# ASCEND
# SUMMER HOMEWORK
# RISING 8TH GRADE

Dear Families,

Research shows that kids who read over the summer are much more prepared for the next school year than those who do not. For that reason, we have selected a book for our rising 8th grade scholars to read over the summer – *The Hunger Games* by Suzanne Collins.
We hope it will encourage your scholar's love of reading! In this packet, you'll find questions and activities for scholars to complete after they read. The activities are meant to challenge your scholar's thinking, while also being fun and engaging. On page 3, you'll find a place for both you and your scholar to sign, to certify that this reading assignment has been completed.

Math and science activities are also included in our summer homework packets. Our seventh graders had a busy year learning new math skills; mastery of these skills is extremely important in developing a solid math foundation. The eighth grade program will build onto these seventh grade skills, so any time spent learning or reinforcing these concepts over the summer, and completing the practice pages in the packet, will be very beneficial for your child. The science activities included will give your scholar a sneak peek and introduction to the exciting work they will be doing in 8th grade science.

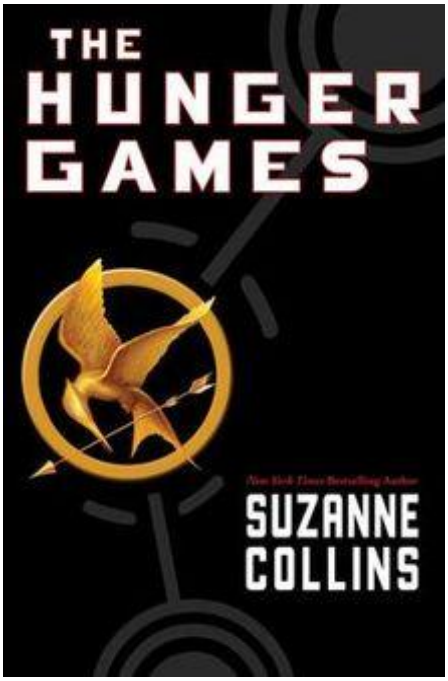
Thank you for supporting your scholar's learning. Together, we can push them to new heights!

Happy summer!

Ascend Public Charter Schools

# TABLE OF CONTENTS

# RISING 9TH GRADE ENGLISH




Name: _____

Homeroom:_____

Parent Signature: _____

Directions:

After reading the book *The Hunger Games* by Suzanne Collins, complete all questions and activities using the strategies you have been taught and the text! Submit this packet to your English teacher on the first day of school. Happy summer ☺

## Chapter 1:

The Hunger Games is set in a dystopian world. How does Collins emphasize that *The Hunger Games* is set in a dystopia? Use details from the text to support your answer.

## Chapter 2:

After volunteering as tribute, Effie Trinket asks the crowd to applaud for Katniss, but they instead remain silent and offer a silent gesture instead. Evaluate this gesture. Why is this gesture significant and what impact does this gesture have on Katniss?

Chapter 3:

Imagine you are Katniss's cousin, and you have been granted the opportunity to say goodbye to her before she is taken to the capitol for training. How would you instill confidence in her? How might you assuage her fears? What advice would you give her? Use the lines below to compose your response.

Why do you think that Peeta Mellark's father comes to say goodbye to Katniss? How do you think his goodbye to Katniss differed from his goodbye to Peeta?

## Chapter 4

What is the significance of the woods to Katniss? What dual purpose do they serve in her life?

Evaluate Haymitch as a coach and mentor. Does he make you feel optimistic or pessimistic about Katniss and Peeta's chances of survival? Why?

## Chapter 5

In this chapter, we meet Cinna, Katniss's stylist. Cinna is not like the other people in the capitol. What makes him stand out? How does he help Katniss and Peeta to also stand out among the other tributes? Why is this an important strategy?

## Chapter 6

How is the author trying to make Effie both likeable and unlikable to the reader? Why might the author be choosing to do this?

| | |
|---|---|
| What makes Effie likeable? | • <br> • <br> • |
| What makes Effie unlikable? | • <br> • <br> • |
| The author is likely doing this because… | |

## Chapter 7

Describe Katniss's final act in this chapter. How does it reflect her true character? How does this behavior support other actions we have seen her take so far in the novel?

## Chapter 8

You are Katniss and you have been given the rare opportunity to send a letter home to Prim. What information would you share about the capitol and your experience thus far? (The information you choose to share with Prim is just as important as the information you choose NOT to share with her. Consider the relationship that Katniss has with Prim, as well as Prim's character, when constructing your response.)

## Chapter 9

Both Haymitch and Cinna try to give Katniss advice for how to conduct herself during the interview. Whose advice is more effective in helping Katniss? Why do you think that is? Support your answer with details from the text.

## Chapter 10

Read the following quote from p. 141:

> "I don't know how to say it exactly. Only…I want to die as myself. Does that make any sense?...I don't want them to change me in there. Turn me into some kind of monster that I'm not."

What does Peeta mean when he says this? How could he die as anyone but himself?

What factors in the arena could change the person Peeta is?

Chapter 11

Describe the setting of the actual Hunger Games that Katniss and Peeta are participating in. Does the setting of the Games make you feel that Katniss has a better or worse chance of winning the Hunger Games? Why? Explain your answer using details from the text.

Chapter 12:

How do each of the following components pose a challenge to Katniss's survival in the Hunger Games?

| Component | How it poses a challenge to Katniss's survival |
|---|---|
| Other tributes | |
| Gamemakers | |
| Animals and creatures | |
| Sponsors | |
| Basic survival needs | |

Chapter 13

How does the author emphasize the difference between the career tributes and the tributes from the other districts? Why is this distinction important?

Chapter 14

Evaluate Peeta's feelings for Katniss. Do you believe that Peeta is really in love with Katniss? Or do you think his admission was just part of his strategy to win the Hunger Games? Justify your answer using evidence from the text.

Chapters 15-16

How do the events in these chapters stress the idea that teamwork is important for survival in the Hunger Games? How does this message conflict with the rules and values that surround the Games?

Chapters 17-18

How does Rue's death impact Katniss? (Think about the impact on her physically, mentally emotionally, as well as the impact on her attitude towards other tributes and the Hunger Games). What does this reveal about Katniss's character?

Imagine you are from District 11 and you are allowed to attach a small note to the sponsor gift that your district sent to Katniss. In two sentences, what would your message be?

Chapter 19

Do you think Katniss was right to kiss Peeta? Why or why not? Explain.

Chapter 21

How does the author create and maintain tension during the scene at the cornucopia? (pages 282-288). Explain using details from the text.

Chapter 23

Describe Katniss's reaction when Peeta doesn't whistle back. Evaluate her response. Are her feelings for Peeta true feelings or are they just an act?

Chapter 25

Summarize the final events that lead up to Katniss and Peeta being declared the official victors of the Hunger Games.

Extended Response

*The Hunger Games* is an intense story that provides a commentary on several different aspects of society through the characters and the story's plot. What is one of the major themes of *The Hunger Games* and how does the author express this theme?

In your response, be sure to:

- Include an introduction and concluding paragraph
- Effectively explain one of the novel's major themes
- Demonstrate how this theme is expressed throughout the novel
- Use evidence from the text to support your response

Opinion:

Read the following interview with Suzanne Collins, and then answer the question that follows.

## Q & A with Hunger Games Author Suzanne Collins

## By Hannah Trierweiler Hudson

The author of *The Hunger Games* says we need to get real about war, violence, and TV.

Six years ago, a savvy audience of teachers and kids fell for the Underland Chronicles, a Wonderland-like series about a boy named Gregor who discovers a magical universe underneath New York City. Now the rest of the world has caught on to Suzanne Collins's captivating storytelling, devouring her dystopian Hunger Games trilogy. Along with the success of the series — about teens in a post-apocalyptic United States forced to fight to the death on television — have come the inevitable challenges and discussion of what kids can handle. But with the publication of *Mockingjay*, the third and final title, The Hunger Games is more popular than ever. Collins argues that not only can kids contend with the books' complicated themes, but that we need to talk with students about violence, war, and the difficult search for "reality" in our media-saturated world.

*The Hunger Games* is hugely popular with both boys and girls. Why do you think that is?
Whenever I write a story, I hope it appeals to both boys and girls. But maybe in its simplest form, it's having a female protagonist in a gladiator story, which traditionally features a male. It's an unexpected choice. Or I don't know, maybe the futuristic, grim nature of the story is larger than that. I wouldn't care who was the lead in a good dystopian story. You know what I mean?

What's been the most memorable feedback you've gotten from teachers and kids?
One of the most memorable things I hear is when someone tells me that my books got a reluctant reader to read. They'll say, "You know, there's this kid and he wouldn't touch a book and his parents found him under a blanket with a flashlight after bedtime because he couldn't wait to find out what happened in the next chapter." That's just the best feeling. The idea that you might have contributed to a child's enjoyment of reading.

Who contributed to your love of reading and writing?
In fifth and sixth grade, I went to school in an open classroom. And the English teacher,

Miss Vance, was wonderful. On rainy days, she would take whoever was interested over to the side and read us Edgar Allan Poe stories. I remember all of us sitting around just wide-eyed as she read "The Telltale Heart" or "The Mask of the Red Death." She didn't think we were too young to hear it. And we were riveted. That made a huge impression on me.

If only we could all know a Miss Vance! How do you convince the adults who are more concerned about your themes?
I think it's how you present it. Kids will accept any number of things. The Underland Chronicles — which I wrote for kids the same age as I was when Miss Vance read me Edgar Allan Poe — features death, loss, and violence. The third book has biological warfare, the fourth book has genocide, the fifth book has a very graphic war. And I wondered if at some point that was going to become a problem. Not for the kids so much but for parents or schools. And it never seemed to. I think somehow if you went on that journey with me from the beginning, you kind of worked into the more violent places and were prepared by what had come before.

What drew you to writing science fiction?
Telling a story in a futuristic world gives you this freedom to explore things that bother you in contemporary times. So, in the case of The Hunger Games, issues like the vast discrepancy of wealth, the power of television and how it's used to influence our lives, the possibility that the government could use hunger as a weapon, and then first and foremost to me, the issue of war.

