

Grade 6

Assignment Bundle

Name: _____ Class: _____

Two Famous Friends

By Jean K. Potratz
2016

John Adams and Thomas Jefferson were the second and third Presidents of the United States of America, respectively. They were also among the Founding Fathers who helped draft the Declaration of Independence. But despite everything they had in common, they had several disagreements throughout their lives. As you read, take notes on the issues that Jefferson and Adams disagreed.

Did you ever have an argument with a friend? Did you stop being friends? Forever? Or after a while were you friends again?

Two famous friends who had their ups and downs were John Adams and Thomas Jefferson. They met in 1775 when they both served in the First Continental Congress.[1] A strong bond grew between them as they worked on the Declaration of Independence. After the end of the Revolutionary War[2] they were both sent to France, to serve their country by making trade treaties.[3]



"Adams, Jefferson, and the Second Continental Congress" by U.S. National Archives is in the public domain.

When Adams was then sent to London, the two men wrote to each other. Jefferson's letters expressed his "sincere esteem[4] and respect" for Adams. When Jefferson visited the Adamses in London in 1786, Adams's wife, Abigail, wrote to her sister that Jefferson was "one of the choice[5] ones of the earth."

But in 1789 the two friends disagreed over the revolution in France. Jefferson supported it, but Adams was not so sure.

They also disagreed about the role of government in their own new nation. Adams, a Federalist, wanted a strong central government. Jefferson, a Republican, believed that states' rights were most important.

In the presidential election of 1796 Adams and Jefferson opposed each other. Adams won. Jefferson became vice president. But Jefferson wanted Adams to know that he didn't mind placing second in the election, and he told him, "I have no ambition[6] to govern men."

Only two years later, however, their friendship was strained when Adams imprisoned editors and publishers who spoke out against the government. Citizens' First Amendment rights[7] were being violated, Jefferson stated. He called Adams a traitor to the Revolution.

Adams, Jefferson, and the Second Continental Congress

Jefferson defeated Adams in the next election. Jefferson told Dr. Benjamin Rush, a friend of both Jefferson and Adams, about a conversation he had had with Adams before the result of the election was known.

Adams had said, "Well, I understand that you are to beat me in this contest, and I will only say that I will be as faithful a subject[8] as any you will have."

Jefferson had replied, "Mr. Adams, this is no personal contest between you and me. Two systems of government divide our fellow citizens into two parties. With one of these you concur,[9] and I with the other." And Adams had agreed.

It seemed that the two men had put away hostilities.[10] But before Jefferson took office, Adams quickly used a new law to appoint several judges. Then, hurt by his defeat in the election, he went home to Massachusetts, missing Jefferson's inauguration.[11]

Immediately President Jefferson pardoned[12] everyone jailed by Adams. And since he felt that Adams's appointment of judges was a personal attack, Jefferson had the new law repealed.[13] This meant that Adams's son, John Quincy Adams, lost his post. Both Adams and his wife Abigail blamed Jefferson.

Jefferson and Adams wrote several more letters, but they were filled with hurt. To halt more harsh words, they stopped writing.

Dr. Rush called the rift[14] between Jefferson and Adams "a national misfortune." After all, the two men were symbols of American independence.

Then in October 1809 Dr. Rush claimed to have had a dream: Jefferson and Adams would renew their friendship, and be "sunk into the grave nearly at the same time." He encouraged both men to begin writing to each other again. Finally, on New Year's Day in 1812, Adams wrote a note to Jefferson and sent him two volumes published by his son. Jefferson responded in a letter dated January 21.

From then on, for fourteen years, the two old friends wrote back and forth, discussing natural science, history, architecture, religion, art, and agriculture.

As Dr. Rush said he had dreamed, Jefferson and Adams died within hours of each other. That was on July 4, 1826, fifty years to the day after approval of the Declaration of Independence.

Upon renewing their friendship, Jefferson had written to Adams, "We were fellow laborers in the same cause... Still we did not expect to be without rubs and difficulties; and we had them."

Many friends have problems. But theirs were surely greater than ours. For when Jefferson and Adams did not agree, the whole country lined up behind the one or the other. Even so, their respect for each other brought them back together.

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Text-Dependent Questions

Directions: For the following questions, choose the best answer or respond in complete sentences.

1. PART A: Which statement best expresses the main idea of the text?
 - A. Like many friends, Jefferson and Adams disagreed, but their disagreements often had political results.
 - B. While Jefferson and Adams often disagreed, they kept their personal disagreements from affecting their political decisions.
 - C. The problems over the years between Jefferson and Adams are proof that even the best friends are allowed to fight occasionally.
 - D. The United States would have likely been stronger if Jefferson and Adams had agreed on more political issues.

2. PART B: Which detail from the text best supports the answer to Part A?
 - A. "Adams had said, 'Well, I understand that you are to beat me in this contest, and I will only say that I will be as faithful a subject as any you will have.'" (Paragraph 9)
 - B. "'Mr. Adams, this is no personal contest between you and me. Two systems of government divide our fellow citizens into two parties. With one of these you concur, and I with the other.'" (Paragraph 10)
 - C. "And since he felt that Adams's appointment of judges was a personal attack, Jefferson had the new law repealed. This meant that Adams's son, John Quincy Adams, lost his post." (Paragraph 12)
 - D. "Dr. Rush called the rift between Jefferson and Adams 'a national misfortune.' After all, the two men were symbols of American independence." (Paragraph 14)

3. Which statement best captures the author's purpose in the text?
 - A. The article shows how Jefferson and Adams' disagreements negatively impacted both their friendship and America.
 - B. The article encourages readers to resolve whatever problems they might have with a close friend.
 - C. The article illustrates how difficult it is to maintain close relations with people of opposing views.
 - D. The article emphasizes that true friendship can survive extreme disagreement, like the one between Jefferson and Adams.

4. PART B: Which detail from the text best supports the answer to Part A?
 - A. "Adams had said, 'Well, I understand that you are to beat me in this contest, and I will only say that I will be as faithful a subject as any you will have.'" (Paragraph 9)
 - B. "Jefferson and Adams wrote several more letters, but they were filled with hurt. To halt more harsh words, they stopped writing." (Paragraph 13)
 - C. "Jefferson had written to Adams, 'We were fellow laborers in the same cause... Still we did not expect to be without rubs and difficulties; and we had them.'" (Paragraph 14)
 - D. "Many friends have problems. But theirs were surely greater than ours...Even so, their respect for each other brought them back together." (Paragraph 19)

5. Explain the connection between Jefferson and Adams' issues and their political decisions. Cite evidence from the article in your response.

Discussion Questions

Directions: Brainstorm your answers to the following questions in the space provided. Be prepared to share your original ideas in a class discussion.

1. Throughout their friendship, Thomas Jefferson and John Adams often stood on opposing sides of political debates despite their personal friendship. How is Jefferson and Adams' ability to disagree with each other an important part of American democracy? Does this make America unique? Why or why not?
2. The author describes Jefferson and Adams as having a rocky relationship. Would you consider them friends, despite the long break they took from keeping in touch? Why or why not?
3. After a long silent period, Thomas Jefferson and John Adams were able to repair their friendship. What does it take to forgive? Describe a time when you had a disagreement with a friend, but were able to resolve it.

Name: _____ Class: _____

We Have Been Friends Together

By Caroline Elizabeth Sarah Norton
1830

Caroline Elizabeth Sarah Norton (1808-1877) was an English author who wrote during the early and mid-nineteenth century. She worked hard to change what she thought was wrong in society. In this poem, a speaker describes a conflict in a friendship.

As you read, take notes on how the speaker describes their friendship and what is troubling it.

[1] We have been friends together,
In sunshine and in shade;
Since first beneath the chestnut-trees
In infancy we played.

