Name: _____

What *Is* Pollination?

_____ is the fine powder at the center of most flowers. When it moves from one flower to another flower of the same kind, _____ takes place. Flowers must be pollinated to make _____ and _____. Animals that carry pollen from one flower to another are called _____. They are not pollinating flowers on purpose. Most animals visit flowers because they are looking for _____!

Directions: Cut out the cards below and place them in the paragraph above. Then, listen as your teacher reads the book *What Is Pollination?*

fruits	**pollen**	**nectar**
pollination	**seeds**	**pollinators**

Name: _____

Pollinator Model Design Challenge

Challenge: Design a model of a pollinator that can be used to demonstrate how it moves pollen from one flower to another while getting food.

Directions: Choose a real pollinator as an inspiration for your model. Then, design your model using the materials provided.

Real Pollinator	Model Pollinator
Name and photo	Labeled sketch
How does the pollinator get food from the flower?	How will your model show this?
What parts of the pollinator's body does the pollen stick to?	How will your model show this?

1. How do both plants and pollinators benefit from pollination?

   Plants get _____

   Pollinators get _____

2. How do humans benefit from pollination?

_____

Name: _____

4~3~2~1
Pollination Presentation Rubric

Demonstrate the model of a pollinator that you designed. Your presentation should include the following:

4 Points: A demonstration of how your model pollinator moves pollen from one flower to another

4 3 2 1 0

3 Points: A description of the body parts that your model pollinator uses to get food from the flower and the body parts that the pollen sticks to

3 2 1 0

2 Points: An explanation of how both plants and pollinators benefit from pollination

2 1 0

1 Point: An explanation of how humans benefit from pollination

1 0

Score: _____/10

Name: _____

STEM at Home

Dear _____,

At school, we have been learning about **pollinators**, or animals that move pollen from one flower to another.

I learned that: _____

_____

_____

My favorite part of the lesson was: _____

_____

_____

At home, we can watch a video together called "RoboBees to the Rescue" about how **roboticists,** or engineers who design robots, at Harvard University are designing a robotic bee to pollinate plants.

Search "RoboBees to the Rescue" on ***pbslearningmedia.org*** to find the video at ***www.pbslearningmedia.org/resource/arct14.sci.nvrobobee/robobees-to-the-rescue.***

After we watch the video, we can design our own robot that is based on a different pollinator, such as a butterfly, hummingbird, beetle, moth, or bat.

Sketch of Real Pollinator	Sketch of Robot Pollinator

Chapter 19

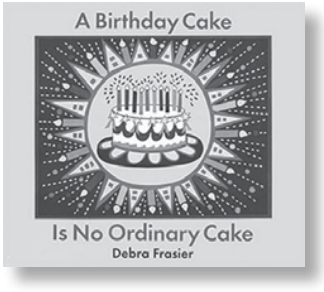
A Birthday *Is* No Ordinary Day

Description

Every trip around the Sun brings us to another one—birthday, that is! There aren't many events in a child's life quite as exciting as his or her own birthday. Through an engaging picture book, students are invited to consider each birthday as a celebration of one more trip around the Sun. They investigate how many hours of daylight there will be on their next birthday and compare this number with those of other students, leading them to conclude that the hours of daylight are greater in the summer months and fewer in the winter months. Then, students design a birthday card for a family member or friend that teaches the recipient how truly remarkable a birthday is!

Suggested Grade Levels: K–2

LESSON OBJECTIVES Connecting to the *Framework*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Analyzing and Interpreting Data Using Mathematics and Computational Thinking	**ESS1.B:** Earth and the Solar System	Patterns Cause and Effect



Featured Picture Books

TITLE: ***A Birthday Cake Is No Ordinary Cake***
AUTHOR: **Debra Frasier**
ILLUSTRATOR: **Debra Frasier**
PUBLISHER: **Harcourt Children's Books**
YEAR: **2006**
GENRE: **Story**
SUMMARY: *A lyrical recipe uses the changes in the natural world to explain the time that passes between one birthday and the next.*

TITLE: ***Jump Into Science: Sun***
AUTHOR: **Steve Tomecek**
ILLUSTRATOR: **Carla Golembe**
PUBLISHER: **National Geographic**
YEAR: **2016**
GENRE: **Non-Narrative Information**
SUMMARY: *Part of the* Jump Into Science *series, this book introduces the Sun as a star and explains the daily and yearly phenomena that are results of the position of the Earth relative to the Sun.*