War seems to be a very important theme for you.
My father was career Air Force and was also a Vietnam veteran. He was in Vietnam the year I was six. But beyond that, he was a doctor of political science, he was a military specialist, he was very well educated. And he talked about war with us from very early on. It was very important to him that we understood things, I think because of both what he did and what he had experienced.

If you went to a battlefield with him you didn't just stand there. You would hear what led up to this war and to this particular battle, what transpired there, and what the fallout was. It wasn't like, there's a field. It would be, here's a story.

How does war connect to your concerns about TV, especially reality TV?
The Hunger Games is a reality television program. An extreme one, but that's what it is. And while I think some of those shows can succeed on different levels, there's also the voyeuristic thrill, watching people being humiliated or brought to tears or suffering physically. And that's what I find very disturbing. There's this potential for desensitizing the audience so that when they see real tragedy playing out on the news, it doesn't have the impact it should. It all just blurs into one program. And I think it's very important not just for young people, but for adults to make sure they're making the distinction. Because the young soldiers dying in the war in Iraq, it's not going to end at the commercial break. It's not something fabricated, it's not a game. It's your life.

How do you think teachers can help children be more conscious about the media they're consuming?

Well, the first distinction is what is real and what is not real. I've written for children's television for a long time and very young children don't even have the capacity to distinguish. But as kids get older, you have to sit down with them on a case-by-case basis and say, "You know, this is a game, this is made up," and make sure they understand. Then, "This is news footage, this really happened," so that children understand someone getting voted off a show is not the same thing as a tsunami.

That's an extreme example, but they have to know that it's not just stuff that happens in this box and it's contained and you can turn it on and off. That there's real life occurring that doesn't end when the commercials roll.

Television isn't the only place kids make that distinction.
Absolutely. There's an infinite amount of material on the Internet. And then there's movies. Kids have so much screen time, and it's a concern. I know how overloaded I can feel sometimes. When I was a kid, the news stood out as different from other programming. And now, you've got hundreds of channels and innumerable things to click on the Web. And I wonder if it all begins to acquire a sameness.

Do you think real-world kids have the same opportunities as your heroine, Katniss, to make a difference in society?
The interesting thing about Katniss is when the story begins, she doesn't have much political awareness. There are things she knows about her world to be true and untrue. But no one has ever educated her in that area. It is not in the Capitol's interest that she know anything about politics. And there's only the one TV channel, which is completely controlled by the Capitol. And so she is struggling to put things together as she goes through the series, and it's quite difficult, because no one seems to think it's in their interest to educate her.

So it's interesting, because even though hers is an extreme case, I think all of us have to work to figure out what's going on. It's hard to get the truth and then to put it in a larger perspective.

You have to do the work.
Right. And sometimes you don't have the tools to do the work, because you can't verify what's being presented to you. You have to take it on trust, or you can disbelieve out of hand something that you're seeing on television or online. So you have to work very hard to, first of all, decide what you believe to be a true and a fair representation of something. And then to form an opinion about it, and then possibly to take action on it. It's confusing and it's hard.

It is! What advice do you give to young writers?
A lot of people tell writers to write about what they know. And that's good advice, because it gives you a lot of things to draw on. But I always like to add that they should write about things that they love. And by that I mean things that fascinate or excite them personally.

The Hunger Games is full of things that intrigue me; you know, it's dystopia, it's got kids in it, it's gladiators, it's war, there are genetic mutations. The Underland Chronicles has

fantasy, animals, sword fighting. And if you write about things that you feel passionately about, it is so much easier to write.

Imagine you are the parent of a middle school aged child. The school librarian is torn about whether or not to stock the novel *The Hunger Games* in the school's library. Using your knowledge of the novel, as well as the information contained in the interview with the author, Suzanne Collins, write a 1-page letter to the school librarian convincing them to either allow or disallow *The Hunger Games* in your child's school.

# RISING 8TH GRADE MATH

This math packet has been designed so that you will review and maintain your math skills during the summer. The packet is divided into eight weekly sections. Complete one section a week. Please monitor your progress so that you complete work on a weekly basis and not at the last minute the day before school starts in September.

Have a great summer!

**HELPFUL WEBSITES:**

http://www.khanacademy.org/

http://www.aplusmath.com

http://funbrain.com

http://aaamath.com

http://math.com

**HELPFUL APP:**

"Virtual Nerd Mobile"

**Requirements: iOS 6.0 or later; compatible with iPhone, iPad, and iPod Touch**

**Features: Virtual Nerd's on-screen instructors provide clear and approachable explanations; students can mark "favorite" videos so that they can instantly return to them in the future.**

**Price: Free**

# Week 1

**Complete the statement using <, >, or =.**

1. $|-6|$ ___?___ $6$
2. $0$ ___?___ $|3|$
3. $|-5|$ ___?___ $|-9|$

4. One fish is 4 feet below sea level. Another fish is 3 feet below sea level. Write each position as an integer. Which integer is greater?

**Add.**

5. $6 + (-3)$
6. $8 + (-1) + (-3)$

7. You start hiking at an elevation that is 80 meters below base camp. You increase your elevation by 42 meters. What is the new elevation with respect to base camp?

**Subtract.**

8. $10 - (-3)$
9. $-9 - (-9)$

10. The temperature falls from 3°C to −4°C. What is the difference in these temperatures?

**Multiply.**

11. $7 \bullet (-4)$
12. $-2(-5)(-3)$

**Divide, if possible.**

**13.** $-12 \div (-4)$

**14.** $-18 \div 6$

**15.** $\frac{-16}{8}$

**16.** $0 \div (-10)$

**Evaluate the expression when $r = -7$, $s = 2$, and $t = -5$.**

**17.** $s + t$

**18.** $t + s - r$

**19.** $s^2 - rt$

**20.** $\left|\frac{r+1}{s}\right|$

**Use mental math to solve the equation.**

**21.** $n + (-8) = 5$

**22.** $8 - d = 14$

**Find the next two numbers in the pattern.**

**23.** 6, −12, 24, −48, ...

**24.** −2, 20, −200, 2000, ...

**25.** The table shows the temperature in Des Moines, Iowa, for certain times during a particular day.

| Time | 3 A.M. | 8 A.M. | 1 P.M. | 5 P.M. | 10 P.M. |
|---|---|---|---|---|---|
| Temperature | −15°F | −6°F | 22°F | 10°F | −11°F |

**a.** What are the high and low temperatures for the day?

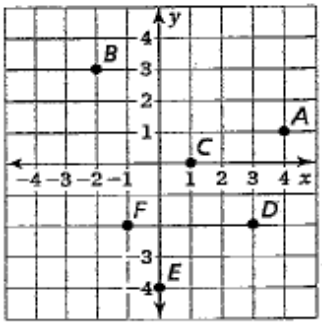
**b.** Find the range of temperatures for the day.

**c.** Find the change in temperature from 5 P.M. to 10 P.M.

**d.** Based on the given five temperatures, what is the average temperature for the day?

**e.** Explain why your answer to part (d) is not an accurate average temperature for the day.

**26.** Write an ordered pair corresponding to the point.




**a.** Point $A$ **b.** Point $B$

**c.** Point $C$ **d.** Point $D$

**e.** Point $E$ **f.** Point $F$

**27.** Which point in Exercise 26 is located in Quadrant III?

**28.** The pool is located at $(0, 0)$.

**a.** To get to your house from the pool, you walk 3 blocks west and 1 block north. What ordered pair corresponds to the location of your house?

**b.** What quadrant is your house located in?

# Week 2

**Write the rational number as a decimal.**

1. $-\frac{3}{11}$

2. $-3\frac{13}{20}$

**Write the decimal as a fraction or mixed number in simplest form.**

3. $3.42$

4. $-0.35$

5. Your skateboard ramp is $2\frac{3}{8}$ feet high. Your friend's skateboard ramp is $2\frac{2}{5}$ feet high. Which skateboard ramp is higher?

**Add or subtract. Write fractions in simplest form.**

6. $5.73 - (-3.56)$

7. $-\frac{5}{3} + 2\frac{1}{3}$

8. A gallon jug of milk is $\frac{3}{4}$ full. After breakfast the jug is $\frac{1}{12}$ full. Find the difference of the amounts before breakfast and after breakfast.

9. You buy a bag of dog food for $12.59 and a bottle of dog shampoo for $4.75. How much more did the dog food cost than the shampoo?

**Multiply. Write fractions in simplest form.**

**10.** $\left(-\frac{2}{5}\right)\left(-1\frac{1}{4}\right)$

**11.** $0.15 \times (-0.6)$

**Divide. Write fractions in simplest form.**

**12.** $-4.2 \div 12$

**13.** $-\frac{2}{7} \div \left(-\frac{8}{21}\right)$

**14.** How many $\frac{2}{3}$-ounce packages of peanuts can be made with 8 ounces of peanuts? Explain how you found your answer.

**Solve the equation. Check your solution.**

**15.** $n - 6 = 21$

**16.** $-8.3 = d + 4.7$

**17.** $p + 1\frac{3}{4} = 4\frac{5}{8}$

**18.** $-2 = \frac{w}{-5}$

**19.** $5h = 40$

**20.** $-0.5x = -4.3$

**Write the verbal sentence as an equation. Then solve.**

**21.** 6 more than a number $w$ is 2.

**22.** The product of $\frac{3}{4}$ and a number $s$ is $\frac{3}{5}$.

**Write an equation for the situation. Then solve.**

**23.** The temperature is $-4°\text{F}$. A high pressure front increases the temperature to $8°\text{F}$. By how many degrees did the temperature increase?

**24.** One eighth of the students in the seventh grade are in the school band. There are 44 students in the school band. Find the number of students in the seventh grade.