[5] But coldness dwells within thy¹ heart,
A cloud is on thy brow;
We have been friends together —
Shall a light word part us now?

We have been gay² together;
[10] We have laugh'd at little jests;³
For the fount of hope was gushing
Warm and joyous in our breasts.
But laughter now hath fled thy lip,
And sullen glooms thy brow;

[15] We have been gay together —
Shall a light word part us now?

We have been sad together,
We have wept, with bitter tears,
O'er the grass-grown graves, where slumber'd
[20] The hopes of early years.
The voices which are silent there
Would bid thee clear thy brow;
We have been sad together —
Oh! what shall part us now?



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"We Have Been Friends Together" (1830) by Caroline Elizabeth Sarah Norton is in the public domain.

1. another term for "your"
2. lighthearted and carefree
3. **Jest** (*noun*): a joke

Text-Dependent Questions

Directions: For the following questions, choose the best answer or respond in complete sentences.

1. PART A: Which statement best expresses a theme of the poem?
 - A. Even the strongest friendship will end with an argument.
 - B. A friendship that has endured difficult times is more likely to last.
 - C. Best friends that have been through good and bad times can survive anything.
 - D. No matter how close friends are in the beginning, they will eventually grow apart.

2. PART B: Which quote from the poem best supports the answer to Part A?
 - A. "Since first beneath the chestnut-trees / In infancy we played." (Lines 3-4)
 - B. "But laughter now hath fled thy lip, / And sullen glooms thy brow" (Lines 13-14)
 - C. "O'er the grass-grown graves, where slumber'd / The hopes of early years." (Lines 19-20)
 - D. "We have been sad together — / Oh! what shall part us now?" (Lines 23-24)

3. How does the repetition of the phrase "Shall a light word part us now?" contribute to the meaning of the poem?
 - A. It emphasizes the disbelief the speaker feels that their friendship should end.
 - B. It stresses the real concern that speaker feels that their friendship will end.
 - C. It shows how unbothered the speaker is by the possibility of their friendship ending.
 - D. It minimizes the speaker's fight with their friend.

4. What does "O'er the grass-grown graves, where slumber'd / The hopes of early years" in lines 19-20 mean as used in the poem?
 - A. The speaker and their friend lost someone close to them.
 - B. The speaker considers their friendship to be dead.
 - C. The speaker and their friend have been greatly let down in the past.
 - D. The speaker doesn't think there is hope for their friendship in the future.

5. How does the final stanza contribute to the development of the poem's theme? Cite evidence from the poem in your response.

Discussion Questions

Directions: Brainstorm your answers to the following questions in the space provided. Be prepared to share your original ideas in a class discussion.

1. Based on your own experience, what is a friend? Do friends experience both good and bad times together, as described in the poem? Have you ever had a fight with a friend? How did you resolve it?
2. What does it take to forgive? Should friends be able to forgive and forget? Do you think the speaker's friend should forgive the speaker for whatever hurtful thing was said? Why or why not?

Informational Writing Prompt and Checklist

Grades 6-9

Writing Prompt: You have just read two texts about friendship. Write an informational essay explaining what it means to be a friend.

Be sure to:

- Plan your writing using the two texts and your responses to the two discussion questions from each text.
- Use the checklist as a guide for organizing and writing your essay.

Writing Checklist

Introduction	<input type="checkbox"/> Introduces the topic <input type="checkbox"/> Provides a thesis statement that addresses the prompt
Body	<input type="checkbox"/> Structures a logical progression of ideas in multiple paragraphs that support the thesis statement <input type="checkbox"/> Includes transitions to clarify relationship between and among ideas <input type="checkbox"/> Cites at least two pieces of evidence from Text 1 that most strongly supports the ideas <input type="checkbox"/> Elaborates and explains how each piece of text evidence supports the topic and ideas <input type="checkbox"/> Cites at least two pieces of evidence from Text 2 that most strongly supports the ideas <input type="checkbox"/> Elaborates and explains how each piece of text evidence supports the topic and ideas
Conclusion	<input type="checkbox"/> Restates key ideas <input type="checkbox"/> Ends with an effective closure for audience and purpose
Entire Essay	<input type="checkbox"/> Has few errors in sentence formatting, capitalization, punctuation, and spelling.

Selecting Books for Your Child: Finding 'Just Right' Books

By: Kathleen Rogers

How can parents help their children find books that are not "too hard" and not "too easy" but instead are "just right"? Here's some advice.

Five finger rule

1. Choose a book that you think you will enjoy.
2. Read the second page.
3. Hold up a finger for each word you are not sure of, or do not know.
4. If there are five or more words you did not know, you should choose an easier book.
5. Still think it may not be too difficult? Use the five finger rule on two more pages.

Choose a book that is a good fit for you!

Read two or three pages and ask yourself these questions:

Will it be an easy, fun book to read?

- Do I understand what I am reading?
- Do I know almost every word?
- When I read it aloud, can I read it smoothly?
- Do I think the topic will interest me?

If most of your answers were "yes", this will be an easy book to read independently by yourself.

Will this book be too hard for me?

- Are there five or more words on a page that I don't know, or am unsure of?
- Is this book confusing and hard to understand by myself?
- When I read it aloud, does it sound choppy and slow?

If most of your answers were "yes," this book is too hard. You should wait awhile before you read this book. Give the book another try later, or ask an adult to read the book to you.

Tips on reading with your child

- When they can't read the word, say...
- Can you sound it out?
- Fingertap it.
- Can you think of the word or movement that helps you remember that vowel sound?
- What is the first and last sound? What word would make sense?
- Does it have a pattern that you have seen in other words? (ex-an, ack)
- How does the word begin?
- You said _____. Does that make sense?
- What word would make sense that would start with these sounds?
- Put your finger under the word as you say it.

When they want to read a book that is too hard, say...

- Let's read it together.
- This is a book you will enjoy more if you save it until you are older — or later in the year.
- [Be honest!] When people read books that are too hard for them, they often skip important parts. You will have more fun with this book if you wait until you can read it easily.

HERE'S THE IMPACT OF READING 20 MINUTES PER DAY!

A student who reads

20:00

minutes per day

will be exposed to
1.8 MILLION
words per year
and scores in
90th PERCENTILE
on standardized tests

A student who reads

5:00

minutes per day

will be exposed to
282,000
words per year
and scores in
50th PERCENTILE
on standardized tests

A student who reads

1:00

minute per day

will be exposed to
8,000
words per year
and scores in
10th PERCENTILE
on standardized tests

Source: Nagy, Anderson and Herman, 1987

Home Reading Log

Student Information	
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Student Name		Grade Level	
School Name		Teacher	

Log

[illegible]

6.NS Jayden's Snacks

Task

Jayden has \$20.56. He buys an apple for 79 cents and a granola bar for \$1.76.

- a. How much money did Jayden spend?
- b. How much money does Jayden have now?



6.NS Jayden's Snacks

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6.NS Buying Gas

Task

Sophia's dad paid \$43.25 for 12.5 gallons of gas. What is the cost of one gallon of gas?