Chapter 19

Time Needed

This lesson will take several class periods. Suggested scheduling is as follows:

Day 1: **Engage** with *A Birthday Cake Is No Ordinary Cake* Read-Aloud and **Explore** with My Birthday Cake

Day 2: **Explain** with Birthday Seasons and *Jump Into Science: Sun* Read-Aloud

Day 3: **Elaborate** with Birthday Celebrations (ongoing) and **Evaluate** with Design a Birthday Card

Materials

- Crayons
- List of student birthdays
- Computer or tablet
- App or website providing sunrise time, sunset time, and hours of daylight information
- 4 pieces of poster board
- Desktop globe
- Pushpin or small sticker
- Lamp with the shade removed

SAFETY

- Remind students not to not touch electric light bulbs.
- Be sure never to use the lamp near a water source.
- Tell students to be careful when handling pushpins because they are sharp and can puncture skin.

Student Pages

- My Birthday Cake
- Happy Birthday template
- STEM at Home

Background for Teachers

As our planet rotates, we experience day and night. Most days of the year, however, the hours of daylight and nighttime are not equally divided. When we are experiencing summer, there are more hours of daylight. When we are experiencing winter, there are fewer. In the Northern Hemisphere, the longest day of the year (the *summer solstice*) falls between June 20 and June 22, and the shortest day of the year (the *winter solstice*) falls between December 20 and December 23. The changes in length of day are caused by the tilt of Earth on its axis and the orbit of Earth around the Sun. As Earth orbits the Sun, one hemisphere is always tilted more toward the Sun than the other (except on two days—the *vernal equinox* and the *autumnal equinox*). The hemisphere that is tilted toward the Sun experiences longer periods of daylight. At the same time, the opposite hemisphere experiences the opposite season and shorter periods of daylight.

The *Framework* suggests that students in elementary school develop an understanding of Earth and the Solar System, specifically the observable patterns caused by the movements of the Sun, Earth, Moon, and planets. One of these patterns is the seasonal changes in the hours of daylight throughout the year. In the primary grades, students should understand that this pattern can be observed, described, and predicted. They should have opportunities to make observations of how the hours of daylight change throughout the year and recognize a pattern. This task can be challenging to do on a long-term basis in

the early elementary classroom, so this lesson puts the concept in the context of most children's favorite day of the year—their birthday! Students learn that each candle on their birthday cake represents one trip around the Sun. Using a website or app, the teacher provides each student the times of sunrise and sunset and the hours and minutes of daylight on his or her birthday. The class then compares the day lengths for all of the students' birthdays throughout the year. Students learn the basic concept that the longest days of the year are in the summer and the shortest in the winter. It should be noted that the emphasis in this lesson is on relative comparisons of the amount of daylight in different seasons and that students are not assessed on measuring or calculating the hours of daylight. Likewise, although the cause of seasons is introduced in one of the featured picture books, students should not be assessed on this concept because it is more appropriately assessed in middle school.

engage

A Birthday Cake Is No Ordinary Cake Read-Aloud

Making Connections: Text to Self

Note: Before beginning the read-aloud, have a list of student birthdays available for any student who cannot recall the date of his or her birthday.

Show students the cover of *A Birthday Cake Is No Ordinary Cake* and introduce the author and illustrator, Debra Frasier. Then, *ask*

? What makes a birthday cake so special? (It is given on a birthday, often during a party. It has colorful decorations, it usually has a name written on it, it has candles on top, etc.)

? Do you have any special birthday traditions? (Answers will vary.)

? Do you eat cake, go out to dinner, or open presents? (Answers will vary.)

Turn and Talk

Have students turn and talk to a partner about their family's birthday traditions. Share some of your own birthday traditions or a story about a special birthday you had.

Determining Importance

Next, point out to students the picture of the Sun on the cover of the book. *Ask*

? What do you think the Sun has to do with birthdays? (Answers will vary.)

Tell students that as you read, you would like them to listen for how the book connects the Sun to birthdays.