**Solve the equation. Check your solution.**

**25.** $3d - 8 = 13$

**26.** $-7 = \frac{z}{2} + 1$

**27.** $2y - 3y = 5$

**28.** $-2.9 = 3f + 4.3$

**29.** A rectangular garden has a length of 12 feet. You need 36 feet of fencing to enclose the garden. What is the width of the garden? Explain how you found your answer.

# Week 3

**Write the ratio as a fraction in simplest form.**

1. 15 girls to 6 boys

2. 24 players : 3 teams

**Find the unit rate.**

3. 405 rotations in 5 minutes

4. 72 ounces for 12 servings

**Tell whether the ratios form a proportion.**

7. $\frac{8}{24}, \frac{5}{15}$

8. $\frac{3}{7}, \frac{12}{21}$

9. You can buy 5 stickers for $3. Write a proportion that gives the cost $c$ if you buy 12 stickers.

**Solve the proportion.**

**10.** $\frac{2}{3} = \frac{n}{12}$

**11.** $\frac{33}{p} = \frac{3}{28}$

**12.** $\frac{k}{6} = \frac{15}{18}$

**13.** $\frac{2}{3} = \frac{3}{q}$

**Copy and complete the statement. Round to the nearest hundredth, if necessary.**

**14.** 3 in. ≈ ___?___ cm

**15.** 4 L ≈ ___?___ qt

**16.** 30 mi/h ≈ ___?___ km/h

**17.** 40 oz ≈ ___?___ kg

**18.** Use the table to find the rate.

| **Quarters** | 2 | 3 | 4 | 6 |
|---|---|---|---|---|
| **Minutes** | 30 | 45 | 60 | 90 |

**19.** Your baseball team has won 6 games and lost 4 games. If the team does not lose any more games, how many games must the team win to have a win : loss ratio of 2 : 1? Explain your answer.

**20.** It costs $145 for 10 people to attend a concert. How much does it cost a group of 8 people?

**21.** The weekly cost per person to rent a cottage on a lake varies inversely with the number of people who share the cost. When four people share the cost, each one pays $312.

**a.** Write an equation relating the cost per person $c$ and the number $n$ of people who share the cost.

**b.** If six people share the cost instead of four, how much does the cost per person decrease?

# Week 4

**Write and solve an equation to answer the question.**

1. 17 is what percent of 68?
2. What number is 16% of 80?
3. 35% of what number is 21?
4. 70 is what percent of 56?

**Identify the percent of change as an *increase* or *decrease*. Then find the percent of change. Round to the nearest tenth of a percent, if necessary.**

5. 15 books to 21 books
6. 60 cars to 24 cars
7. 12 calculators to 3 calculators
8. 100 pennies to 101 pennies

**Use the percent of change to find the new amount.**

9. 40 employees increased by 15%
10. 120 pounds decreased by 30%
11. $84 increased by 12%
12. 820 brushes decreased by 25%

**21.** The percent of sales tax is 6%. What is the sales tax on a skateboard that costs $98?

**22.** The price of your favorite brand of jeans was $35 last month. This month the price is $42. What is the percent of change from last month to this month?

**23.** You are shopping for a cell phone. At which store should you buy the cell phone? Explain your answer.

| Store | Original Price | Discount |
|---|---|---|
| A | $129 | 30% |
| B | $135 | 35% |
| C | $150 | 40% |

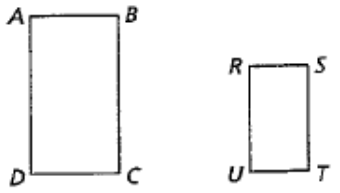
**24.** You deposit $200 in an account earning 3.5% simple interest. How long will it take for the balance of the account to be $221?

# Week 5

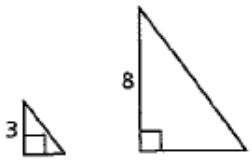
**Name the corresponding angle or the corresponding side of the similar figures.**

**1.** $\angle B$

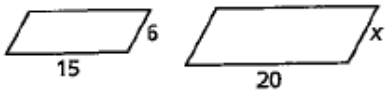
**2.** Side $CD$




**3.** The two figures are similar. Find the ratio (small to large) of the perimeters and of the areas.




**4.** The polygons are similar. Find the value of $x$.



**Find the missing dimension. Use the scale factor 1 : 8.**

5. Model length: 6 cm

   Actual length: ?

6. Model height: ?

   Actual height: 28 in.

7. Your rectangular vegetable garden is 12 feet long and 8 feet wide. Your friend's rectangular vegetable garden is 15 feet long and 10 feet wide. Are the gardens similar?

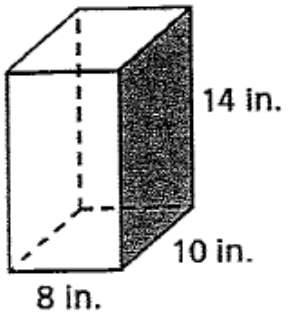
8. The ratio of the corresponding side lengths of two similar MP3 players is 4 : 3. The area of the larger MP3 player is 8 square inches. What is the area of the smaller MP3 player?

**9.** The ratio of the side length of square A to the side length of square B is 3 : 5. The perimeter of square B is 60 feet. What is the area of square A?

**10.** The scale on a map is 1 in. : 50 mi. The actual distance between two cities is 350 miles. What is the distance between the cities on the map?

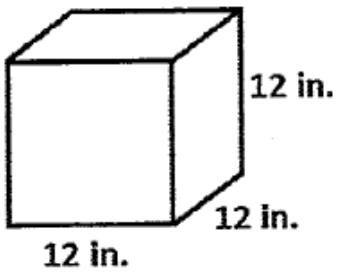
**11.** Find the surface area of the rectangular prism.

**12.** Find the volume of the rectangular prism.




**13.** Find the surface area of the cube.

**14.** Find the volume of the cube.



# Week 6

**1.** Joey is putting all of his trophies onto 7 shelves. If he places 6 trophies on each shelf but still has 2 trophies left over, how many trophies does he have?

**2.** Angie read 3 books in 4 days, and each book contained 280 pages. If Angie read the same number of pages each day, how many pages did she read per day?

**3.** Mike put 304 baseballs into 8 trash bins. He put the same number of baseballs in each bin. He took 5 trash bins of baseballs to the baseball field. How many baseballs did Mike take?

**4.** Workers Inc. just bought 14 boxes of pens to put in their storage room for employees to use as needed. Each box contains 50 pens. If each of the 33 employees working for Workers Inc. takes 4 pens when they are first brought into the office, how many pens will be left in the storage room?

**5.** John has 9 boxes of apples. Each box holds 16 apples. If 7 of the boxes are full, and 2 of the boxes are half full, how many apples does John have?

**6.** The temperature outside is -5°F, and the wind chill is -12°F. What is the difference between the temperature and the windchill?

**7.** Jena has a rope that is $4\frac{1}{4}$ inches long. If she divides the rope into sections that are exactly $\frac{1}{4}$ inch in length, how many $\frac{1}{4}$–inch sections will she have?

**8.** Mrs. Jones decided to buy some pencils for her class. She bought 3 packages of pencils, and each package contained 72 pencils. There are 24 students in her class and she divided up the pencils so that each student had the same amount of pencils. If there were no pencils left over, how many pencils did each student get?

**9.** Griffin ordered a pair of sneakers online. He had a $16 credit that he applied toward the purchase, and then he used a credit card to pay for the rest of the cost. If the shoes cost $80, how much did Griffin charge to his credit card when he bought the sneakers?

**10.** Caleb had 27 video games. He bought 8 more from a garage sale. He then sold $\frac{1}{35}$ of his games to a used video game store. How many video games did he sell?

**11.** For a scavenger hunt, Jim's mom distributed a bag of 725 jelly beans evenly into 29 plastic containers and hid them around the yard. If, after the hunt, Jim has a total of 275 jelly beans, then how many of the plastic containers did he find?

**12.** Sandra, Robert, and some other friends had a total of $73. Sandra spent $28 on videos and Robert spent $14 on videos.

How much money did the group have after Sandra and Robert bought the videos?

**13.** Jimmy is writing a paper for one of his classes. The paper has to be 3,000 words long, and so far he has written 696 words. If he only has 6 more days to write his paper and wants to write the same number of words each day, then how many words must he write per day to finish the paper?

**14.** Lindsey went skydiving. When she jumped out of the plane, its elevation was 13,000 feet. She was in free fall for 10,000 feet, and then she deployed her parachute. At what elevation did Lindsey deploy her parachute?

**15.** On his bookshelf, Adam has the difference between two-thirds of Brett's books and two thirds of Charlie's books. If Brett has 72 books and Charlie has 27 books, how many books does Adam have?

**16.** Fredo has a coupon for $1.00 off the price of a loaf of bread at the grocery store. After he arrived at the store, he found out the bread had already been marked down $2.00. What is the total discount on the price of the bread?

**17.** Carla, Patricia, and Angelina went on a car trip together, and they took turns driving. When they reached their destination, Carla and Patricia had driven a total of 259 miles, and Angelina and Patricia had drive a total of 255 miles.

If Carla drove 101 miles, who drove the most miles?

**18.** The temperature of a city at sunset was -3°F. Overnight, the temperature decreased by 13°F. What was the lowest temperature overnight in that city?

**19.** A pet store sold 245 cans of cat food last weekend for a total of $90.65. What was the price per can?

**20.** Sam, James, and Leonard participated in a fundraiser for their school.

Sam sold 23 candles. Together, Sam and James sold 51 candles. Together, James and Leonard sold 54 candles.

How many candles did Leonard sell?

# Week 7

**The stem-and-leaf plot at the right shows the lengths (in inches) of some snakes.**

| Stem | Leaf |
|---|---|
| 0 | 3 |
| 1 | 1 3 3 |
| 2 | 0 3 7 8 |
| 3 | 3 |
| 4 | 5 6 7 9 |

**Key: 1 \| 5 = 15**

1. How many data values are in the set?

2. Find the least value and the greatest value.

3. What is the median?

4. What is the range?

5. Which value occurs the most often?

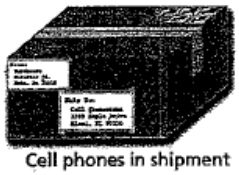
6. Is the value 31 in the set? Explain.