6.NS Buying Gas
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Addition of Decimals I**Progression of Exercises**

1. $1.3 + 2.1$

2. $14.3 + 12.6$

3. $56.56 + 12.12$

4. $24.5 + 42.9$

5. $365.8 + 127.4$

6. $76.67 + 40.33$

7. $872.78 + 135.86$

8. $549.2 + 678.09$

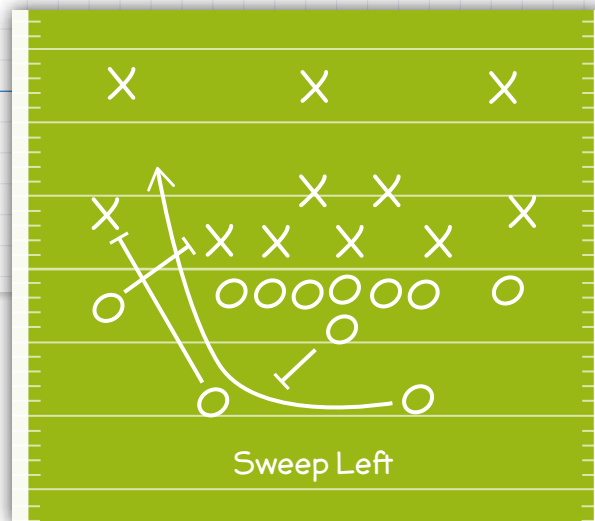
9. $821.3 + 106.87$

10. $108.97 + 268.03$

Explore Ordering Positive and Negative Numbers

Previously, you learned about positive and negative numbers. In this lesson, you will learn about ordering and comparing positive and negative numbers.

► **Use what you know to try to solve the problem below.**



A diagram of a football play

A youth football team tries several different plays. The goal of each play is to gain yards. The coach records the result of each play. List the plays from worst to best.

Name of Play	Wedge	Hook	Flag	Draw	Sweep	Toss
Result: Yards Gained (+) or Lost (–)	–3	+4	–5	+2	0	–4

**TRY
IT**



Math Toolkit algebra tiles, number lines, two-color counters

DISCUSS IT

Ask: What did you do first to decide which play is the worst?

Share: The first thing I did was ...



Learning Targets SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6

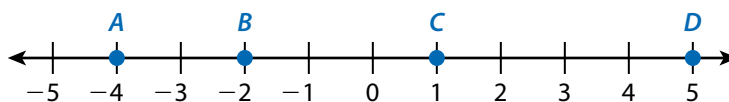
- Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram.
- Write, interpret, and explain statements of order for rational numbers in real-world contexts.

CONNECT IT

1 Look Back List the plays from worst to best. Explain how you know.

2 Look Ahead The goal of a football play is to gain yards. The more yards gained or the fewer yards lost, the better the play is. Number lines can be used to help make these types of comparisons with positive and negative numbers.

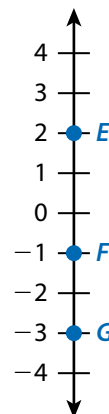
- a. Look at the horizontal number line.
Point D is farther to the right from 0 than point C . Which point represents a greater number?



- b. Point A is farther to the left from 0 than point B . Which point represents a greater number?

- c. Look at the vertical number line. Point G is farther down from 0 than Point F . Which point represents a greater number?

- d. Point E is above Point F . Which point represents a lesser number?
What is always true when comparing a negative number and a positive number?



3 Reflect How do the values change on a horizontal number line as you move left? How do the values change on a vertical number line as you move up?

Prepare for Ordering Positive and Negative Numbers

- 1 Think about what you know about positive and negative numbers. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.

Word	In My Own Words	Example
positive numbers		
negative numbers		
rational numbers		
inequality		

- 2 Choose a negative rational number. Write an inequality using the symbol $>$ to compare your number to 0. Explain your thinking.

- 3 Some friends play history trivia. Players gain 1 point for a correct answer. Players lose 1 point for an incorrect answer. The player with the greatest score wins. The players' scores are shown in the table.

a. List the players from worst score to best score. Show your work.

Player	Score
Brett	-7
Ellema	-1
Felipe	+3
Jennifer	0
Kamal	+2
Riley	-5

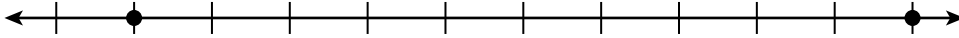
SOLUTION

b. Check your answer to problem 3a. Show your work.



Understanding Positive and Negative Numbers

- 1 The points on the number line are opposite numbers. The tick marks represent intervals of 1 unit.



Label 0 at the correct spot on the number line.

Label the point plotted to the right of 0.

Label the point plotted to the left of 0.

- 2 Use this list of numbers to answer the following questions:

$0, 4, -2, \frac{2}{3}, -1.8, 16, 3.2, -\frac{5}{4}$

Which numbers are rational numbers that are not integers?

Of the remaining numbers, which are integers but not whole numbers?

Of the remaining numbers, which are whole numbers?

- 3 Use the following terms to complete the following statements: *integers*, *rational numbers*, and *whole numbers*. Use each term only once.

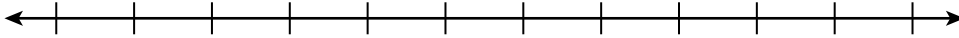
The counting numbers and zero are _____.

The counting numbers and their opposites, along with zero, are _____.

Integers and the decimal equivalents of fractions are _____.

Understanding Positive and Negative Numbers *continued*

- 4 Plot and label 4, -3 , 1, and their opposites on the number line.



- 5 If several points are graphed on a number line, is the point that is the farthest from 0 always the greatest? Explain.

Addition of Decimals II**Progression of Exercises**

1. $4.2 + 3.5$

2. $452. + 53.7$

3. $32.45 + 24.77$

4. $16.87 + 17.3$

5. $78.04 + 8.29$

6. $247.12 + 356.78$

7. $74.54 + 0.97$

8. $154 + 85.3$

9. $438.21 + 195.7$

10. $0.648 + 3.08$

Lesson 4: The Opposite of a Number

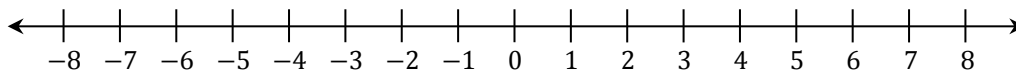
Classwork

Exercise 1: Walk the Number Line

- Each nonzero integer has an opposite, denoted $-a$; $-a$ and a are opposites if they are on opposite sides of zero and the same distance from zero on the number line.

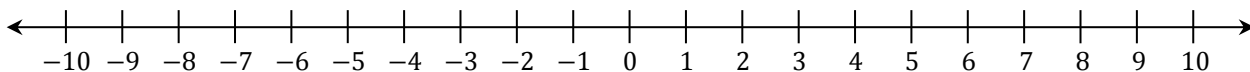
Example 1: Every Number Has an Opposite

Locate the number 8 and its opposite on the number line. Explain how they are related to zero.



Exercises 2–3

- Locate and label the opposites of the numbers on the number line.
 - 9
 - 2
 - 4
 - 7



3. Write the integer that represents the opposite of each situation. Explain what zero means in each situation.

a. 100 feet above sea level

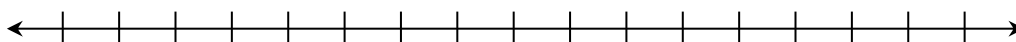
b. 32°C below zero

c. A withdrawal of \$25

Example 2: A Real-World Example

Maria decides to take a walk along Central Avenue to purchase a book at the bookstore. On her way, she passes the Furry Friends Pet Shop and goes in to look for a new leash for her dog. Furry Friends Pet Shop is seven blocks west of the bookstore. She leaves Furry Friends Pet Shop and walks toward the bookstore to look at some books. After she leaves the bookstore, she heads east for seven blocks and stops at Ray's Pet Shop to see if she can find a new leash at a better price. Which location, if any, is the farthest from Maria while she is at the bookstore?

Determine an appropriate scale, and model the situation on the number line below.

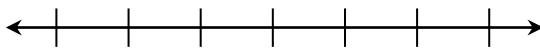


Explain your answer. What does zero represent in the situation?

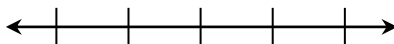
Exercises 4–6

Read each situation carefully, and answer the questions.

4. On a number line, locate and label a credit of \$15 and a debit for the same amount from a bank account. What does zero represent in this situation?