Connecting to the Common Core
Reading: Literature
Integration of Knowledge and Ideas: K.7, 1.7, 2.7

Read the book aloud, stopping to discuss what the Sun has to do with birthdays each time the Sun appears. For example, you could say the following:

- Page 7: "The Earth spins eastward toward the Sun to make morning, then spins away to make night. No spinning, no cake."
- Pages 8–9: "The Earth spins in a circle around the Sun from your birthday to your next birthday."
- Pages 12–13: "Collect the first sunrise after your birthday. You will need 364 more sunrises until your next birthday."
- Pages 26–27: "After collecting your 365th sunrise …"

- Pages 30–31: "Light a candle for each time you've circled the Sun. … And remember—we're traveling a circle. This recipe is a circle. It's all coming round again."

Questioning

After reading, *ask*

? So what does the Sun have to do with birthdays? (Students should realize that each birthday represents another trip they have taken around the Sun during their life.)

? Can you recall some of the ingredients in the birthday cake in the book? (365 sunrises, bright spring flowers, at least 12 full moons, the shade of two trees on the longest day of the year, the first cool fall morning, the sound of snowflakes falling, etc.)

? What message do you think the author is trying to communicate through this book? (To have a birthday, you must experience a whole year of seasons. The author came up with a creative way to express the idea that a birthday equals one more trip around the Sun.)

explore

My Birthday Cake

Connecting to the Common Core
Reading: Literature
Key Ideas and Details: K.1, 1.1, 2.1

Reread page 30 of the book that says, "At last, your cake is done. Let's light a candle for each time you've circled the Sun." Give each student the My Birthday Cake student page. *Ask*

? How many candles should your cake have? (The same number of candles as their age.)

? How many times have you circled the Sun? (The same number of times as their age.)

Have students draw candles on top of the cake to represent each time they have circled the Sun in their lifetime. They should write their name beneath the words *Happy Birthday,* write their birth date on top of the cake, and then write in the number of trips around the Sun for their *next* birthday. *Ask*

? What other information needs to be written on your birthday cake? (sunrise, sunset, hours, and minutes of daylight)

? Where do you think you could find that information? (Answers will vary.)

Connecting to the Common Core
Mathematics
Measurement and Data: 1.MD.3, 2.MD.7

Ask

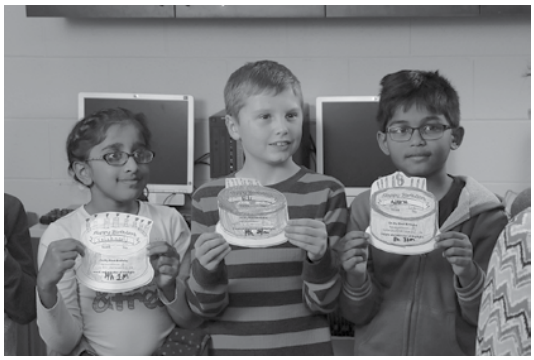
? Do sunrises and sunsets occur at the same time every day? (Answers will vary.)

? What have you observed in your daily life about sunrises and sunsets? In other words, what evidence makes you think so? (Students may have noticed that sometimes when they wake up in the morning, it is dark outside, and other times, it is light outside. They may have also noticed that it gets dark earlier in the winter, and the days seem longer in the summer.)

Tell students that scientists are able to predict the *exact time* sunrise and sunset occur for each day. In fact, many websites and apps can tell the exact time sunrise and sunset will occur on their birthdays (see "Websites" section for such an app). Model how to use one of these apps to find the time of sunrise and sunset on your next birthday. If you do not have tablets for classroom use, you can get this information from the Time and Date Sun Calculator (see "Websites" section).

Have students watch as you enter your location and the month. Model where to find the sunrise time, sunset time, and total hours of daylight. Remind students that *a.m.* refers to the time before noon and *p.m.* refers to the time after noon. Then,

FINDING HOURS OF DAYLIGHT



OUR BIRTHDAYS

if tablets are available for student use, have students enter their next birthday and look up the sunrise time, sunset time, and hours of daylight data for that day. If tablets aren't available, you will need to look up the data for each student. (You can have students work on cutting out their cakes and decorating them with crayons while they are waiting for you to look up the information.)