7. Display the data in a histogram.

| Books Read | |
|---|---|
| **Books** | **Frequency** |
| 0–3 | 6 |
| 4–7 | 7 |
| 8–11 | 6 |
| 12–15 | 5 |

**11. Identify the population and the sample.**

2 cell phones



Cell phones in shipment

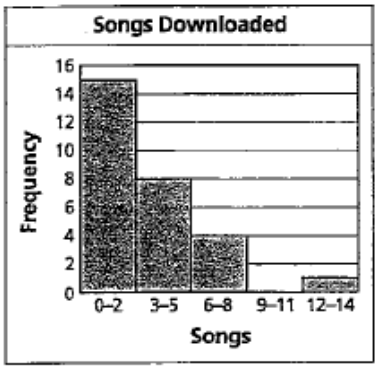
**12.** Which sample is better for making a prediction? Explain.

Predict the amount of nitrates in the river.

*Sample A:* A random sample of 5 gallons of water from one location in the river

*Sample B:* A random sample of 5 gallons of water from five different locations in the river

**In Exercises 13–15, use the histogram that shows the number of songs downloaded per week by students in a class.**

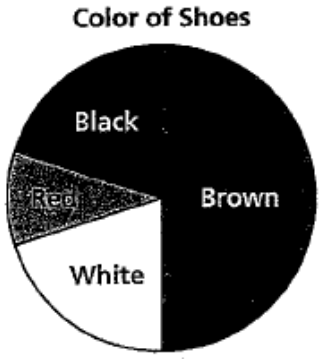



**13.** Which interval contains no data values?

**14.** How many students are in the class?

**15.** What percent of the students downloaded fewer than 6 songs? Round to the nearest tenth.

**In Exercises 16–20, use the circle graph that shows the results of a shoe store's survey on favorite color of shoes.**




**16.** Which color is the most popular?

**17.** Which two colors were chosen the same number of times?

**18.** Forty adults were surveyed. How many adults chose brown?

**19.** Find the angle measure that corresponds to the percent of shoes that are *not* brown.

**20.** Predict the number of customers out of 250 who would choose red as their favorite color.

# Week 8

**You randomly choose one of the tiles shown. Find the favorable outcomes of the event.**


1. Choosing an odd number less than 4

2. Choosing a number less than 1

3. Choosing a number divisible by 4

**You randomly choose one of the tiles shown above. Determine the theoretical probability of the event.**

4. Choosing an even number greater than 7

5. Choosing a negative number

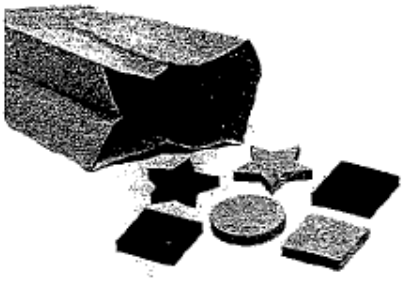
6. Choosing a number divisible by 3

**You randomly choose one shape from the bag. (a) Find the number of ways the event can occur. (b) Find the favorable outcomes of the event.**

7. Choosing a square

8. Choosing a circle

9. *Not* choosing a star



**In Exercises 10 and 11, use the following information.**

You check 20 batteries. Fourteen of the batteries do not have a charge.

**9.** What is the experimental probability that the next battery you check does not have a charge?

**11.** Out of the next 70 batteries that you check, how many would you expect to not have a charge?

**You throw two sticks 15 times and record the results. Use the table to find the experimental probability of the event.**

**12.** Tossing 2 blue

**13.** Tossing 1 blue and 1 pink

**14.** *Not* tossing all blue

| Outcome | Frequency |
|---|---|
| 2 blue | 4 |
| 2 pink | 3 |
| 1 blue, 1 pink | 8 |

**15.** You have 160 songs on your MP3 player. The probability of randomly choosing a rock song is 30%. How many of the songs on your MP3 player are *not* rock songs?

**Tell whether the events are *independent* or *dependent*. Explain.**

**16.** You flip a coin twice.

First Flip: You flip tails. Second Flip: You flip tails.

17. Two students are selected to serve on the student council.

First Choice: You are chosen. Second Choice: Your friend is chosen.

**A spinner has 4 equal sections numbered 1 to 4. You spin it twice. Find the probability of the events.**

18. Spinning a 2 and then an even number

19. Spinning an odd number and then another odd number

**A game has a deck of cards with 10 red cards, 4 blue cards, and 2 yellow cards. You randomly choose two cards. Find the probability of choosing the given cards.**

20. two red cards

21. a blue card and a yellow card

# Rising 8th Grade Science

Activities to do this summer to prepare for eighth grade:

1. Complete the Science Choice Board.
   - Choose 3 science activities from the choice board.
   - Put an X on the square to mark the activity as complete.
   - **Important Safety Note:** You must ask an adult's permission before using materials, conducting an investigation, or visiting any sites on the internet.
   - Remember:
     - You may substitute materials for other similar items that you have at home!
     - Some activities require internet access. If you do not have internet access or want to enjoy screen-free time, you can choose from the other exciting activities!
     - Have fun!

2. Read a book about science

Science Books

Look for these great books about science at your local library through e-book access, or try ReadWorks! ReadWorks offers richly illustrated eBooks and a read aloud feature to support readers at all levels. You'll finda quick tutorial video about using eBooks at https://about.readworks.org/parents_remote.html

Or, if possible, look for these great books about science at your local library!

| Titles | Author | Topic |
|---|---|---|
| Trailblazers: 33 Women In Science Who Changed The World | Rachel Swaby | Learn the untold story of 33 different women in science. |
| Extreme Scientists: Exploring Nature's Mysteries From Perilous Places | Donna M. Jackson | Learn about extreme scientists, ranging from those who explore everything from caves to trees, and all sorts of daredevils! |
| How To Build Robots | Louise Derrington | Learn how to build robots in this easy-to-use book. |
| The Basics Of Cell Life With Max Axiom, Super Scientist | Amber Keyser | Review cells through this fun graphic novel. |

Summer is a great time to explore science in the city. Consider taking a virtual trip to these exciting sites!

| Place | Website | What to do |
|---|---|---|
| Brooklyn Botanic Gardens | https://www.bbg.org/ | Visit the Brooklyn Botanic Gardens website for activities, games, recipes, and crafts your scholar can do at home. |
| Prospect Park Zoo (or any zoo!) | https://prospectparkzoo.com/ | Have your scholar take notes on animals and their structures. |

Note: Activities marked ** are included in this packet.

| | | |
|---|---|---|
| Listen to a science podcast from Brains On.<br><br>"Brains On!" features talks with food scientists and snake handlers, and much more.<br><br>Link:<br>https://www.brainson.org/ | Investigate the question: How does your skin keep you safe?**<br><br>Use the printed directions** or this Exploratorium link:<br>https://www.exploratorium.edu/snacks/skin-shield | Visit the American Museum of Natural History's Ology site to learn more about many science topics.<br><br>Link:<br>https://www.amnh.org/explore/ology |
| Investigate the question: Can you bring vegetables back to life?**<br><br>Use the printed directions** or this Exploratorium link:<br>https://www.exploratorium.edu/snacks/vegetable-revival | Investigate the question: How do plants produce water? **<br><br>After you complete the activity, use this link to learn more:<br>https://kids.kiddle.co/Stomata | Write a Message in DNA**<br><br>Suggestion: Substitute beads for colored cereal, Lego blocks, or any similar objects you have at home. You also can draw your DNA message with crayons!<br><br>Use the printed directions** or this Exploratorium link:<br>https://www.exploratorium.edu/snacks/secret-codon |
| Investigate the question: What are the odds of getting an autoimmune disorder?**<br><br>Suggestion: If you do not have a die at home, use the digital dice roller below or write the numbers 1-6 on pieces of paper.<br><br>https://www.calculator.net/dice-roller.html<br><br>Use the printed directions** or this Science Buddies link:<br>https://www.sciencebuddies.org/science-fair-projects/project-ideas/BioMed_p017/medical-biotechnology/modeling-the-chances-of-getting-an-autoimmune-disease#summary | Take a virtual field trip to Liberty Science Center for special presentations from scientists.<br><br>Presentations include:<br>• Meet the Animals<br>• Live from Surgery<br><br>Link:<br>https://lsc.org/education/lsc-in-the-house | Build a Plant Cell Model**<br><br>Use these resources to help you match the cell structures to their functions. There is a printed option and a digital option.<br><br>1- reading passage**<br>2- Use the interactive plant cell model at Cells Alive.<br>Link:<br>https://www.cellsalive.com/ |

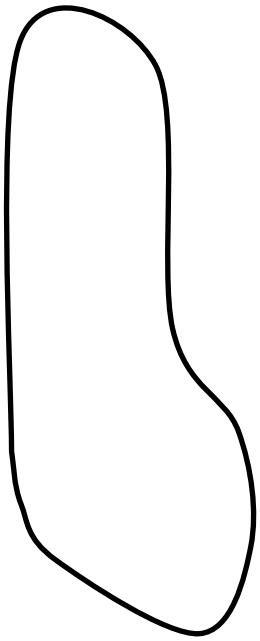
Name:_____ Date:_____

# Plant Cell

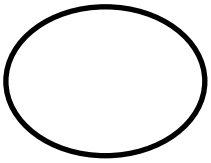
Student Directions

- Color the organelle, name tag and function tag all the same color.
  - For example: color nucleus, nucleus name tag and nucleus function tag blue; color chloroplast, chloroplast name tag and chloroplast function tag green, etc.
- Cut and paste the organelles to make a cell.
- Cut out the name and function tags. Match them up and then paste around the cell.
- Draw arrows from the tags to the organelle they describe.