5. On a number line, locate and label 20°C below zero and 20°C above zero. What does zero represent in this situation?



6. A proton represents a positive charge. Write an integer to represent 5 protons. An electron represents a negative charge. Write an integer to represent 3 electrons.

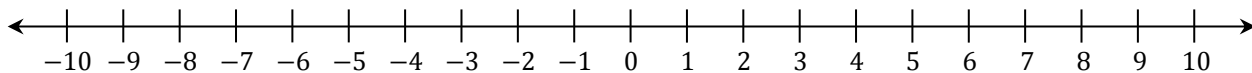
Problem Set

1. Find the opposite of each number, and describe its location on the number line.

- a. -5
- b. 10
- c. -3
- d. 15

2. Write the opposite of each number, and label the points on the number line.

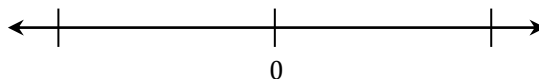
- a. Point A : the opposite of 9
- b. Point B : the opposite of -4
- c. Point C : the opposite of -7
- d. Point D : the opposite of 0
- e. Point E : the opposite of 2



3. Study the first example. Write the integer that represents the opposite of each real-world situation. In words, write the meaning of the opposite.

- a. An atom's positive charge of 7
- b. A deposit of $\$25$
- c. $3,500$ feet below sea level
- d. A rise of 45°C
- e. A loss of 13 pounds

4. On a number line, locate and label a credit of $\$38$ and a debit for the same amount from a bank account. What does zero represent in this situation?

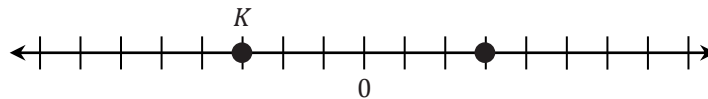


5. On a number line, locate and label 40°C below zero and 40°C above zero. What does zero represent in this situation?



Problem Set

1. Read each description carefully, and write an equation that represents the description.
 - a. The opposite of negative seven
 - b. The opposite of the opposite of twenty-five
 - c. The opposite of fifteen
 - d. The opposite of negative thirty-six
2. Jose graphed the opposite of the opposite of 3 on the number line. First, he graphed point P on the number line 3 units to the right of zero. Next, he graphed the opposite of P on the number line 3 units to the left of zero and labeled it K . Finally, he graphed the opposite of K and labeled it Q .

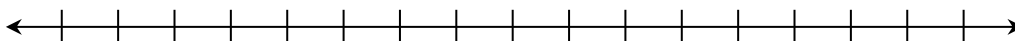


- a. Is his diagram correct? Explain. If the diagram is not correct, explain his error, and correctly locate and label point Q .
- b. Write the relationship between the points:

P and K _____

K and Q _____

P and Q _____
3. Read each real-world description. Write the integer that represents the opposite of the opposite. Show your work to support your answer.
 - a. A temperature rise of 15 degrees Fahrenheit
 - b. A gain of 55 yards
 - c. A loss of 10 pounds
 - d. A withdrawal of \$2,000
4. Write the integer that represents the statement. Locate and label each point on the number line below.
 - a. The opposite of a gain of 6
 - b. The opposite of a deposit of \$10
 - c. The opposite of the opposite of 0
 - d. The opposite of the opposite of 4
 - e. The opposite of the opposite of a loss of 5



Subtraction of Decimals**Progression of Exercises**

1. $49.5 - 32.1 =$

2. $7.48 - 2.26 =$

3. $116.32 - 42.07 =$

4. $128.43 - 87.3 =$

5. $239.5 - 102.37 =$

6. $448.9 - 329.18 =$

7. $134.25 - 103.17 =$

8. $187.49 - 21 =$

9. $336.91 - 243.38 =$

10. $323.2 - 38.74 =$

6.NS Mile High

Task

Denver, Colorado is called “The Mile High City” because its elevation is 5280 feet above sea level. Someone tells you that the elevation of Death Valley, California is -282 feet.

- Is Death Valley located above or below sea level? Explain.
- How many feet higher is Denver than Death Valley?
- What would your elevation be if you were standing near the ocean?



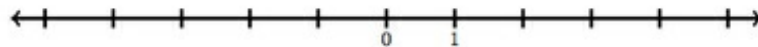
6.NS Mile High

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6.NS Integers on the Number Line 2

Task

Below is a number line with 0 and 1 labeled:



- Find and label the numbers -2 and -4 on the number line. Explain.
- Find and label the numbers $-(-2)$ and $-(-4)$ on the number line. Explain
- Find and label the number -0 on the number line. Explain.



6.NS Integers on the Number Line 2
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Simulating Physical and Chemical Weathering at Home



How does rock weather the ages? Learn about these physical and chemical processes with a little sweet science! Credit: George Retseck

Introduction

Have you ever visited a canyon or cave and wondered how those formations came to be? Or observed smooth stones by a river or beach? These results are due to a process called weathering. Weathering, or the wearing-away of rock by exposure to the elements, not only creates smooth rocks as well as caves and canyons, but it also slowly eats away at other hard objects, including some statues and buildings. Try this process out on a sugar cube and feel how powerful weathering can be.

Background

Rock might seem permanent, but it is actually constantly being broken down. We often do not notice this process because it happens so slowly. As soon as rock is exposed to the elements it can start being broken down through the process of weathering. Scientists categorize this processes into two groups: physical weathering and chemical weathering.

In this activity you will model physical and chemical weathering with sugar cubes—so you can see it happen before your eyes.

Materials

At least four sugar cubes	Clay (optional)
Water	Spray bottle (optional)
Dark colored paper or countertop	Frosting (optional)
Glass	Nail file (optional)
Dropper	Tray or large dish with sides
Work area that can get wet	(optional)
Towel for cleaning up (optional)	

Procedure

Think of a few ways you can break or pulverize your rock (sugar cube) with mechanical weathering.

Try it out with one of your sugar cubes!

Did you crush it, smash it or apply another force on it? Can you list examples of how rocks get smashed or crushed in nature?

Now take two new sugar cubes, and grind one against the other over a dark colored piece of paper or countertop. *What happens? Do you see sugar dust on the paper or countertop? What is happening to your rock (sugar cube)?*

Try rounding the edges of your sugar cube this way. *Does it work?*

Look back at what is left of your sugar cube. *What does it look like? Is it still sugar?*

Now take a new sugar cube. *What are some ways you could break down your rock (sugar cube) with chemical weathering?*

In this activity we'll use water drops to simulate rain. Place the sugar cube in a glass.

Fill your dropper with water, and squeeze a few drops on the sugar cube. Look and feel to observe what happens.

What do you think will happen if you drop more water on the sugar cube? What do you think would happen if you drop 10 or 100 (or more) drops on the sugar cube? Will it still be a sugar cube? Will it still be sugar?

Drop more water on your sugar cube. *Where does the sugar go? Can you make the cube disappear completely?*

Extra: Place a few sugar cubes in a glass. Cover them with clay. The sugar cubes represent a layer of rock, and the clay represents topsoil. Make a few holes or a crack in the clay so rainwater can seep into the ground and reach the layer of rock. Spray water over your glass, representing rain coming down over your piece of land. *What do you think will happen to your layer of rock? Might caves form? How does this process depend on having different types of materials in the ground?*

Extra: Make a sugar-cube sculpture or structure. To glue cubes together, wet one side of the cube and press it against another cube. If you need stronger glue, frosting can do the trick. Make sure your sculpture has some details and sharp edges. A nail file can help you sculpt the cubes. *What do you think will happen to your sculpture when it is exposed to rain?* Place your sculpture on a tray or dish with sides, and use a spray bottle to let it rain over your sculpture. First a little—then more. What happens? Look carefully at the details and edges: Do they change? What will happen eventually after a lot of rain? This is exactly what acidic rain can do to some statues and buildings over time.