Once students have the data for their own birthdays, they can record the sunrise time, sunset time, and hours of daylight (in hours and minutes) on the My Birthday Cake student page. Make sure they write the hours and minutes of daylight large enough that others can read it from a distance. Then, have students cut out the cakes, if they haven't already. They will be using their cake cutouts for the next activity.

explain

Birthday Seasons

In advance, place four posters evenly spaced around the room, with the words *Spring, Summer, Fall,* and *Winter* written on them. Then, *ask*

? During what season is your birthday: spring, summer, fall, or winter? (Answers will vary.)

Tell students that they will be using the posters of the four seasons to help them line up in order by birthday. Have students hold their completed paper cakes in front of them and line up to form a large circle in chronological order of their birthdays.

You may need to help them figure out where to stand relative to the poster of their birthday season and each other's birthdays. Once they have formed a semblance of a circle and are standing in approximately the right place relative to each other, help them analyze data from their "human graph."

Connecting to the Common Core
Mathematics
MEASUREMENT AND DATA: 1.MD.4, 2.MD.10

Questioning

Ask

? Is the length of day the same on everyone's birthday? (No, they are different.)

? Why are they different? (The sunrise and sunset times are different every day.)

? Which student's birthday has the most hours and minutes of daylight? (Answer will vary, depending on your students' birth dates.)

? In what season is that person's birthday? (summer)

? Which student's birthday has the fewest hours and minutes of daylight? (Answer will vary, depending on your students' birth dates.)

DAY AND NIGHT DEMONSTRATION

? In what season is that person's birthday? (winter)

? How do the hours of daylight in the summer compare with the hours of daylight in the winter? (There are more hours of daylight in the summer than in the winter.)

? What patterns do you notice? (Students should notice that the most hours of daylight, or the longest days, occur in the summer months, and the fewest hours of daylight, or the shortest days, occur in the winter months. They may notice that the hours of daylight are similar in spring and fall.)

Jump Into Science: Sun Read-Aloud

Tell students that you have a nonfiction book called *Jump Into Science: Sun* that can help explain why the length of day changes as the seasons change. You will need the four seasons posters spaced out evenly around the room for the read-aloud. Also, have a desktop globe (tilted on its axis) handy to refer to as you read. Tell students that you will be using the globe as a model of the Earth to demonstrate some of the events in the book as you read. Have a volunteer help you locate and mark your school's general location on the globe, using a pushpin or sticker to represent your place on Earth. This can help students visualize some of the phenomena described in the book.

Show them the cover of *Jump Into Science: Sun* and introduce the author and illustrator, Steve Tomecek and Carla Golembe, respectively. Tell them that as you read the book aloud, you will be stopping to demonstrate some of the ideas in the book.

Stop and Try It

Earth's Axis Demonstration

Begin reading *Sun* aloud, skipping pages 10–15 (these pages are not relevant to the concept being taught). Stop after reading page 17, and point out Earth's tilted axis on your desktop globe. Spin the globe counterclockwise to show that "Earth is always spinning, just like a basketball on a player's finger. The line that Earth spins around is called an axis" (p. 17). Point out that the axis is imaginary; you can't really see it from space!

Day and Night Demonstration

Then, read pages 18–19, about day and night. After reading, place the lamp in the center of the room to represent the Sun, and turn it on. Turn off the classroom lights. Using the globe to represent Earth, model how day changes to night in your location by slowly spinning the globe and having students observe the pushpin or sticker move from the lighted part of the globe to the shaded part of the globe. Turn the classroom lights back on and turn off the lamp. (*Note:* Although the reason for the seasons is introduced here, students should not be assessed on this concept because it is more appropriately assessed in middle school.)

Connecting to the Common Core
Reading: Informational Text
Key Ideas and Details: K.1, 1.1, 2.1

Questioning

Next, read page 22, which is about the summer. Ask students to examine the illustration carefully. *Ask*

- What time is it on the clock? (9:00 p.m.)
- Is that morning or evening? (evening)
- What is the girl doing? (sleeping)
- What is it like outside her window? (It is daylight.)
- What time of year is it? (summer)
- Have you ever had to go to bed when it is still light outside in the summer?

Then, reread the text on page 22, which explains that there are more hours of daylight in the summer than any other season. Next, read page 23, which is about the winter. Ask students to examine the illustration carefully. *Ask*

- What time is it on the clock? (7:00 a.m.)
- Is that morning or evening? (morning)
- What is the boy doing? (eating a bowl of cereal)
- What is it like outside his window? (snowing and dark)
- What time of year is it? (winter)
- Have you noticed that it is dark in the morning when you leave for school on some winter days? (Answers will vary.)