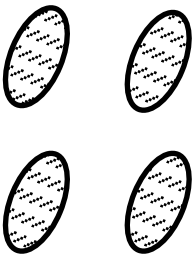
Vacuole



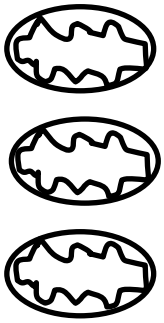
Nucleus



Chloroplast

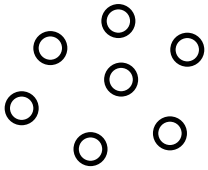


Mitochondria



Endoplasmic Reticulum

Ribosome



Golgi Body

---

controls what enters and leaves the cell

transports materials in the cell

command center, directs the cell's activities

fluid that fills the cell

receives, packages and distributes materials

protects and supports the cell

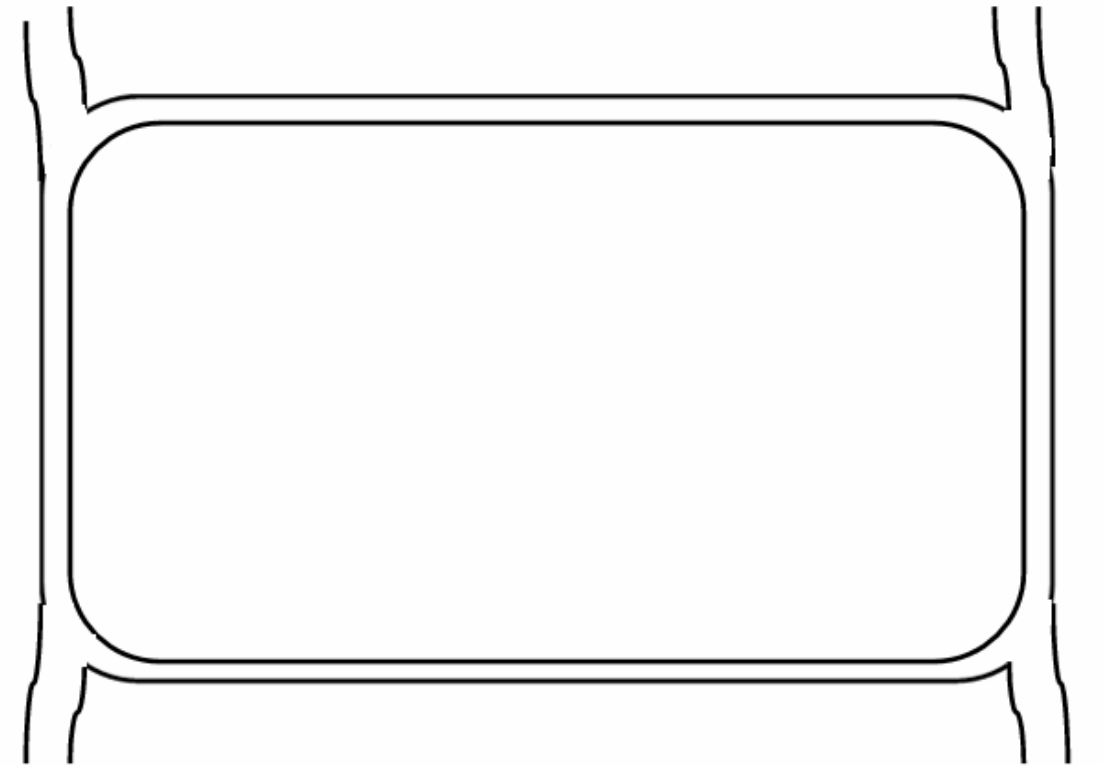
converts energy to food for the cell

builds proteins for cell functions

storage area for the cell

powerhouse of the cell, produces energy

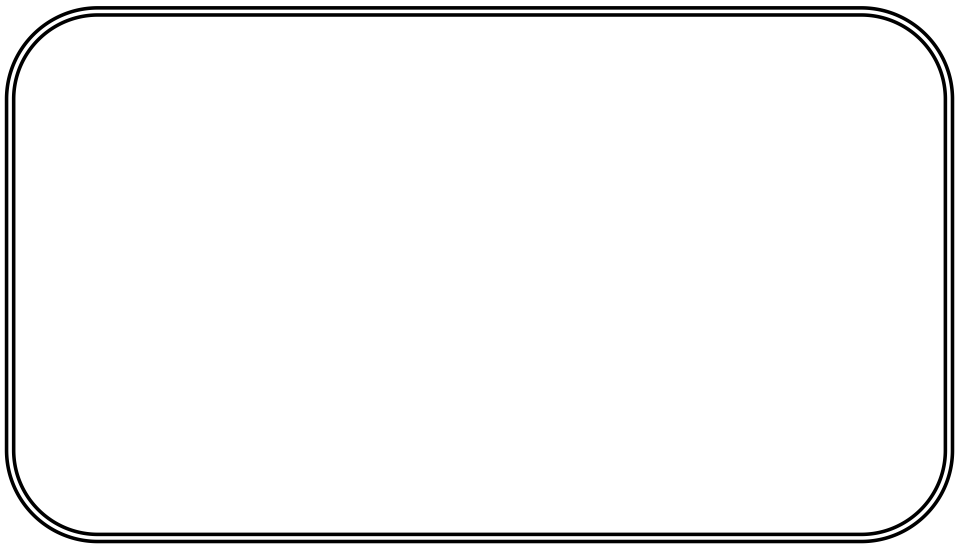
Cell Wall



---

Cell Membrane

Cytoplasm



# Plants Form Water

## Research Questions

- How do plants produce water?

The leaves of plants contain small pores called stomates. During the process of photosynthesis, plants give off water through the stomates in their leaves. This water can be collected and consumed in a survival situation.

## Materials:

- potted plant
- sandwich-size plastic bag
- string

## Experimental Procedure:

1. Gather the necessary materials.
2. Carefully cover a leaf of the plant with the small plastic bag. Secure the bag with the string being careful to not close too tightly.
3. Be sure the soil of the plant is moist. Place the plant in a partly sunny window. Wait one hour.
4. After one hour, check the plastic bag on the leaf. Record the results.
5. Continue checking the plastic bag on the leaf every hour for five hours. Record the results.
6. At the end of the 5 hours, record your conclusion.

**Terms/Concepts:**

- transpiration: the process by which plants produce water through their leaves
- photosynthesis: the process of plants using carbon dioxide and water and light absorbed by chlorophyll
- A plant uses sunlight and carbon dioxide from the air to produce food. It also produces water.

Author: Nancy Rogers Bosse

# Secret Codon

## Write a message in DNA.

DNA is referred to as the genetic code for life, because it contains information about which amino acids join together to create different proteins. You can use the one-letter abbreviations for amino acids to make a secret message that will give new meaning to the description of DNA as beads on a string.

**COVID-19 Learning Note:** All living things use the same genetic code, but some viruses, including coronaviruses, use RNA instead of DNA to store their code. RNA decoding works the same way as DNA decoding, with uracil (U) swapping in for thymine (T). The host cell translates the viral RNA into amino acids that make up viral proteins. Detection of this viral RNA is how doctors verify whether a patient has been infected with this specific coronavirus.

## Tools and Materials

- Pony beads in four different colors
- Cotton string
- Amino acid codon table

## Assembly

Assign each pony bead color to one of the four DNA bases – adenine (A), thymine (T), cytosine (C), and guanine (G). The string pictured above uses this color key:

A: red
T: yellow
C: blue
G: green

## To Do and Notice

Think of a word or short phrase that you want to encode into your DNA strand. Make sure it can be spelled or sounded out without using the letters *B*, *J*, *O*, *U*, *X*, or *Z*. These letters are not abbreviations for any of the amino acids. Determine what amino acids the letters in your phrase correspond to by looking up the one-letter amino acid abbreviations in the amino acid codon table. Then, use the table to write down the DNA sequence that encodes for those amino acids. All proteins start with a methionine amino acid residue that is encoded by the DNA sequence ATG. They end when the DNA encodes one of the three stop codons. Add ATG to the beginning of your sequence, and pick one of the three stop codons for the end of your sequence. Make your DNA strand by stringing the beads so that the colors match the order of the DNA sequence that you wrote down. Don't forget to include the proper start and stop codons in your sequence. Trade strands with a friend and see if you can decode each other's secret message!

## What's Going On?

Proteins are long chains of individual amino acid subunits. The order of the amino acids in the chain is determined by the DNA sequence of the gene that encodes for it. This is commonly referred to as the *genetic code*.

DNA is a chain of four different nucleotides (adenine, thymine, cytosine, and guanine), often abbreviated A, T, C, and G. These four nucleotides (sometimes referred to as bases) give the instructions for the 20 different amino acids that compose proteins. Each amino acid is encoded by a sequence of three DNA bases, called a *codon*. Since it takes three DNA bases to designate an amino acid, there are enough combinations of the four different bases to represent all of the amino acids, as well as three stop codons that indicate when the protein ends. Each base can be in any position, which yields $4^3$, or 64, possible combinations, so there is some redundancy between the 20 amino acids. This just means that a given amino acid can be encoded by more than one DNA codon sequence.

For simplicity, individual amino acids are often abbreviated using one or three letter abbreviations. For example, the amino acid arginine can be abbreviated Arg or R. The single-letter amino acid abbreviations provide a fun way to write secret messages using the genetic code. Since there are only 20 different amino acids, there are 6 letters of the alphabet that don't stand for a specific amino acid. With the 20 letters that do, however, you can use the genetic code to determine the DNA sequence that corresponds to your amino acid message.

The message can be written with four different colors that represent the four different bases that make up DNA. The chain in the picture at the top of the page has this sequence:

RYGGBBRGRRBGGBYRRBGRYYBYYGYRYYGRGRRYYGYGRGYRR

The sequence starts with RYG. Using the color key in the Assembly section, this corresponds to the bases ATG, which is the methionine start codon that begins every protein sequence. Can you decode the rest of the message?

