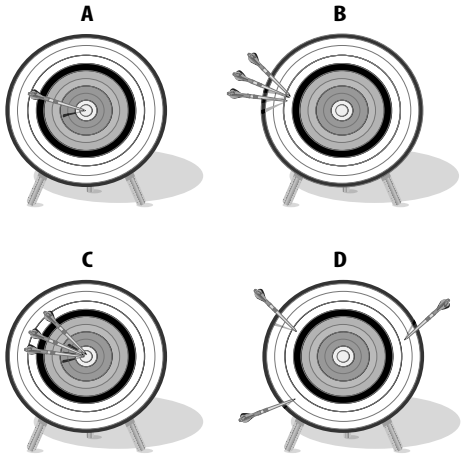
Lesson 2 | Measurement and Scientific Tools (continued)

Main Idea

I found this on page NOS 14 .

Details

Explain *models of* accuracy *and* precision.



Target	Description	Explanation
A	accurate	The arrow in the bull's-eye represents one measurement right on the accepted value.
C	accurate and precise	several measurements close to each other *and* to the accepted value
D	neither accurate nor precise	measurements neither close to each other nor to the accepted value
B	precise but not accurate	measurements close to each other but not to the accepted value

Measurement and Uncertainty

I found this on page NOS 15 .

Relate *two factors that can limit the* accuracy *and* precision *of measurements.*

Lesson 2 | Measurement and Scientific Tools (continued)

Main Idea

Significant Digits

I found this on page NOS 15 .

Details

Classify *numbers as* significant digits, *or not. Write* S *for significant or* N *for not significant.*

S or N?	Digits
S	all nonzero numbers
N	zeros used solely for spacing a decimal point
S	zeros between nonzero digits
S	final zeros after a decimal point

Scientific Tools

I found this on page NOS 16 .

Recognize *the uses of scientific tools.*

science journal used to record descriptions, explanations, plans, and steps	**balance** measures the mass of objects	**thermometer** measures the temperature of substances
glassware used to hold, pour, heat, and measure liquids	**microscope** enables you to see objects too small to view with the eye	**computer** used to process data

Tools Used by Life Scientists

I found this on page NOS 18 .

Describe *tools used by life scientists.*

Tool	Description
Magnifying lens	hand-held lens that enlarges image of an object
Slide	holds material for viewing under compound microscope
Dissecting tools	used to examine tissues, organs, or prepared organisms
Pipette	used to draw up and transfer liquids

Connect It Make a generalization about the importance of tools to science.

Accept all reasonable responses. Sample answer: Tools are very important in science. Many scientific observations could not be made at all without tools, and tools provide reliable ways to keep observations accurate and precise.

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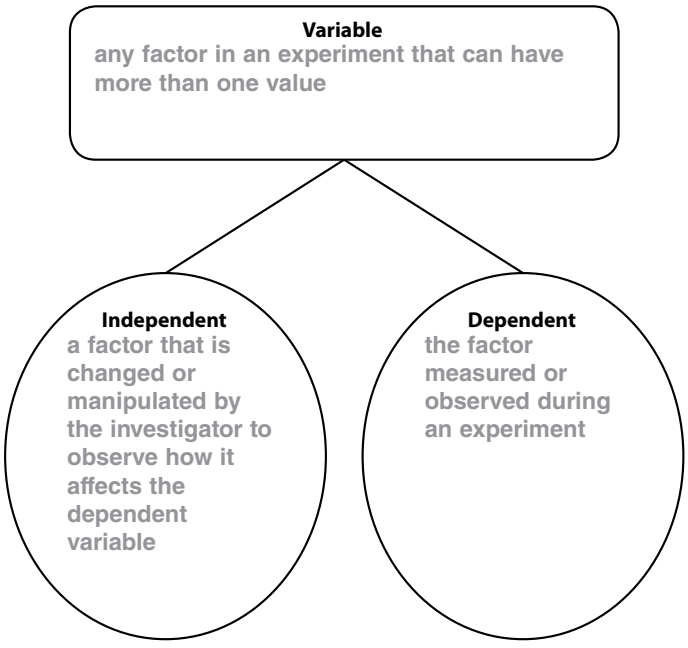
Lesson 3 Case Study: Biodiesel from Microalgae

7.NS.1, 7.NS.4, 7.NS.7

Skim or scan *the heading, boldfaced words, and pictures in the lesson. Identify or predict three facts you will learn from the lesson. Discuss your thoughts with a classmate.*

Main Idea	Details
The Biodiesel Revolution *I found this on page* NOS 20.	**Infer** *a primary difference between biodiesel and the main source of energy people have used in industry and transportation for the last few centuries.* Fossil fuels, the main sources of energy for industry and transportation for the last few centuries, come from once-living organisms. Biodiesel is a fuel made from present living organisms.
Designing a Controlled Experiment *I found this on page* NOS 20.	**Define** variable, *and express the differences between types of* variables.