Observations and Results

Was breaking a sugar cube by smashing, crushing or grinding it easy? Rock breaks down in a similar way—but a lot more slowly—in nature in this process of physical or mechanical weathering. Forces in nature, such as gravity, wind and even the push of freezing water or plant roots, impact rocks. These forces eventually wear the rock down. The result is smaller pieces of rock—just like you were left with smaller pieces of sugar.

What about your chemical weathering test? Did the sugar cube become weak and eventually dissolve in the drops of water? That happens to some types of rock, too. Some minerals in rock react with liquids or gasses, creating new substances, which are often weaker—and sometimes even dissolve in water. After you applied enough water you probably did not have any sugar cube left as it was carried away with the water. In a similar way rocks can dissolve and be washed away, forming caves.

Assignment #2

How did the Grand Canyon form?

Part 1

Have you ever seen one of the 7 natural wonders of the world? Today we're going to explore one... the Grand Canyon! Watch the Grand Canyon Video (<https://bit.ly/2V7iUZP>) to see why it's considered a world wonder!

Write at least three observations from the video in the box below.

What are your initial ideas about how the Grand Canyon and other canyons like this form? It's ok if you aren't sure, just share your best ideas so far.

Write one or more questions about the video in the box below.

Assignment #2

From what type of rock is the Grand Canyon composed?

Part 2

In order to better understand what kind of weathering broke apart the rock from which the Grand Canyon was formed, it's important to establish what we know about the kind of rocks the Grand Canyon is made from.

- Read Page 1 of the *Grand Canyon Rocks!* article.
- Describe each of the three types of rock using information from the article:
 - Igneous rocks:
 - Sedimentary rocks:
 - Metamorphic rocks:
- Look at the images of the Grand Canyon below. Do you see any clues about what classification of rock the Grand Canyon might be made of? Use what you know about characteristics of different rock classifications and the article information to make an evidence-based claim.



https://commons.wikimedia.org/wiki/File:USA_09855_Grand_Canyon_Luca_Galuzzi_2007.jpg



<https://pixabay.com/images/search/rock%20layers/>

Is the Grand Canyon made of igneous rock, metamorphic rock, or sedimentary rock?	What evidence from the images above supports your claim?
I think the Grand Canyon is composed of....	The evidence that supports my claim is....

- Read pages 2-4 of the *Grand Canyon Rocks!* Article to learn more about the types of rocks found at the Grand Canyon and complete the table below with information about each type of rock.

Rock Name	Time Period Formed?	Environment Description	Types of Fossils Found
Precambrian Basement Rocks Rock Type: <i>Igneous & Metamorphic</i>	<i>1.8 billion years ago</i>	<i>Molten rock flowed as magma through cracks of metamorphic rock</i>	<i>Hard to find due to heat and pressure during formation</i>
Bright Angel Shale Rock Type: _____			
Redwall Limestone Rock Type: _____			
Supai Group Rock Type: _____			
Hermit Shale Rock Type: _____			
Coconino Sandstone Rock Type: _____			
Kaibab Limestone Rock Type: _____			

- Does this information support your earlier answer about the type of rock that composes the Grand Canyon?

Grand Canyon Rocks!



How did Grand Canyon form? By studying **geology** we learn about the Earth's history and how places change over time. What plants or animals lived in your town 150 million years ago? The ancient remains of plants and animals preserved in the rock, called **fossils**, tell stories about the past. Take a look at the chart of common fossils at Grand Canyon on the back page.

Think About It

THE OLDEST PANCAKE IN A STACK IS ALWAYS AT THE BOTTOM. THE ROCKS AT GRAND CANYON ARE A LOT LIKE PANCAKES. WHERE DO YOU FIND THE OLDEST ROCKS AT GRAND CANYON?



Vocabulary:

Fossils: the hardened remains or imprints of plants or animals preserved in rock

Geology: the study of the origin, history and structure of the earth

Cool Canyon Facts

River length: 277 miles

Canyon width: 10 miles

Canyon depth: 1 mile

Rocks come in all colors, shapes, and sizes. They can be very different, but to make sense of what is around us, **geologists** put rocks in groups according to how they form. The three families of rock are: **igneous**, **sedimentary** and **metamorphic**. Natural forces create and destroy rock, changing them over time in the rock cycle.

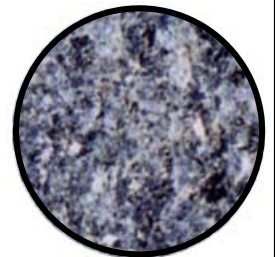


Igneous rocks are formed when rock is super-heated and becomes molten (liquid). There are two kinds of molten rock: magma (found beneath the Earth's surface) and lava (found on the Earth's surface). The molten rock cools and hardens on or beneath the Earth's surface forming a variety of igneous rock. Two examples are granite and basalt.

Sedimentary rocks are made of smaller pieces (like sand or mud), called sediments, that pile into layers. As pressure on the sediment increases over time, minerals act like glue, cementing them into solid rock. The three main types of sedimentary rocks at Grand Canyon are sandstone, shale (or mudstone), and limestone.

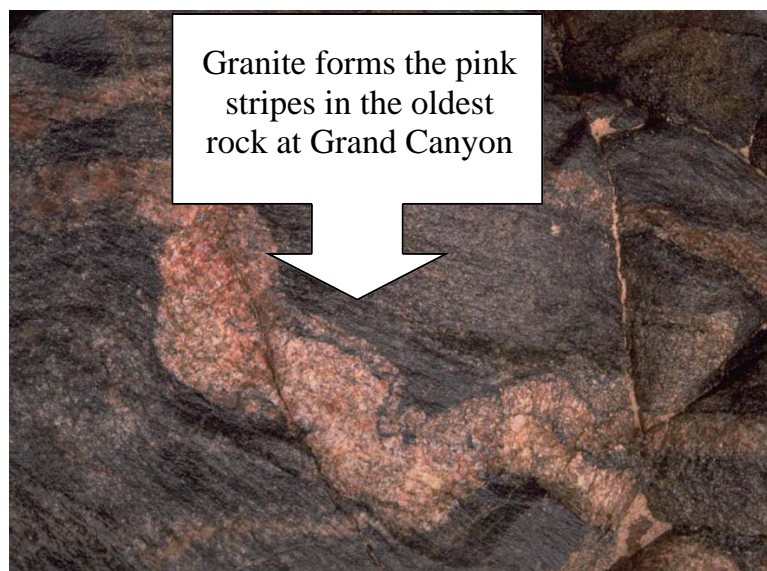


Metamorphic rocks are rocks that have been changed under great heat and pressure. The original rock can be sedimentary, igneous, or even metamorphic. The original rock is changed into something new, just as a caterpillar "metamorphoses" into a butterfly.



Precambrian Basement Rocks

The basement rock formed 1.8 billion years ago when the North American continent collided with an ancient chain of volcanic islands, much like today's Hawaiian Islands. Intense heat and pressure from the collision formed the metamorphic rock called Vishnu Schist. From deep under the earth's surface, molten rock flowed up as magma between the cracks of the Vishnu Schist. As the flowing magma cooled and hardened, it formed igneous rock called Zoroaster Granite. Because of the extreme heat and pressure that folded and changed the metamorphic rock, it is hard to find any fossils in the basement rocks.



Bright Angel Shale

If you came to Grand Canyon area 515 million years ago when the Bright Angel Shale was forming, everything was covered by a very muddy, warm, shallow sea. Trilobites, brachiopods, crinoids and worm-like creatures that burrowed in the sea-floor thrived in the nutrient-rich water. This greenish-colored shale forms the broad, flat area known as the Tonto Platform in Grand Canyon.