## Going Further

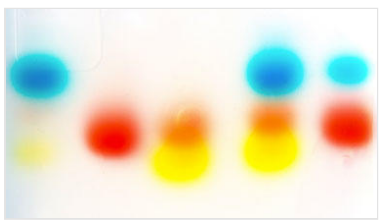
In 2008, researchers at the J. Craig Venter Institute announced that they had constructed the entire genome of a small bacterium from scratch, thus creating the first example of synthetic life. To distinguish the man-made genome from the natural one, the scientists inserted "watermarks" into the DNA sequence. These sequences were

decoded to their one-letter amino-acid abbreviations and revealed five watermarks commemorating those who had worked on the project: VENTERINSTITVTE, CRAIGVENTER, HAMSMITH, CINDIANDCLYDE, GLASSANDCLYDE.

## Related Snacks

**Breakfast Proteins**

Construct a protein through cereal additions.



**Gel Electrophoresis**

Use electricity to separate colored dyes.

READING MATERIAL

# Read About Plant & Animal Cells

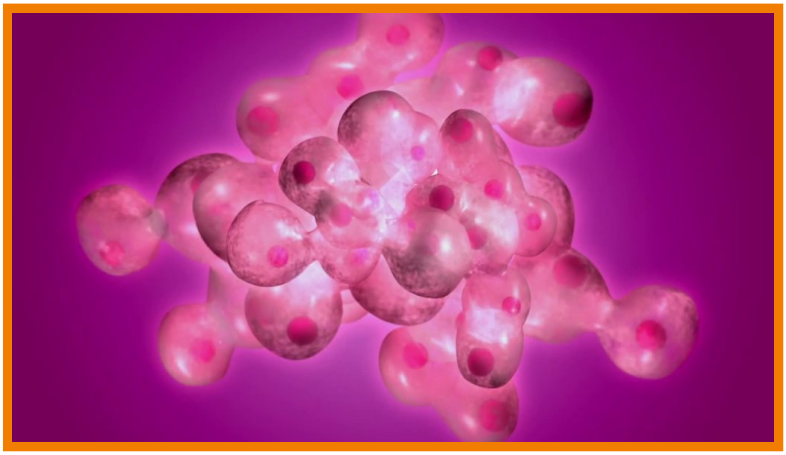
## WHAT IS A CELL?

Cells are the basic unit of all living things. All cells need energy, get rid of waste and contain genetic material to make more cells. Some living things are made of only 1 cell (unicellular) and other organisms like humans are made of many cells working together (multicellular).

***To better understand cells...***

## *LET'S BREAK IT DOWN!*

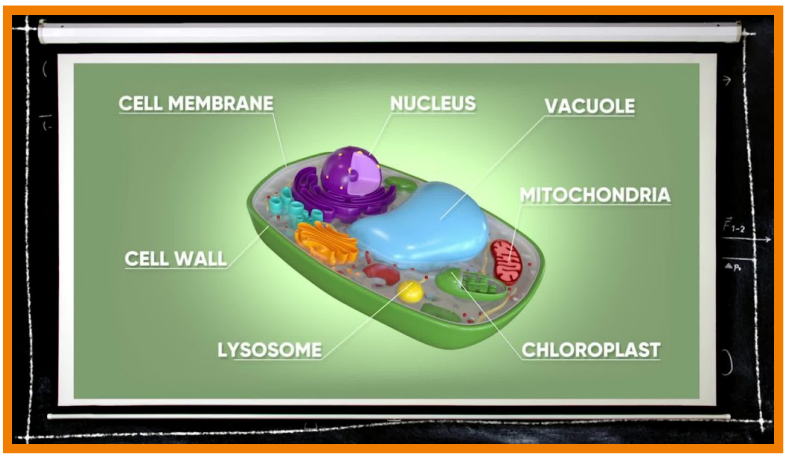
### All living things are made of cells.



Cells can be seen with a light microscope which can magnify objects up to 1,000 times. Typically a microscope slide is prepared which creates a thin layer of cells and holds them in place. Dye is used to stain the cells, making them easier to see. Cells can range in size. For example, an amoeba is about 1 mm in length and the biggest ones can be seen without a microscope. A red blood cell is 100x smaller at 0.01 mm and a bacteria is 1000x smaller than an amoeba at about 0.001 mm.

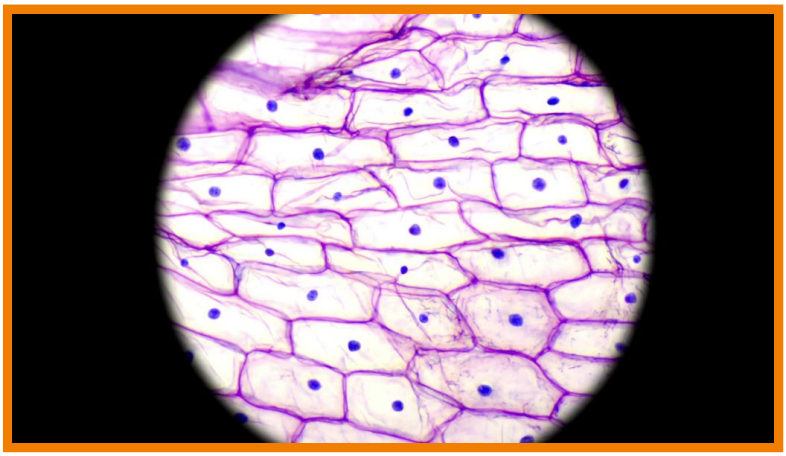
## Plant & Animal Cells Have Organelles.

Organelles are parts of a cell that help the cell to function and stay organized. The mitochondria, for example, is where sugars are used to produce energy. The vacuole is a membrane bound organelle that stores fluids. The cell membrane controls what comes in and out of a cell. Plant and animal cells need organelles in order to carry out their everyday functions.

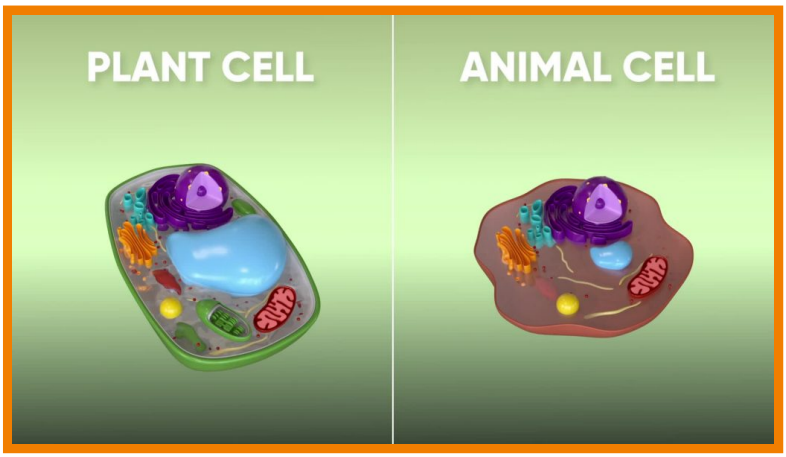



## Cells are specialized, depending on their function.

Not all cells are the same. In the human body, for example, there are many kinds of cells. A nerve cell has long arm like features to help the cell communicate with other nerve cells. A muscle cell is more tubular in shape and it can get longer and shorter when muscles contract. These kinds of differences between the cells of an organism is called cell differentiation. Cells are structured in ways that help them achieve their function.



## Plant and animal cells have similarities and differences.




Although plant and animal cells have many of the same organelles, there are some notable differences. Plant and animal cells both have a cell membrane, but in addition to a cell membrane, a plant cell also has a cell wall. The cell wall gives the plant cell structure. Plant cells also contain chloroplasts, green organelles that do photosynthesis. Animal cells do not have chloroplast because they do not do photosynthesis.

## Studying cells can help us cure diseases.

There are several specialized types of scientists that study cells. Pathologists look at human cells under microscopes to diagnose diseases. For example, red blood cells normally have a disc like shape. In a disease called sickle cell anemia, cells are shaped like the letter "c" and this can be seen under a microscope to diagnose the disease so the patient can get treatment. Many other types of scientists also study cells such as molecular biologists, biochemists and more.

## *PLANT & ANIMAL CELLS VOCABULARY*

| | |
|---|---|
| **Cell** | The basic unit of all living things. |
| **Organelle** | Parts of a cell that help it function. |
| **Nucleus** | The organelle that contains DNA, the genetic material of the cell. |

| | |
|---|---|
| **Cytoplasm** | The jelly-like liquid inside the cell where the organelles are found. |
| **Cell Membrane** | The thin, flexible barrier surrounding the cell. |
| **Cell Wall** | Found outside the cell membrane, this organelle gives the plant structure. Animal cells do not have cell walls. |

## *PLANT & ANIMAL CELLS DISCUSSION QUESTIONS*

### What is the difference between a unicellular organism and a multicellular organism?

Single celled organisms are made up of only one cell. An amoeba is an example of a unicellular organism. Multicellular organisms are made up of more than one cell. People, dogs and plants are all examples of multicellular organisms.

### Why is the mitochondria of a cell important?

The mitochondria is where sugar is converted into energy. The cell needs energy in order to carry out its everyday functions.

### What function does a cell wall serve for a plant?

The cell wall gives a plant cell support and structure allowing the plant to stand upright. This is important so that the plant can get sunlight in order to do photosynthesis.

### Describe what you might see if you were to look at cells through a microscope.

Depending on the power of the microscope, you would be able to see the cell membranes (or cell walls if looking at plants). You would also most likely be able to see the nucleus of each cell. Other organelles might be too small or not colored.

### Why does a piece of onion skin not contain any chloroplasts?

Onions are from the root of a plant, which is typically under the ground. Chloroplasts are found mostly in the leaves of plants. The leaves are where the process of photosynthesis takes place.