I found this on page NOS 20.	**Identify** *the factors in an experiment that remain the same.* constants

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Lesson 3 | Case Study: Biodiesel from Microalgae (continued)

Main Idea	Details
Biodiesel *I found this on page* NOS 21 .	**Assess** *how these two factors affect the preference for biodiesel as a fuel source.* Petroleum: Petroleum was preferred because it is cheaper than the production of biodiesel. Source of biodiesel: Concern about food shortages makes it undesirable to shift crop production from food to biodiesel.
Aquatic Species Program *I found this on page* NOS 21 .	**Depict** *the shift in focus of the Aquatic Species Program.* Original focus: aquatic species that use CO_2 during photosynthesis Shifted focus: producing oils for biodiesel from microalgae
Which Microalgae? *I found this on page* NOS 22 .	**Record** *a hypothesis formed by scientists evaluating species of microalgae for usefulness in producing biodiesel.* Hypothesis: Microalgae species in shallow saltwater ponds are most resistant to variations in temperature and salt content.
Oil Production in Microalgae *I found this on page* NOS 22 .	**Evaluate** *the effect that starving microalgae of nitrogen has on oil production.* Less nitrogen Size of microalgae: decreased Smaller microalgae: produce less oil Overall oil production: saw no increase

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Scientific Explanations 11

Lesson 3 | Case Study: Biodiesel from Microalgae (continued)

Main Idea

Outdoor Testing v. Bioreactors

I found this on page NOS 23 .

Contrast *three different growing environments that represent hypotheses about growing microalgae. Identify the major challenge posed by each strategy.*

Growing Environment	outdoor ponds	glass bioreactors	long plastic bags
Major Challenge	native algae invasion	expensive	algae expensive to harvest

Why so many hypotheses?

I found this on page NOS 24 .

Restate *what it means for research to be "hypothesis-driven."*

You come up with a question… → You propose some strategies for answering the question based on objectives.

Increasing Oil Yield

I found this on page NOS 24 .

Record *a prediction made by scientists seeking to increase the oil yield of microalgae.*

Prediction: If light is distributed more evenly, then more microalgae will grow, and more biodiesel will be produced.

Bringing Light to Microalgae

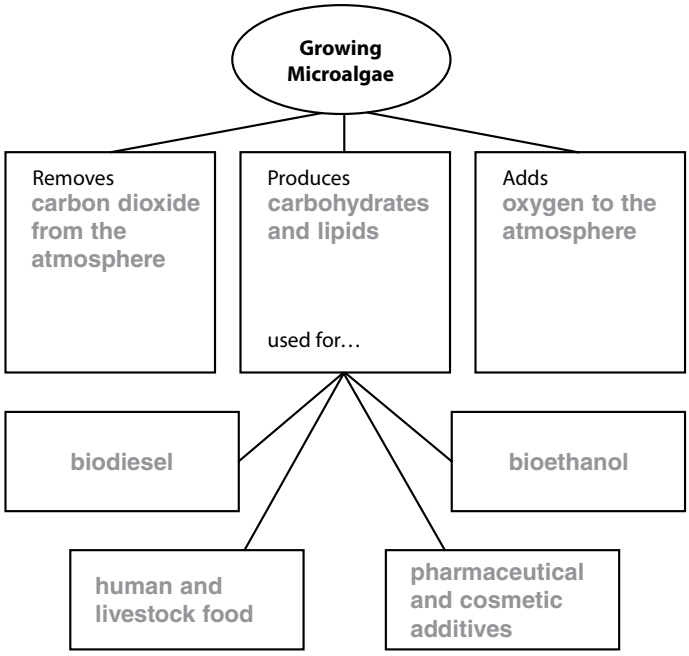
I found this on page NOS 25 .

Identify *2 ways that scientists devised to deliver more light to microalgae to increase productivity of a pond.*

1. use light rods to take light to algae below the water's surface
2. use paddle wheels to circulate the microalgae to the lighted surface

Lesson 3 | Case Study: Biodiesel from Microalgae (continued)

Main Idea	Details
Why Grow Microalgae? *I found this on page* NOS 26 .	**Organize** *information about the benefits of growing microalgae.*



Are microalgae the future?
I found this on page NOS 27 .