Then, reread the text on page 23, which explains that there are fewer hours of daylight in the winter than any other season.

Synthesizing

Finally, finish reading the book aloud. After reading, ask students to think about some of the "big ideas" that they learned from the books *A Birthday Cake Is No Ordinary Cake* and *Sun*, as well as from the activities. *Ask*

- What causes day and night? (Earth spinning on its axis.)
- What causes the hours of daylight, or the length of day, to be longer in the summer? (Our place on Earth is tilted toward the Sun in the summer.)
- What causes the hours of daylight, or the length of day, to be shorter in the winter? (Our place on Earth is tilted away from the Sun in the winter.)
- How long does it take Earth to travel, or orbit, all the way around the Sun? (365 days, or one year.)
- So how many orbits old are you? (same number as their age)

Turn and Talk

Have students turn and talk to a partner about the season their birthday falls in and the observations they have made about the hours of daylight (length of day) on their birthday.

elaborate

Birthday Celebrations

Create a large version of the graphic on the back inside cover of *A Birthday Cake Is No Ordinary Cake* and display it in your classroom (see "Websites" section for a printable called "How Many Days to *Your* Birthday?" from author Debra Frasier's website). Have students each write his or her name and birthdate on a small cake- or cupcake-shaped cutout or sticky note and place it in the appropriate spot around the graphic.

On or near each child's actual birthday, use an app or website to look up sunrise time, susnset time, and hours of daylight for that day. Share the data with the class, noting the changes in day length as you do this throughout the year. You can mark the occasion of summer birthdays, too, by celebrating "half birthdays" for students whose birthdays fall

A BIRTHDAY CELEBRATION

during summer break (e.g., an August 16 birthday would be celebrated on February 16). Compare the hours of daylight on each summer birthday with the hours of daylight on the "half birthday," which falls in the opposite season.

You can also give each birthday boy or girl a special bookmark that says, "Congratulations! You've circled the Sun ___ times!" (printable from the author's website; see "Websites" section), reinforcing the idea that a birthday represents a trip around the Sun. To further reinforce the concept, celebrate birthdays throughout the year by having the birthday boy or girl walk in a circle around the room (holding a globe, if you would like) to model the Earth's orbit around the Sun. The student who has the next birthday can stand in the center of the room to represent the Sun (holding a picture or cutout of the Sun if you like). Sing this variation of the "Happy Birthday" song as the birthday boy or girl walks around the "Sun" one time for each year of his or her life:

Happy birthday to you

____ *trips around the Sun* (fill in the blank with the student's age)

You're another year older

And we hope you've had fun!

evaluate

Design a Birthday Card

Connecting to the Common Core
Writing
Research to Build and Present Knowledge: K.8, 1.8, 2.8

Writing

Ask students to think of a friend or family member who has a birthday coming up. Tell them that they are going to have the opportunity to design a birthday card for that person, but this will not be an ordinary birthday card! This card will use science, technology, and math to teach the recipient about what a birthday actually represents—another trip around the Sun.

Students can use the birthday card template provided in the student pages or make their own cards. They will need to use an app or website to look up the sunrise time, sunset time, and hours of daylight data for the recipient's birthday. After writing the recipient's name on the cover and coloring in the Sun, students should fill out the following information on the inside of the card for full credit:

1. The month and day of the recipient's birthday
2. Sunrise time on the recipient's birthday
3. Sunset time on the recipient's birthday
4. The hours and minutes of daylight on the recipient's birthday
5. A comparison with the hours of daylight

on the student's own birthday (more/less/the same)

6. A suggestion of what the recipient could do outside on his or her birthday (considering the season and the length of day)
7. A response to "A birthday is no ordinary day. A birthday is another trip around the _____!" (Sun)
8. A labeled sketch showing that a birthday represents a trip around the Sun

Students' labeled drawings for item 8 will give you an opportunity to assess their understanding of the key concepts in this lesson. Visit students as they work, and ask them to use their drawings to explain their thinking.

Finally, have the students sign their cards and decorate or personalize them as they wish.