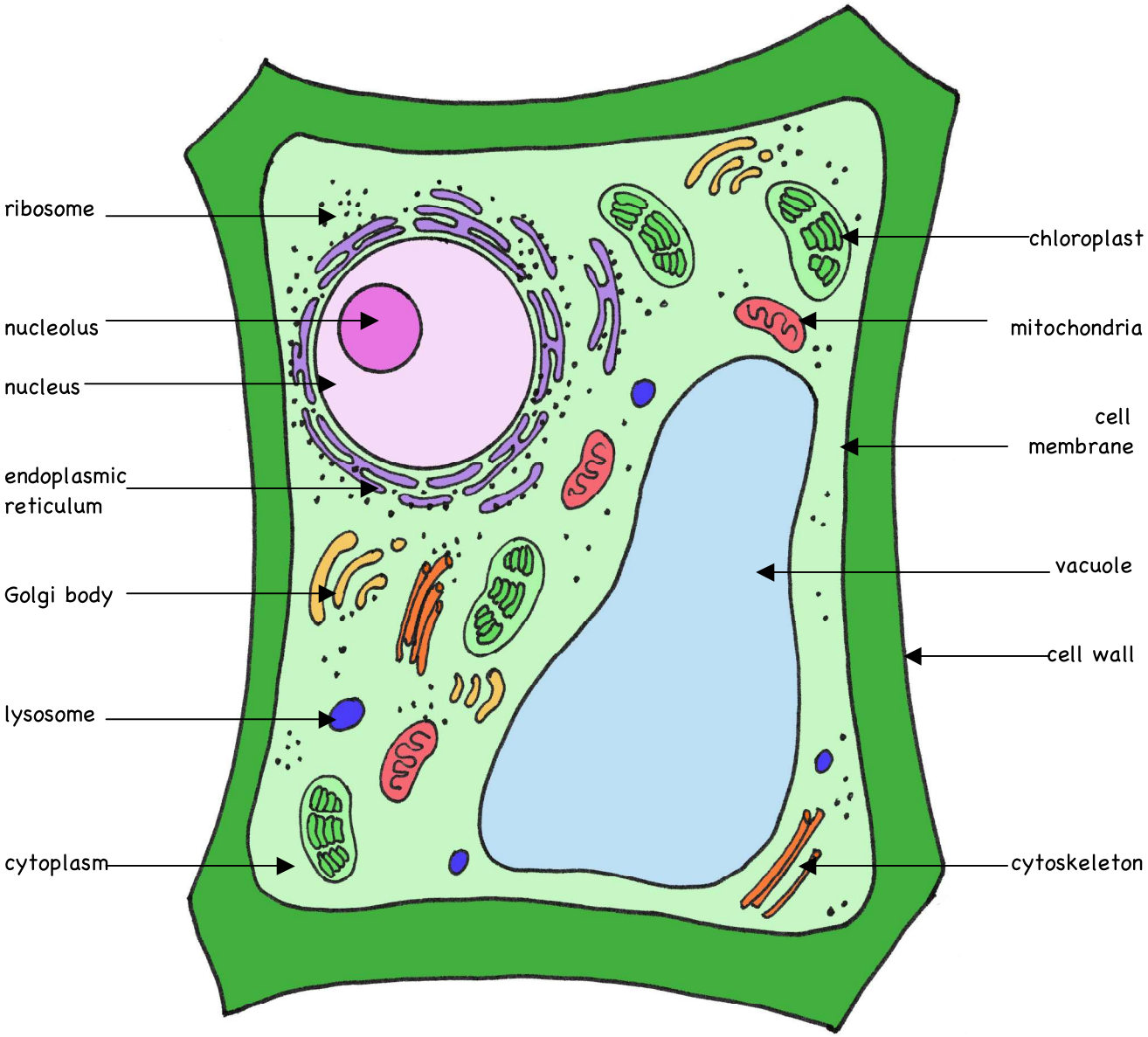
## What would happen if one of the organelles stopped working?

All the organelles in a cell work together to keep the cell alive. If there was no nucleus the cell wouldn't be able to grow or reproduce. If there was no mitochondria, it would have no energy and if there was no cell membrane there wouldn't be any cell at all.

---

**The Plant Cell to Color** **Name: KEY**

***Color the plant cell drawn below. Use the colors indicated in the box.***




***Parts of a plant cell:***

**cell wall** – provides rigid structure and protection; made of cellulose (dark green)
**cell membrane** – surrounds the internal cell parts; controls passage of materials in and out of the cell
**cytoplasm** – everything inside of the cell membrane except for the nucleus (light green)
**nucleus** – control center of the cell; contains DNA (light pink)
**nucleolus** – composed of protein and RNA; involved in ribosome production (dark pink)
**cytoskeleton** – provides strength and shape to the cell; network of protein fibers (orange)
**endoplasmic reticulum** (ER) – passageways that transport proteins within the cell (purple)
**mitochondria** – produces energy (rust or red)
**chloroplast** – uses the energy of sunlight to produce glucose during photosynthesis (medium green)
**vacuole** – vesicle that provides storage of water and other materials; full vacuoles provide support (blue)
**lysosome** – vesicle that contains substances that break down materials (navy)
**Golgi body** – packages and transports proteins from the ER to other parts of the cell (gold)
**ribosomes** (the dots) – where proteins are made in the cell

# Skin Shield

## Explore the body's first line of defense against pathogens.

How does your skin keep you safe? In this Snack, a tomato lets you see what happens when you breach this line of defense.

**COVID-19 Learning Note:** Your skin and mucous membranes are the first line of defense against viruses, including the one that causes COVID-19. To become infected, the coronavirus has to come into contact with your respiratory cells, which is why it's important to wash your hands, which could be harboring viruses, before touching your face.

## Tools and Materials

- Two similar-sized tomatoes (nectarines, plums, or similar soft fruits will also work)
- A plate or tray (juices may run!)
- Toothpick
- Hand lens
- Optional: Digital scale (not shown) and ruler

## Assembly

1. Put the tomatoes on the plate or tray.
2. Poke six holes in one of the tomatoes with a toothpick. Leave the other tomato alone.
3. Put the tomatoes in a safe place at room temperature where they won't be disturbed.

## To Do and Notice

*Note: Be sure to wash your hands after handling the tomatoes, and do not try tasting them!*

Watch the tomatoes every day for at least a week. Record your observations. How do the poked and unpoked tomatoes differ? How does color, smell, texture, and shape change?

Take measurements with a ruler and weigh the tomatoes with your digital scale (if you have one).

Use a hand lens to look carefully at the surfaces of both tomatoes. What do you see? What organisms can you find living on each? How do the size and color of the "infections" in the poked tomato change over time?

You'll probably see significant differences between the injured and uninjured tomato. Notice that the injured tomato has likely shrunk and lost mass, and the sites of injury have probably become colonized with a variety of fungi and other microorganisms.

When you've concluded your experiment, compost the tomatoes or throw them away.

## What's Going On?

This experiment shows the important role of the skin as an organism's first line of defense against pathogens. Like an "injured" tomato, a cut in your skin can become infected by pathogens, too. Bacteria—and sometimes fungi—can enter through the cut and take up residence in your tissues, causing an infection. Your intact skin is the primary structure protecting you from these kinds of infections.

The outer layer of your skin, or epidermis, forms a physical and chemical barrier that most pathogens can't penetrate. (The mucous membranes lining your airways and gut have a similar role to play inside your body.) The cells of the skin are joined tightly together, and they're full of a protein that makes them tough and resistant to bacteria. Your skin is also salty and slightly acidic, making it a less hospitable environment for microorganisms.

The skin of the fruit plays an identical role for the plant. Plant skin, or cuticle, contains wax and other molecules that help it retain water and prevent invasion by pathogens. When you injured the fruit by poking holes in it, microbes in the environment jumped at the opportunity to invade and colonize within the exposed tissue. You may have observed molds, bacteria, and various protists and nematodes growing in your injured fruit.

Even after injury and infection, plants still have ways to protect themselves. Plant cells produce a variety of antimicrobial enzymes and other molecules that can help inhibit the reproduction of microscopic pathogens, although they don't target specific pathogens. The human body also has non-pathogen-specific defenses that respond to cell damage caused by infection. These systems are all part of the innate immune system. All plants and animals have versions of these systems.

## Going Further

Try this experiment using different types of fruits and see whether the course of their infections differ.

Design an experiment to answer a question: Does the size of the wound matter? If you treat the wound with a bandage or antiseptic—as you would with a cut on your finger—does this change the course of the infection? How do you think these treatments work?

Measuring and weighing the fruits over the course of the experiment can give you more information about the effects of injury on plants. If your fruit changes size and mass in response to injury, what do you think is going on?

# Vegetable Revival

## Bring food scraps back to life.

Under the right conditions, the vegetables in your fridge can start growing again, thanks to the presence of special cells called *meristematic cells*. Experiment with various plants to find out where these cells are located and what it takes to make them grow.

## Tools and Materials

- One or more of the following: Head of lettuce, bok choy, or celery (not just the individual leaves or stalks); scallions (aka green onions); root vegetables such as carrots, beets, turnips, or radishes, with their tops attached; leafy stems of basil or mint; whole potatoes
- Sharp knife
- Cutting board
- Toothpicks
- Glasses or transparent plastic cups (so you can see through)
- Shallow bowls
- Magnifier (or zoom function on a cell phone camera)
- Sunny spot
- Optional: digital scale

## Assembly

Each type of vegetable will be treated slightly differently, but in all cases the goal will be the same: Separate the different parts of the plant, provide each part with water and light, and see what grows.

*Lettuce or bok choy*: Cut the leaves off the bottom of the head, leaving a few centimeters where each is attached (click photo to enlarge). Place a few of the leaves in water. Place the remaining piece of the head of lettuce or bok choy in a shallow dish of water, bottom-side down.

*Celery*: Cut off the stalks about 1 1/4 inches (3 cm) from the bottom of the head. Place a celery stalk in a glass of water. Place the bottom of the head into a shallow bowl of water.

*Scallions*: Cut the green part from the white part. Place each piece in a glass of water, roots down for the white part; cut-edge-down for the green part.

*Root vegetables (carrots, beets, turnips, radishes)*: Cut the top (where the leaves are attached) from the vegetable itself. If there are still leaves attached, cut them off, leaving about 1/4 inch (1/2 cm) of each leaf's stem. Place the top in a shallow bowl of water. Stick three toothpicks through the sides of the root, and balance it in a glass of water, root-tip down. Place a leaf (if you have one) in a glass of water.