Accept all reasonable responses. Sample answer shown.

Conclude *whether biodiesel from microalgae should be the preferred fuel source.*

Accept all reasonable responses. Sample answer: The production of biodiesel from microalgae is currently more expensive than petroleum-based diesel. Unless petroleum becomes too expensive or unavailable, biodiesel from microalgae will probably not be preferred.

Synthesize It Identify one hypothesis that was supported and one hypothesis that was not supported throughout the scientific investigation of microalgae as a biodiesel fuel source.

Accept all reasonable responses. Sample answer: Light rods *do* increase the growth of microalgae below the water's surface; starving microalgae for nitrogen *does not* increase overall oil production.

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Scientific Explanations 13

Review **Scientific Explanations**

Chapter Wrap-Up

Now that you have read the chapter, think about what you have learned.

Use this checklist to help you study.

- ❏ *Complete your Foldables® Chapter Project.*
- ❏ *Study this chapter in your Notebook.*
- ❏ *Study the definitions of vocabulary words.*
- ❏ *Reread the chapter, and review the charts, graphs, and illustrations.*
- ❏ *Review the Understanding Key Concepts at the end of each lesson.*
- ❏ *Look over the Chapter Review at the end of the chapter.*

Summarize It Reread the chapter Big Idea and the lesson Key Concepts. Summarize how the case study described in Lesson 3 relates to the Key Concepts in Lessons 1 and 2.

Accept all reasonable responses. Sample answer: The Key Concepts in Lesson 1 are about what science is and how scientific investigations are done. The case study in Lesson 3 describes examples of many cycles of inquiry in which scientists formed hypotheses and predictions and tested them through controlled investigations, observing different variables and outcomes. The Key Concepts of Lesson 2 center on how and why scientists make and record accurate and precise measurements during their investigations. By using these methods, the scientists in the Lesson 3 case study could make valid comparisons during their investigations and draw reliable conclusions.

Challenge Choose another long-term scientific investigation to explore. Research to learn about the problem that scientists are trying to solve. Write a magazine-style article about that real-life application of scientific inquiry. Share your article with your class. (Be sure to avoid personal bias as you write the story!)

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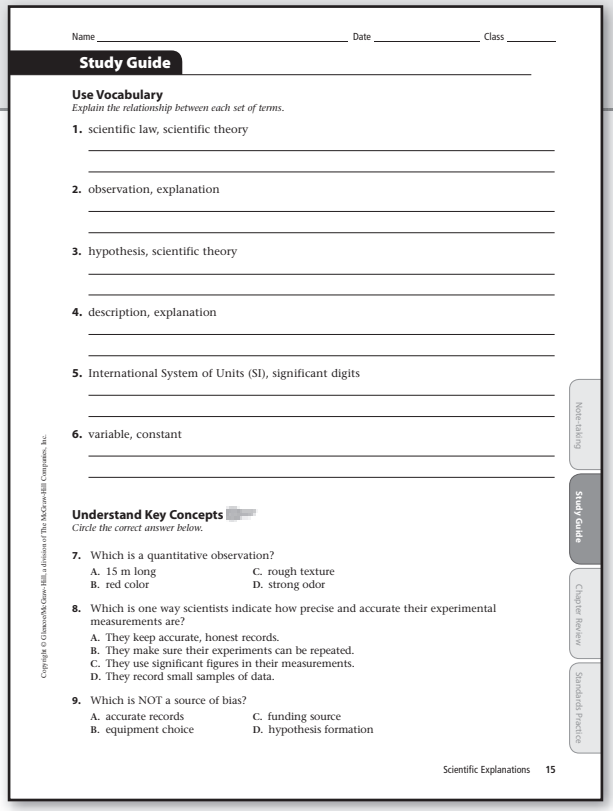


Name _____ Date _____ Class _____

Study Guide

Use Vocabulary
Explain the relationship between each set of terms.

1. scientific law, scientific theory

2. observation, explanation

3. hypothesis, scientific theory

4. description, explanation

5. International System of Units (SI), significant digits

6. variable, constant

Understand Key Concepts
Circle the correct answer below.

7. Which is a quantitative observation?
   A. 15 m long C. rough texture
   B. red color D. strong odor

8. Which is one way scientists indicate how precise and accurate their experimental measurements are?
   A. They keep accurate, honest records.
   B. They make sure their experiments can be repeated.
   C. They use significant figures in their measurements.
   D. They record small samples of data.