Redwall Limestone

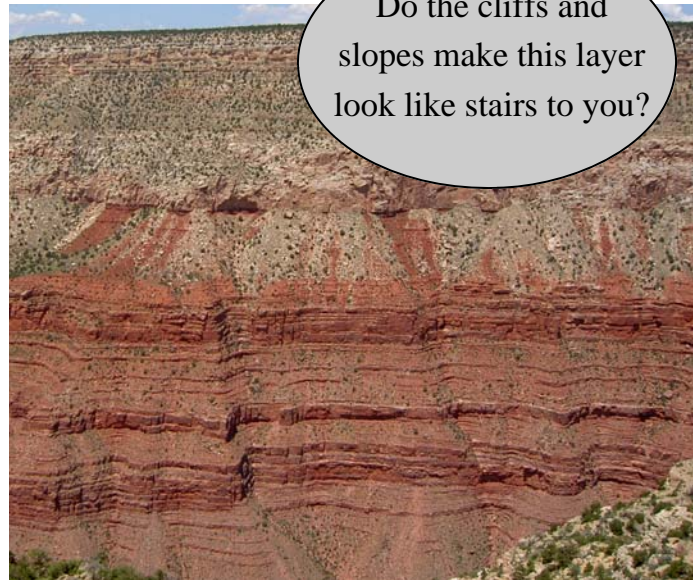
About 340 million years ago, North America lay close to the equator when the Redwall Limestone formed. Grand Canyon was covered by a shallow, warm, clear and well-lit sea where many crinoids lived. Fossils in the rock tell us that corals, cephalopods, bryozoans, and brachiopods lived here. While the limestone itself is gray in color, the surfaces of the exposed cliffs are stained red by iron in rock eroding from the layers above with rain and snow melt.



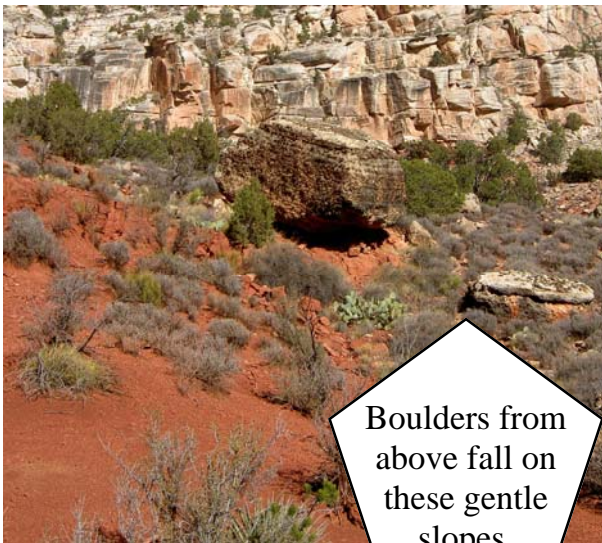
This limestone layer is 500 feet thick and creates the tallest cliff in Grand Canyon.

Supai Group

How do you feel about a trip to the beach? About 300 million years ago, the Grand Canyon area was covered by rapidly changing coastlines as sea levels rose and fell. The Supai group has limestone, sandstone, and shale in it, sharing the story of beaches, dunes, and sometimes oceans that were found here. The ocean environments left behind fossils of brachiopods, while the land environments left various plant fossils for geologists to find. Both environments contained multiple types of burrowing creatures.



Do the cliffs and slopes make this layer look like stairs to you?



Boulders from above fall on these gentle slopes.

Hermit Shale

Are you ready to go wading through the mud? 280 million years ago The Grand Canyon area was covered by a broad coastal plain fed by multiple slowly meandering streams. The environment was prime habitat for an abundance of ferns and conifers, along with reptiles and insects, including dragonflies with three-foot wingspans. This layer consists of siltstones, mudstones, and fine grained sandstones rich in iron that create a gentle, red slope in most parts of Grand Canyon National Park.

Coconino Sandstone

Have you ever wanted to visit the Sahara desert? 275 million years ago the Grand Canyon area was covered with coastal dune-fields that reached as far north as present day Monument Valley, and as far south as Sedona. The ocean lay to the west. Reptiles, spiders, scorpions, and other insects dwelled on the sand dunes of this extensive desert, leaving their tracks fossilized in the sandstone. This sandstone layer creates a broad, light-colored cliff a few hundred feet below the rim of Grand Canyon. Cross-bedding (lines that run at steep angles to one-another) can be seen in the rock, giving evidence to the sand dunes that once covered the area.

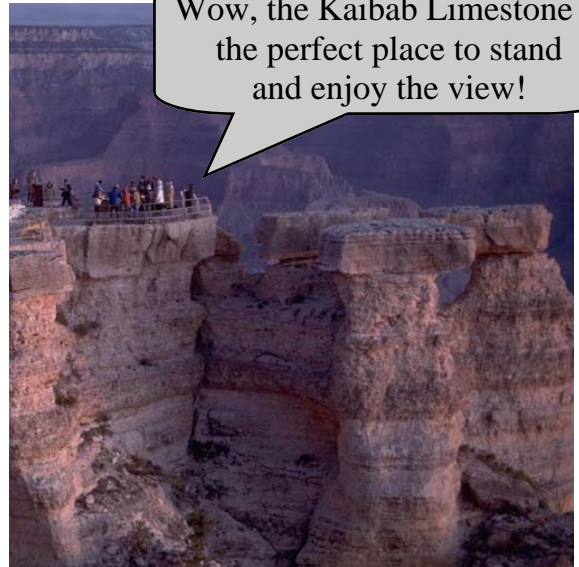


This striking white cliff earns the name "bathtub ring" of Grand Canyon.

Kaibab Limestone

270 million years ago North America was the western part of the super-continent Pangaea. The Grand Canyon region was once again covered by a shallow, warm, and well-lit clear sea with a sandy/muddy floor. The coast was nearby and to the northeast. Brachiopods and sponges dominated these waters. Other species included crinoids, corals, bryozoans, cephalopods, sharks and fish.

This limestone is the youngest rock found at Grand Canyon National Park.



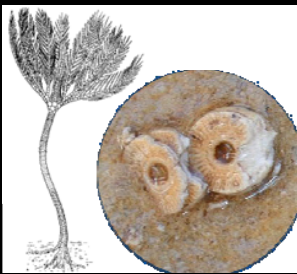
Wow, the Kaibab Limestone is the perfect place to stand and enjoy the view!

Are any of these fossils found in your backyard?

Fossils of Grand Canyon Here are some of the more common fossils found in the sedimentary layers of Grand Canyon...

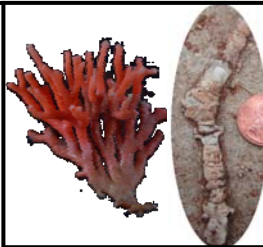


Brachiopods— A variety of shells lived in clear ocean waters.



Crinoids— Tiny disks made the stem and arms of this animal, that was rooted to the sea floor.

Bryozoans— These are apartment complexes for microscopic (that's really small!) animals.



Ferns— These fossils are the imprints of where leaves fell into the mud thousands of years ago.

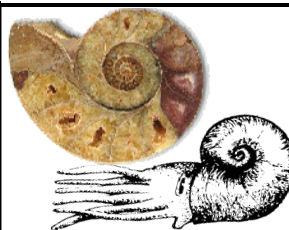


Burrows of animals— Worms and trilobites dug tunnels in the soft muddy sediment under the sea floor.



Sponges— Sea sponges are one of the most common fossils in the youngest layer at Grand Canyon.

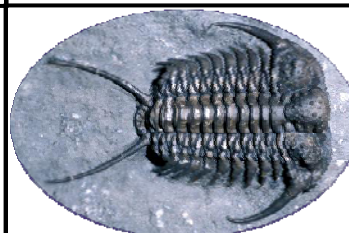
Cephalopods— These creatures roamed the sea and are related to the squid in today's oceans.