STEM at Home

Have students complete the "I learned that …" and "My favorite part of the lesson was …" portions of the STEM at Home student page as a reflection on their learning. They may choose to do the following at-home activity with an adult helper and share their results with the class. If students do not have access to the internet or these materials at home, you may choose to have them complete this activity at school.

"At home, we can find out what time the Sun will rise and set on our birthdays. We can also find out who in our household has the most hours of daylight on his or her birthday and who has the fewest!"

Search "Sunrise Sunset HD" in your web browser to find the app at https://itunes.apple.com/us/app/Sunrise-Sunset-hd/id650453412?mt=8.*Or search "Time and Date Sun Calculator" to find the website at* www.timeanddate.com/sun.

Websites

Debra Frasier's Website: How Many Days to *Your* Birthday?
www.debrafrasier.com/docs/bdaycake/yearmap.pdf

Debra Frasier's Website: Printable Bookmarks
www.debrafrasier.com/docs/bdaycake/bookmarks.pdf

Sunrise Sunset HD App
https://itunes.apple.com/us/app/Sunrise-Sunset-hd/id650453412?mt=8

For Further Exploration

This section is provided to help you encourage your students to use the science and engineering practices in a more student-directed format. This box lists questions and challenges related to the lesson that students may select to research, investigate, or innovate. Students may also use the questions as examples to help them generate their own questions. After selecting one of the questions in the box or formulating their own questions, students can individually or collaboratively make predictions, design investigations or surveys to test their predictions, collect evidence, devise explanations, design solutions, or examine related resources. They can communicate their findings through a science notebook, at a poster session or gallery walk, or by producing a media project.

Research

Have students brainstorm researchable questions:

- ? What do the abbreviations *a.m.* and *p.m.* mean, and where did they come from?
- ? What is a solstice? What is an equinox?
- ? What is Daylight Saving Time? Who first came up with the idea?

For Further Exploration (*continued*)

Investigate

Have students brainstorm testable questions to be solved through science or math:

- How does the length of your shadow change throughout the day? Measure it!
- How many hours of daylight are there on the summer solstice in your area? At the North Pole? At the South Pole?
- How many hours of daylight are there on the winter solstice in your area? At the North Pole? At the South Pole?

Innovate

Have students brainstorm problems to be solved through engineering:

- Can you build a working sundial?
- Can you build a model that shows how Earth is tilted on its axis as it orbits the Sun?
- What problems does Daylight Saving Time solve, and what problems does it cause for people?

Time and Date Sun Calculator
www.timeanddate.com/worldclock/Sunrise.html

More Books to Read

Branley, F. M. 1986. *What makes day and night?* New York: HarperCollins.
Summary: This book provides a simple explanation of how the rotation of Earth causes day and night.

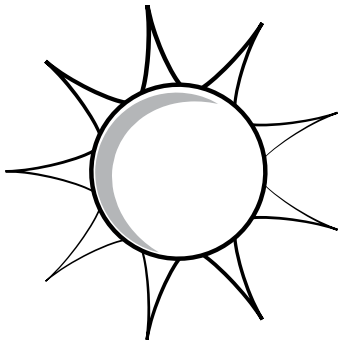
Branley, F. M. 2002. *The Sun: Our nearest star.* New York: HarperCollins.
Summary: This book describes the Sun and how it provides light and energy, which allows plant and animal life to exist on Earth.

Morgan, E. 2013. *Next time you see a sunset.* Arlington, VA: NSTA Press.
Summary: Beautiful photographs and simple explanations describe what is really happening during a sunset—Earth is turning! The book provides other observable evidence of Earth's turn, such as changes in length and direction of shadows and the position of the Sun, Moon, and stars in the sky.

Name: _____

My Birthday Cake

1. Write your name and birthday on top of the cake.
2. Draw a candle on top for each year of your age.
3. Cut out and decorate the cake.
4. Your teacher will help you fill in the rest.



Happy Birthday to

_____

1. Your birthday is on: _____

2. The Sun will rise at _____ a.m.

3. The Sun will set at _____ p.m.

4. You will have ___ hours and ____ min. of daylight on your birthday.

5. Your birthday has (more/less/the same) hours of daylight compared with mine.

6. Here's what you could do outside on your birthday!

_____

_____

_____

_____

_____

_____

_____

7. A birthday is no ordinary day. A birthday is another trip around the _____!

8. Labeled sketch showing the above

Signed,

_____