9. Which is NOT a source of bias?
   A. accurate records C. funding source
   B. equipment choice D. hypothesis formation

Scientific Explanations 15

Note-taking | Study Guide | Chapter Review | Standards Practice

Use Vocabulary

1. Answers will vary. Sample answer: A scientific theory might contain many well-supported hypotheses that explain why something happens. A scientific law usually contains one well-supported hypothesis that states that something will happen.

2. Answers will vary. Sample answer: An observation is the act of watching something and recording what occurs. An explanation is an interpretation of observations.

3. Answers will vary. Sample answer: A hypothesis is a possible explanation about an observation that can be tested by scientific investigations. A scientific theory is an explanation based on repeated observations and scientific investigations. It might contain many well-supported hypotheses.

4. Answers will vary. Sample answer: A description is a spoken or written summary of observations. An explanation is an interpretation of observations.

5. Answers will vary. Sample answer: The International System of Units is the internationally accepted system for measurement. Significant digits are the number of digits in a measurement that are with a certain degree of reliability.

6. Answers will vary. Sample answer: A variable is any factor in an experiment that can have more than one value. A constant is a factor in an experiment that remains the same. There can be many constants in an experiment.

Understand Key Concepts

7. A. 15 m long

8. C. They use significant figures in their measurements.

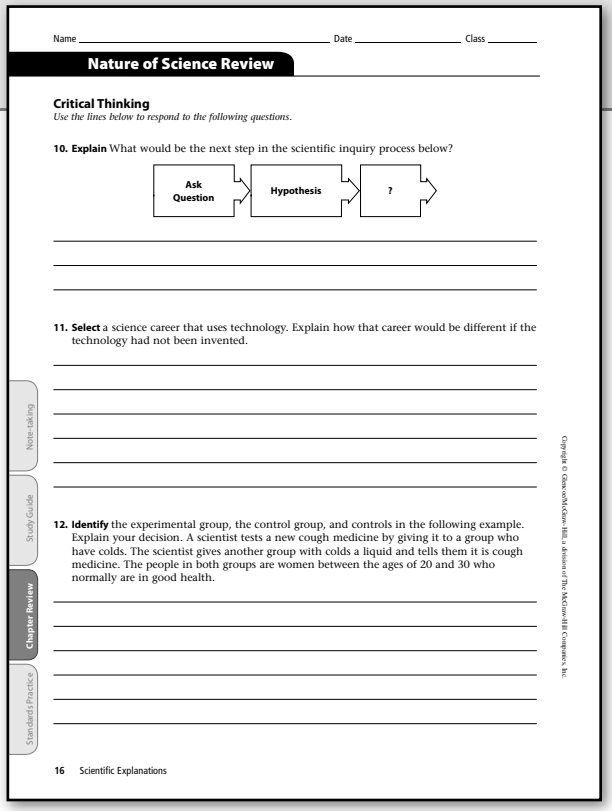
9. A. accurate records

Critical Thinking

10. Test hypothesis, which includes design an experiment, make a model, gather and evaluate evidence, and collect data/record observations.

11. Accept all reasonable answers. Sample answer: A computer programmer uses technology and writes programs to make technology usable and available to more people. If computers did not exist, computer programmers would not exist. All processes and systems that use computers would not exist or would be manual processes.

12. The experimental group is the one that got the real cough medicine because they got the medicine that was being tested. The people that got the inert liquid were the control group because they were given a liquid that did not have active ingredients in it. Constants were that all participants were women ages 20–30 and normally healthy.



Name _____ Date _____ Class _____

Nature of Science Review

Critical Thinking
Use the lines below to respond to the following questions.