Tracks— Reptiles and other animals left their mark in the mud and sand where they lived.



Coral— This predator was rooted to the sea floor. Descendants of this animal still live in today's oceans.



Trilobites— These segmented animals could be the size of your thumb or a dinner plate!

Assignment #3

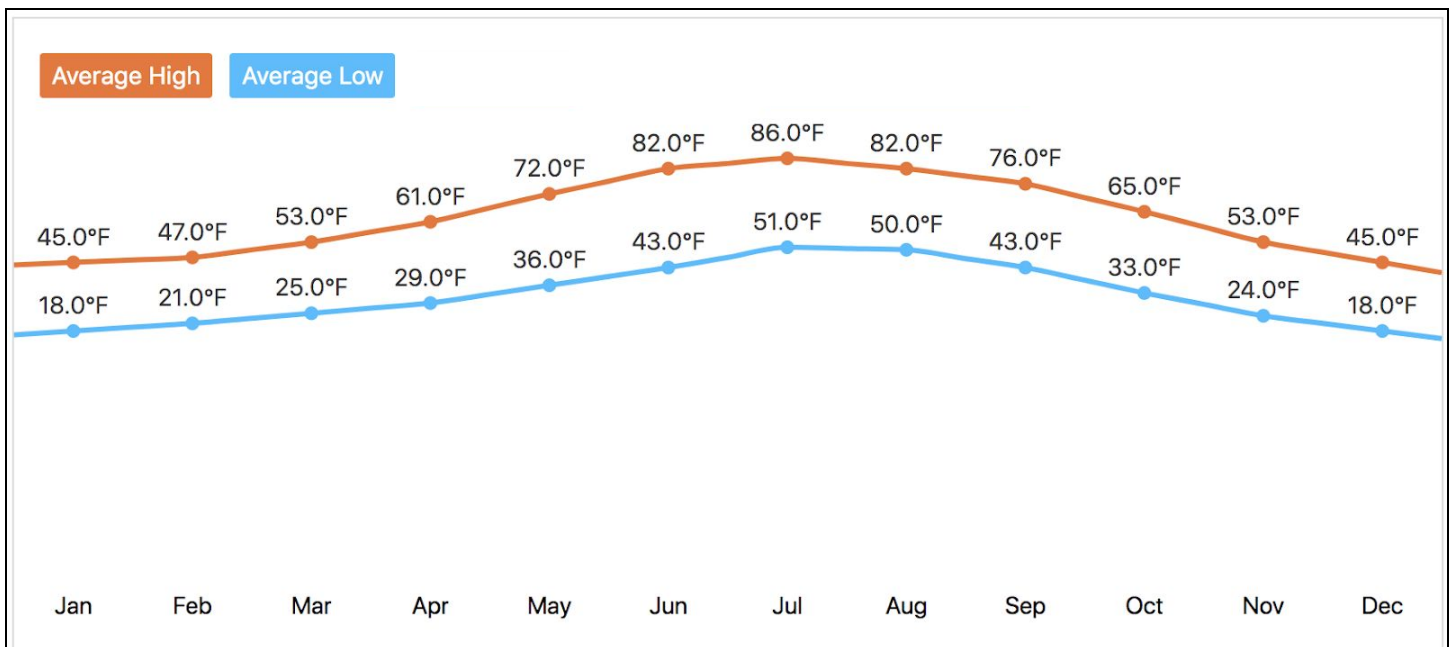
What type of weathering contributed to the formation of the Grand Canyon?

Part 1

Grand Canyon Climate

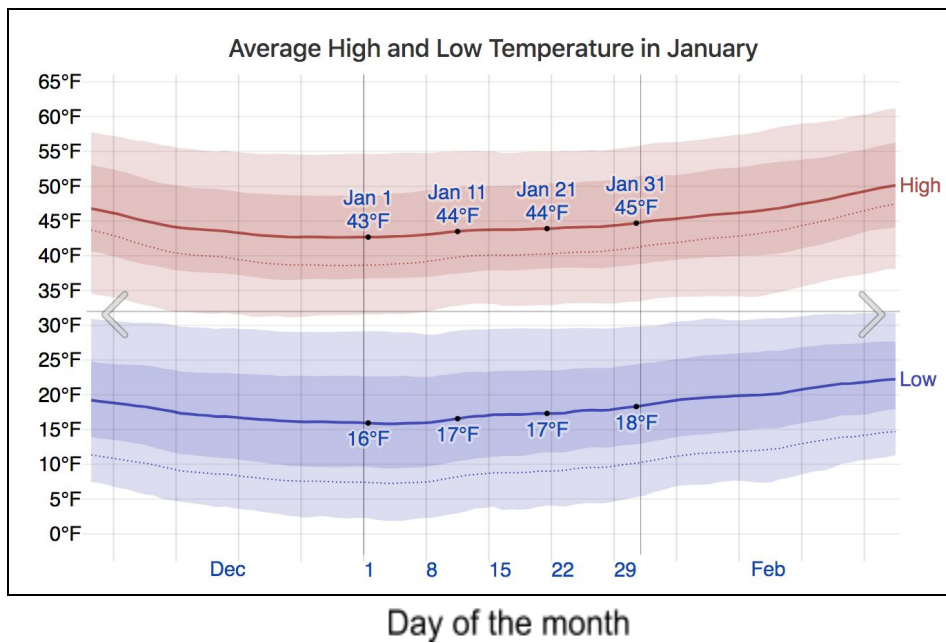
1. Examine the graph below. During which month is there the biggest difference between the average low temperature and the average high temperature? How much is the difference?

Grand Canyon Average Monthly High and Low Temperatures



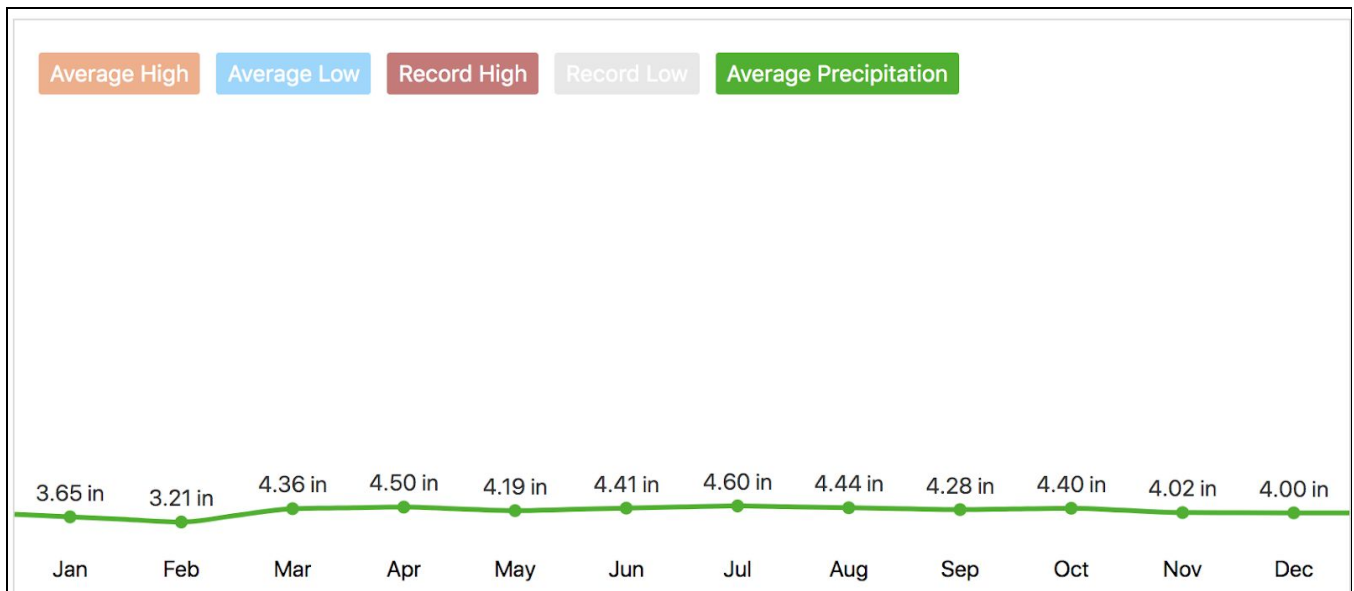
2. One of the coldest months in the Grand Canyon is January. Examine the graph of January temperatures in the Grand Canyon below.