10. Explain What would be the next step in the scientific inquiry process below?

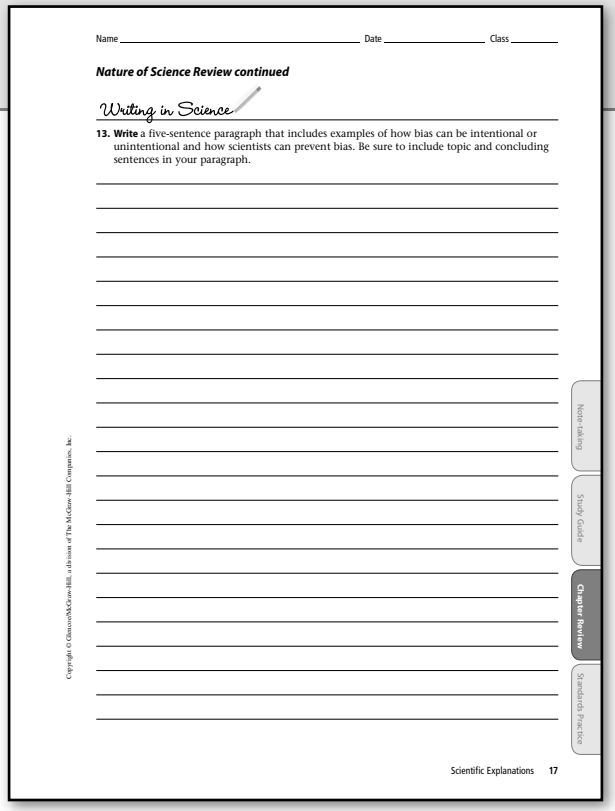
Ask Question → Hypothesis → ?

11. Select a science career that uses technology. Explain how that career would be different if the technology had not been invented.

12. Identify the experimental group, the control group, and controls in the following example. Explain your decision. A scientist tests a new cough medicine by giving it to a group who have colds. The scientist gives another group with colds a liquid and tells them it is cough medicine. The people in both groups are women between the ages of 20 and 30 who normally are in good health.

Note-taking | Study Guide | Chapter Review | Standards Practice

16 Scientific Explanations



Name _____ Date _____ Class _____

Nature of Science Review continued

Writing in Science

13. Write a five-sentence paragraph that includes examples of how bias can be intentional or unintentional and how scientists can prevent bias. Be sure to include topic and concluding sentences in your paragraph.

Note-taking | Study Guide | Chapter Review | Standards Practice

Scientific Explanations 17

Writing in Science

13. Students' paragraphs should contain facts from the chapter and they should include a topic sentence and a concluding sentence.

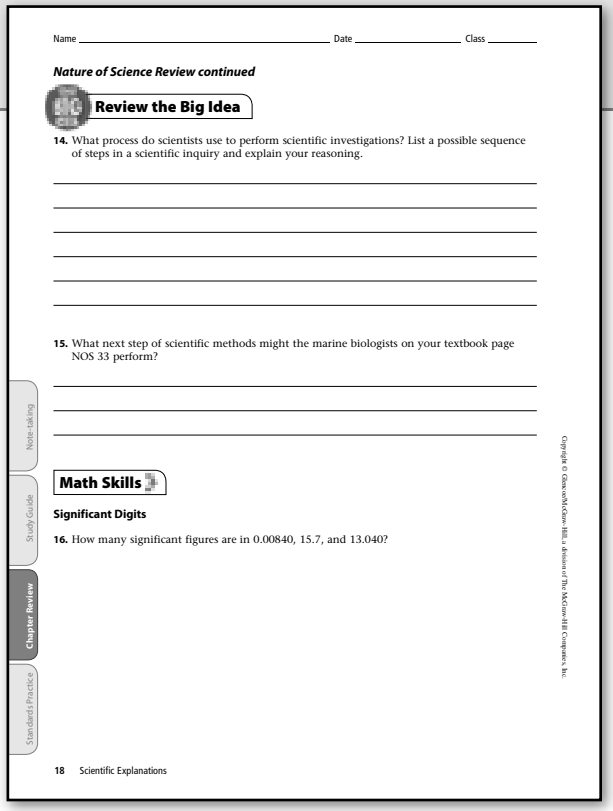
Review the Big Idea

14. Scientists use a process called the scientific method. Steps include: gather information, hypothesize and predict, test hypothesis, analyze results, draw conclusions, communicate results.

15. The biologists might continue to collect more data or might begin to organize and analyze their data.

Math Skills

16. 3; 3; 5



Name _____ Date _____ Class _____

Nature of Science Review continued

Review the Big Idea

14. What process do scientists use to perform scientific investigations? List a possible sequence of steps in a scientific inquiry and explain your reasoning.

15. What next step of scientific methods might the marine biologists on your textbook page NOS 33 perform?

Math Skills

Significant Digits

16. How many significant figures are in 0.00840, 15.7, and 13.040?

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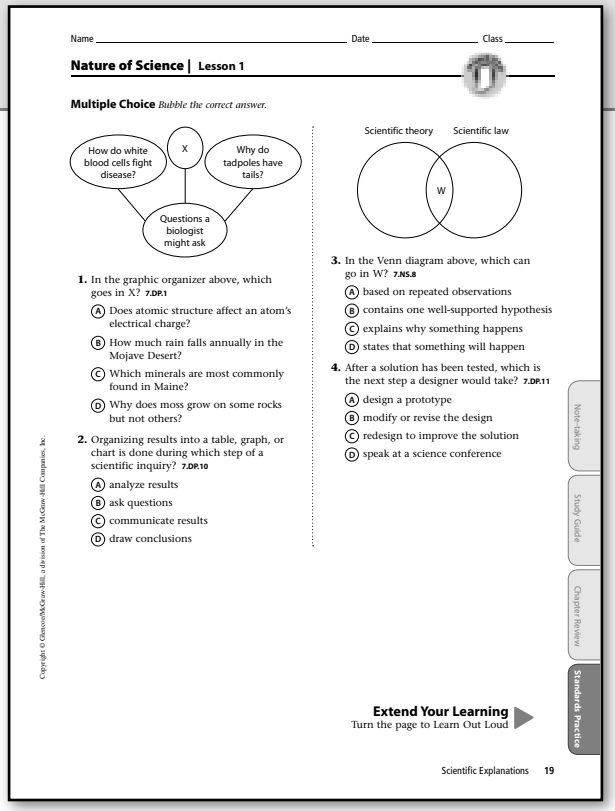
18 Scientific Explanations

Note-taking | Study Guide | **Chapter Review** | Standards Practice



Name _____ Date _____ Class _____

Nature of Science | Lesson 1

Multiple Choice *Bubble the correct answer.*

1. In the graphic organizer above, which goes in X? **7.DP.1**

(A) Does atomic structure affect an atom's electrical charge?

(B) How much rain falls annually in the Mojave Desert?

(C) Which minerals are most commonly found in Maine?

(D) Why does moss grow on some rocks but not others?

2. Organizing results into a table, graph, or chart is done during which step of a scientific inquiry? **7.DP.10**

(A) analyze results

(B) ask questions

(C) communicate results

(D) draw conclusions

3. In the Venn diagram above, which can go in W? **7.NS.8**

(A) based on repeated observations

(B) contains one well-supported hypothesis

(C) explains why something happens

(D) states that something will happen

4. After a solution has been tested, which is the next step a designer would take? **7.DP.11**

(A) design a prototype

(B) modify or revise the design

(C) redesign to improve the solution

(D) speak at a science conference

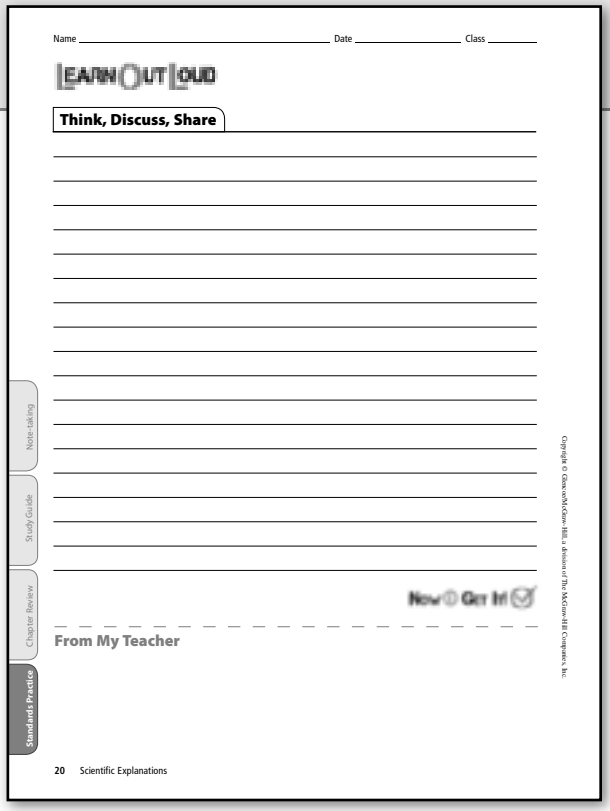
Extend Your Learning
Turn the page to Learn Out Loud

1. D

2. A

3. A

4. C



Name _____ Date _____ Class _____

LEARN OUT LOUD

Think, Discuss, Share

Now I Get It!