Does the Grand Canyon ever experience temperature below and above freezing (32 degrees F) on the same day? Be sure to cite evidence from the graph.

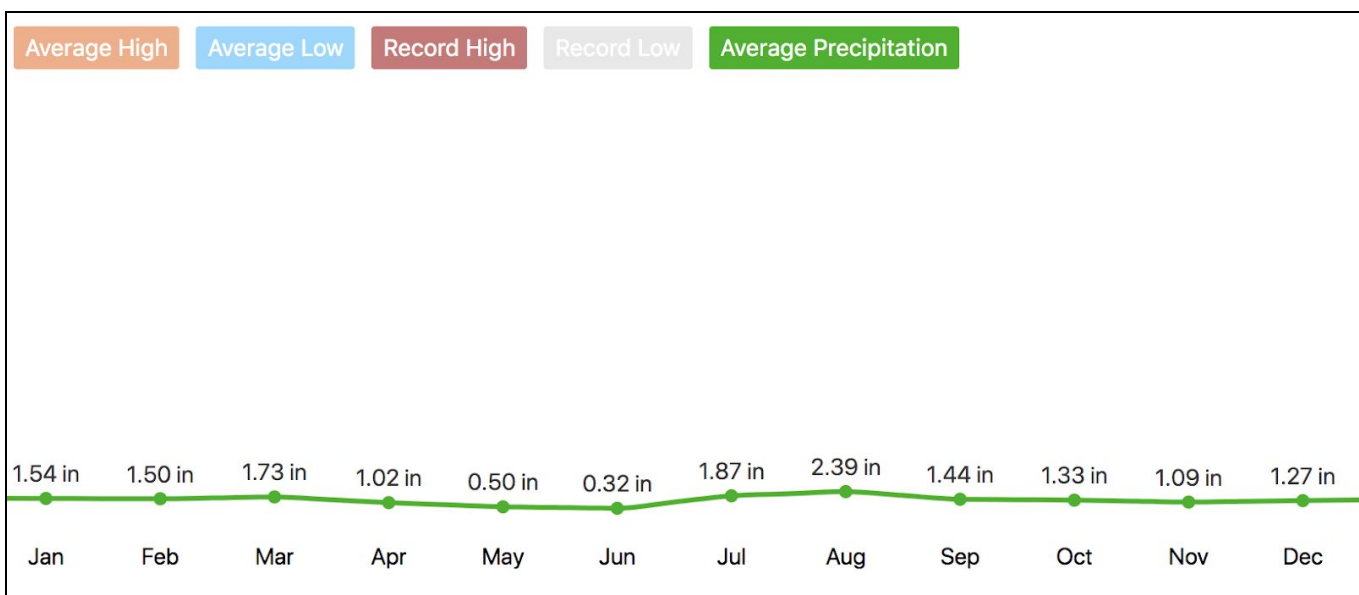


3. Examine the graphs below. Does it rain or snow (precipitation) at the Grand Canyon? How does the precipitation in the Grand Canyon compare to the precipitation in New York City?

Grand Canyon Average Monthly Precipitation



New York City Average Monthly Precipitation



Summarize your observations, thoughts, and questions from **Part 1: Grand Canyon Climate**, in the space provided below.

See What are some of your observations?	Think What does each observation make you think about the Grand Canyon formation?	Wonder What questions do you have about each observation?

Part 2

- Read the text, *Weathering*.
 - As you read, use a yellow highlighter (or underline) to highlight ideas that you think connect to what you learned about the Grand Canyon's climate and might offer clues about the type of weathering that may have broken apart rock to form the Grand Canyon. Use green to highlight (or circle) ideas you don't understand or have questions about.
- 1) What ideas from the text do you think connect to what you learned about the Grand Canyon's climate? Be sure to explain why you think they connect.

- 2) What questions do you have about the text?

- Now that you have read about the types of physical and chemical weathering, make an evidence-based claim below about at least one type of physical weathering and one type of chemical weathering you think could have broken apart rock to form the Grand Canyon.

Physical Weathering Claim

Claim	Evidence Consider rock and mineral composition and climate at the Grand Canyon.	Reasoning How does the evidence connect to the description of the physical weathering you claimed?
The type of physical weathering I think may have broken apart rock to form the Grand Canyon is...		

Chemical Weathering Claim

Claim	Evidence Consider rock and mineral composition and climate at the Grand Canyon.	Reasoning How does the evidence connect to the description of the chemical weathering you claimed?
The type of chemical weathering I think may have broken apart rock to form the Grand Canyon is...		

Weathering

Rocks gradually wear away. This is called weathering. Two types of weathering are:

- physical weathering
- chemical weathering

Physical weathering

Physical weathering is caused by physical changes such as: changes in temperature, freezing and thawing, and the effects of wind, rain and waves. Here is a description of each of the three types of physical weathering:

- **Temperature changes**

When a rock gets hot it expands a little, and when a rock gets cold it contracts a little. If a rock is heated and cooled many times, cracks form and pieces of rock fall away. This type of physical weathering happens a lot in deserts, because it is very hot during the day but very cold at night.

- **Wind, rain and waves**

Wind, rain and waves can all cause weathering. The wind can blow tiny grains of sand against a rock. These wear the rock away and weather it. Rain and waves can also wear away rock over long periods of time.

- **Freeze-thaw**

Water expands slightly when it freezes into ice. This is why water pipes sometimes burst in the winter. You might have seen a demonstration of this sort of thing at school - a jar filled to the brim with water eventually shatters after it is put into a freezer.

The formation of ice can also break rocks. If water gets into a crack in a rock and then freezes, it expands and pushes the crack further apart. When the ice melts later, water can get further into the crack. When the rock freezes again, it expands and makes the crack even bigger.

This process of freezing and thawing can continue until the crack becomes so big that a piece of rock falls off.

Chemical weathering

The weathering of rocks by chemicals is called chemical weathering. Some types include:

- **Rainwater**

Rainwater is naturally slightly acidic because **carbon dioxide** from the air dissolves in it. Minerals in rocks may react with the rainwater, causing the rock to be weathered.

- Some types of rock are easily weathered by chemicals. For example, **limestone** and **chalk** are made of a mineral called calcium carbonate. When acidic rainwater falls on limestone or chalk, a chemical reaction happens. New soluble substances are formed in the reaction. These are washed away and the rock is weathered.



Chemical weathering can hollow out caves and make cliffs fall away.

- Some types of rock are **not** easily weathered by chemicals. For example, **granite** and **gabbro** are hard rocks that are weathered only slowly. Still some of their minerals do react with the acids in rainwater to form new, weaker substances that crumble and fall away.

- **Acid Rain**

When fossil fuels such as coal, oil and natural gas are burned, **carbon dioxide** and **sulphur dioxide** escape into the air. These dissolve in the water in the clouds and make the rainwater more acidic than normal. When this happens, we call the rain '**acid rain**'.

Acid rain makes chemical weathering happen more quickly. Buildings and statues made from rock are damaged as a result. This is worse when the rock is limestone rather than granite.



Statues damaged by acid rain