From My Teacher

Note-taking
Study Guide
Chapter Review
Standards Practice

20 Scientific Explanations

Note-taking
Study Guide
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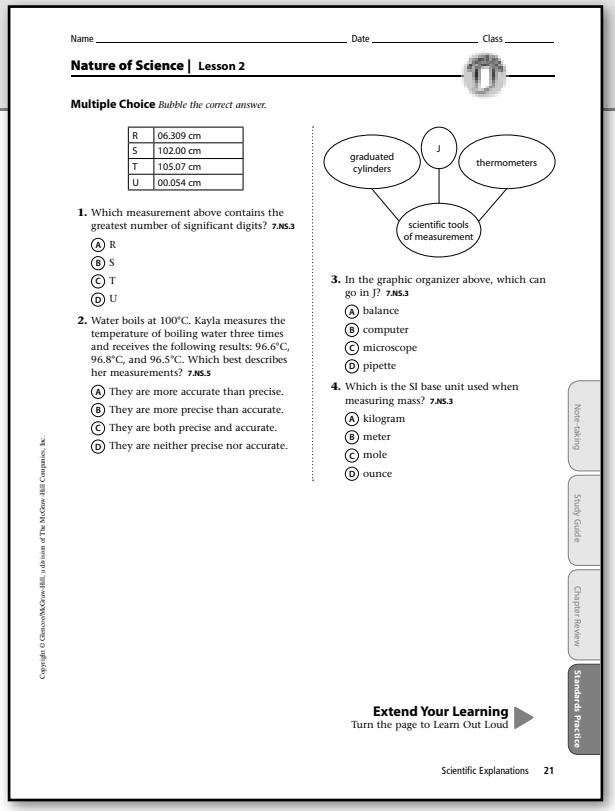


Name _____ Date _____ Class _____

Nature of Science | Lesson 2

Multiple Choice *Bubble the correct answer.*

R	06.309 cm
S	102.00 cm
T	105.07 cm
U	00.054 cm

1. Which measurement above contains the greatest number of significant digits? **7.NS.3**

(A) R
(B) S
(C) T
(D) U

2. Water boils at 100°C. Kayla measures the temperature of boiling water three times and receives the following results: 96.6°C, 96.8°C, and 96.5°C. Which best describes her measurements? **7.NS.5**

(A) They are more accurate than precise.
(B) They are more precise than accurate.
(C) They are both precise and accurate.
(D) They are neither precise nor accurate.

3. In the graphic organizer above, which can go in J? **7.NS.3**

(A) balance
(B) computer
(C) microscope
(D) pipette

4. Which is the SI base unit used when measuring mass? **7.NS.3**

(A) kilogram
(B) meter
(C) mole
(D) ounce

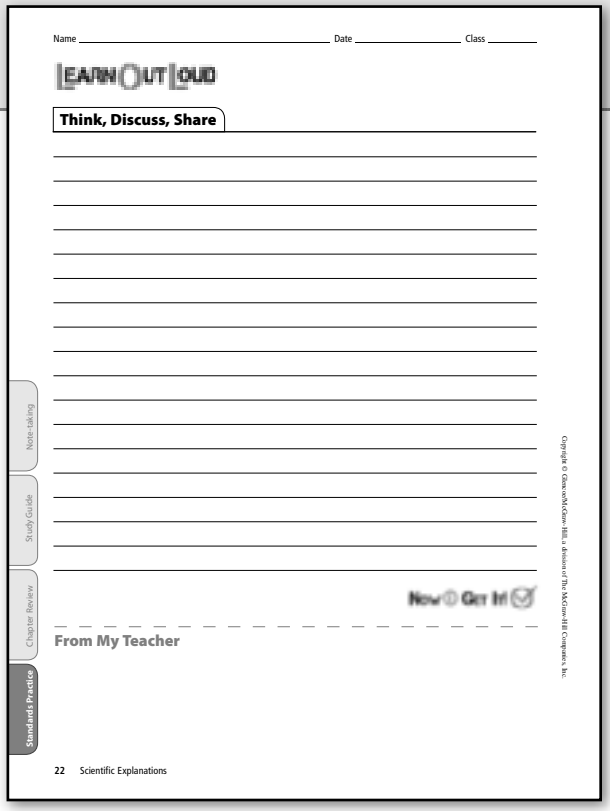
Extend Your Learning
Turn the page to Learn Out Loud

1. C

2. B

3. A

4. A



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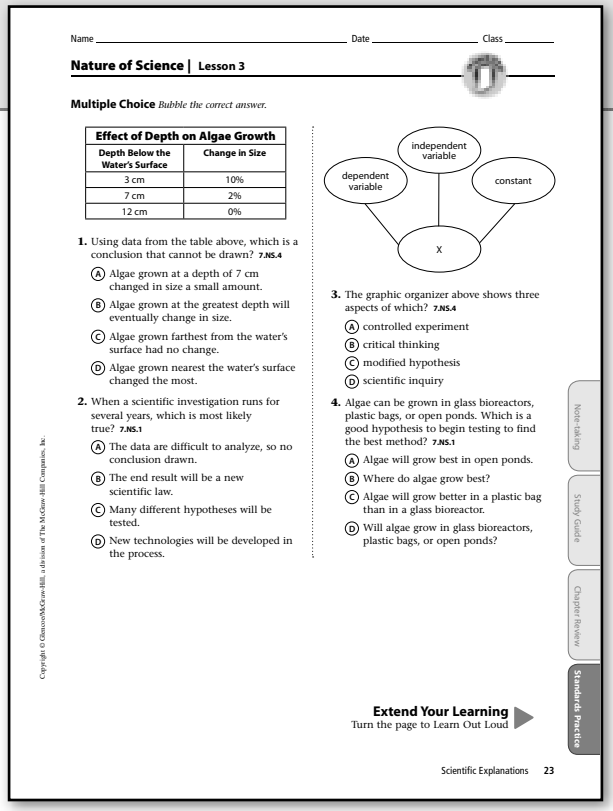
22 Scientific Explanations



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Nature of Science | Lesson 3

Multiple Choice *Bubble the correct answer.*

Effect of Depth on Algae Growth	
Depth Below the Water's Surface	**Change in Size**
3 cm	10%
7 cm	2%
12 cm	0%

1. Using data from the table above, which is a conclusion that cannot be drawn? **7.NS.4**

(A) Algae grown at a depth of 7 cm changed in size a small amount.

(B) Algae grown at the greatest depth will eventually change in size.

(C) Algae grown farthest from the water's surface had no change.

(D) Algae grown nearest the water's surface changed the most.

2. When a scientific investigation runs for several years, which is most likely true? **7.NS.1**

(A) The data are difficult to analyze, so no conclusion drawn.

(B) The end result will be a new scientific law.

(C) Many different hypotheses will be tested.

(D) New technologies will be developed in the process.

3. The graphic organizer above shows three aspects of which? **7.NS.4**

(A) controlled experiment

(B) critical thinking

(C) modified hypothesis

(D) scientific inquiry

4. Algae can be grown in glass bioreactors, plastic bags, or open ponds. Which is a good hypothesis to begin testing to find the best method? **7.NS.1**

(A) Algae will grow best in open ponds.

(B) Where do algae grow best?

(C) Algae will grow better in a plastic bag than in a glass bioreactor.

(D) Will algae grow in glass bioreactors, plastic bags, or open ponds?

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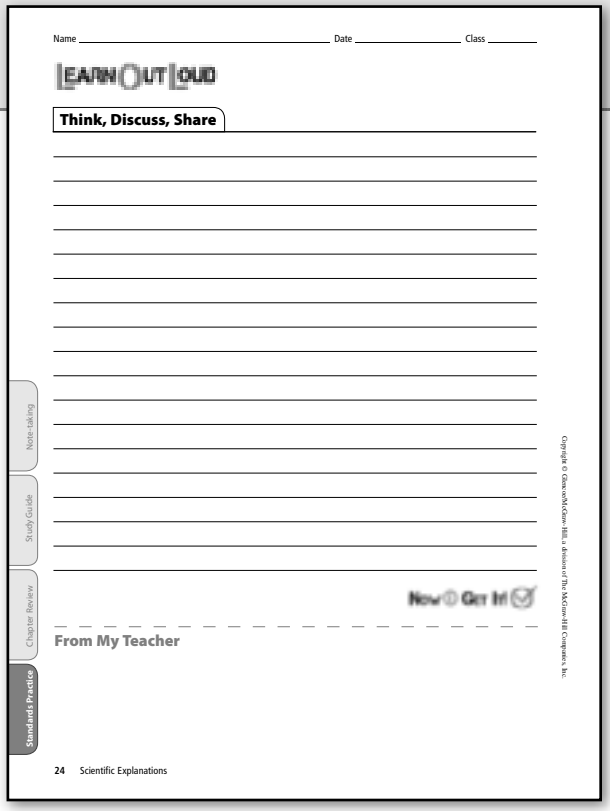
Scientific Explanations 23

1. B

2. C

3. A

4. B



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24 Scientific Explanations

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