(Click photos to enlarge.)

*Leafy stems (basil, mint)*: Recut the bottoms of the stems. Remove the lower leaves (so no leaves will be submerged), and place the stems in a glass of water. Put a few stemless leaves in a small glass of water, stem-attachment-side down.

*Potatoes*: Cut the potato into a few pieces, making sure that some have eyes (those little warty spots) and some don't. Put the pieces in a dry bowl. Because potatoes already contain a lot of water, you don't need to add any extra.

Put your vegetables in a sunny, airy place. Add water if it becomes low, and change the water if it becomes cloudy or colored.

## To Do and Notice

Keep your vegetables in the sun for at least a week, and check them daily to look for changes.

What new growth do you notice? What structures do you see growing? Are there new leaves, stems, or roots?

Use your magnifier or the zoom function on a cell phone camera to look for small changes. Where do you see growth? Which parts don't seem to grow?

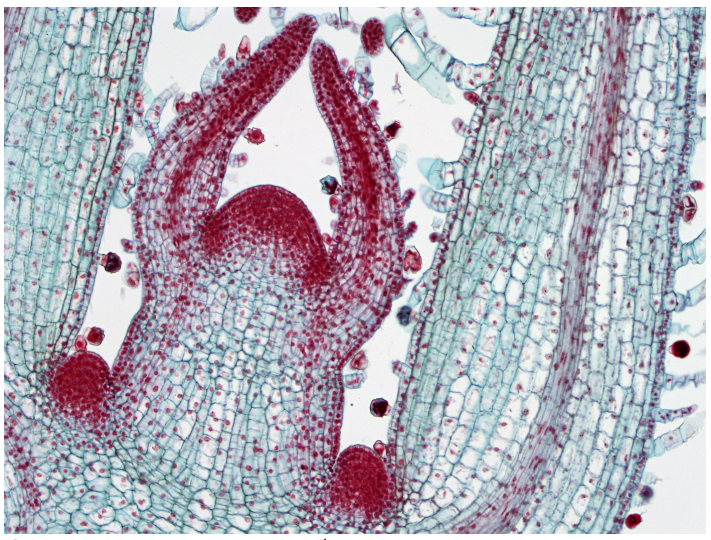
Keep watching your vegetable scraps over a few weeks. Do any stop growing? What changes do you notice? If you have a digital scale, you can weigh your plants over time to track their growth.

## What's Going On?

Unlike people, plants have a special ability to grow continuously throughout their lives. Most will continue making new roots, stems, and leaves until they die.

The continuous growth of plants takes place thanks to *meristems*, perpetually embryonic plant tissues made up of specialized cells called *meristematic cells*. Often compared to the stem cells found in animals, meristematic cells can continuously replicate themselves and are *undifferentiated*, meaning that they have the potential to turn into all different types of plant tissues.

There are several different types of meristems: Some make stems and leaves, some make new roots, some help the plant's stems grow outward, and some do all three. Meristems aren't distributed equally around a plant; instead, they're located in small, distinct compartments, often at the tips of shoots and roots.



*Small, densely packed cells (stained red in this microscopic image) are new shoots emerging from the meristems of a coleus, a popular houseplant.*
*Src: BlueRidgeKitties on Flickr*

The location of any given meristem determines the type of tissue it can become. For example, you probably noticed new roots sprouting from the meristems found in the bottoms of your root vegetables, as well as the bottoms of lettuce, bok choy, and celery heads, and the stems of mint or basil. Meristems capable of making leaves are the source of any leafy growth you noticed in the tops of your root vegetables, or at the tops of your severed celery and lettuce heads.

Some vegetable parts probably didn't show any new growth. Lettuce and herb leaves separated from their heads or stems don't contain any meristems capable of sprouting new stems or roots.

At some point, despite the presence of meristematic cells, your vegetables will probably stop growing. While you may have supplied them with sunlight, water, and air, the main things that plants need for growth, they will eventually run out of other essential nutrients, such as nitrogen, phosphorous, and potassium. As anyone who grows vegetables *hydroponically* (that is, in water without soil) can tell you, these essential nutrients must be added to the water for robust growth.

To keep the growing going, take the vegetables that have sprouted roots (such as herbs, celery, or potatoes) and plant them in soil outside for eventual harvest.

## Going Further

Try designing experiments to investigate which factors are important for different vegetables to regrow. Can your veggies grow without light? Cover a plant with foil or place in a dark cabinet to see. Can they grow in the cold? Put them in the fridge and see what happens. Can they grow without water? What happens if you supply some extra nutrients by adding a little liquid fertilizer to the water?

Experiment with other vegetables: The ones we've suggested will usually grow reliably, but put anything you want in a dish of water and see if it will grow. What mighty meristems can you discover in your fridge?

## Resources

Check out this episode of Hungry for Science to see how to regrow green onions and potatoes.

## Related Snacks

**See Inside a Seed**

Examine the baby plants inside the seeds we eat.

**Seed Germinator**

Watch the life of a plant embryo unfold.

**Photosynthetic Floatation**

Show that gas is produced during photosynthesis.

# What are the Odds? Modeling the Chances of Getting an Autoimmune Disease

| | |
|---|---|
| Areas of Science | Medical Biotechnology (http://www.sciencebuddies.org/science-fair-projects/project-ideas/medical-biotechnology)<br>Diabetes (http://www.sciencebuddies.org/science-fair-projects/project-ideas/diabetes) |
| Difficulty | |
| Time Required | Very Short (≤ 1 day) |
| Prerequisites | None |
| Material Availability | Readily available |
| Cost | Very Low (under $20) |
| Safety | No issues |

## Abstract

Do you know someone who has an *autoimmune disease*? Autoimmune diseases are fairly common, affecting more than *23.5 million people* in the United States, which is about 1 in 13 people! You may have heard of some of them, such as diabetes (type 1), rheumatoid arthritis, and celiac disease. Many autoimmune diseases are poorly understood, but they all have one thing in common: they happen because a person's *immune system* (which normally fights off germs to keep the person healthy) attacks the person's own body by accident. In this science project, you will use M&M's® candies and a die to make a model of the immune system in the human body and find out how a person's *genetics* affect whether they get an autoimmune disease or not.

## Objective

Use a model to investigate how a person's genetics affect their chances of getting an autoimmune disease.

## Credits

Teisha Rowland, PhD, Science Buddies

- M&M's is a registered trademark of Mars, Incorporated.
- Pop Rocks is a registered trademark of Zeta Espacial S.A.

## Cite This Page

General citation information is provided here. Be sure to check the formatting, including capitalization, for the method you are using and update your citation, as needed.

### MLA Style

Science Buddies Staff. "What are the Odds? Modeling the Chances of Getting an Autoimmune Disease." *Science Buddies*, 20 Nov. 2020, https://www.sciencebuddies.org/science-fair-projects/project-ideas/BioMed_p017/medical-biotechnology/modeling-the-chances-of-getting-an-autoimmune-disease. Accessed 13 May 2021.

### APA Style

Science Buddies Staff. (2020, November 20). *What are the Odds? Modeling the Chances of Getting an Autoimmune Disease.* Retrieved from https://www.sciencebuddies.org/science-fair-projects/project-ideas/BioMed_p017/medical-biotechnology/modeling-the-chances-of-getting-an-autoimmune-disease

Last edit date: 2020-11-20

## Introduction

Autoimmune diseases are fairly common, currently affecting more than 23.5 million people in the United States alone. Some autoimmune diseases include lupus, Graves' disease, Hashimoto's disease, rheumatoid arthritis, type 1 diabetes, and celiac disease. It is thought that there are at least 80 different autoimmune diseases, with new ones being added to the list regularly.

What exactly is an autoimmune disease? To understand that, it is important to first understand what the immune system is. The **immune system** is made up of different cells and organs in your body, and it normally defends you against germs (like harmful microorganisms). It does this so that you do not get sick, or so that you get well quickly if you do get sick. You are constantly being exposed to **microorganisms**, which are *microscopic* organisms. This means they are so small that you usually need a microscope to see one of them. Some microorganisms are more dangerous than others. Any microorganism that can make you sick is called a **pathogen**. Pathogens include harmful bacteria, microscopic fungi, and viruses. If a pathogen gets into a person's body and makes them sick, then the person is said to be *infected* by that pathogen, or have an **infection**. Your immune system is constantly working to defend you against all of these pathogens so that you do not get an infection and get sick.

How does your immune system protect you from pathogens and keep you healthy? The immune system goes through a series of steps called the **immune response** to fight off any pathogen. Basically, the immune system must recognize the pathogen and then attack and destroy the pathogen. You can watch this video from KidsHealth to see the immune response in action.

This video gives a detailed introduction to the immune response.
https://www.youtube.com/watch?v=24IYt5Z3eC4 (https://www.youtube.com/watch?v=24IYt5Z3eC4)

Most of the immune response work is carried out by **white blood cells**, also called *leukocytes* (pronounced loo-ko-sites). There are several different types of white bloods cells, each with a specific job; you can think of them as soldiers, each with a special skill, that collectively work to defend your body against an invading pathogen. The job of some white blood cells is to find pathogens (or other tiny objects that do not belong in the body). When they are looking for pathogens, it is very important that these white blood cells can tell the difference between the body's own healthy cells and the pathogens. This is referred to as **self/non-self recognition**. (We will get to why this is so important in a minute.) Once they find a pathogen, these white blood cells then let other cells know that there is a pathogen in the body. When they see the pathogen, **B cells**—which are a type of white blood cell—make antibodies to fight it. An **antibody** is a tiny particle that is much smaller than even a cell or most pathogens and it both tags a pathogen as "non-self" and helps to destroy the pathogen. A diagram of antibodies binding onto a pathogen is shown in Figure 1, below. Usually, many antibodies will bind to a single pathogen. Once bound to the pathogen, the antibody often gets help from white blood cells to come and destroy the pathogen.

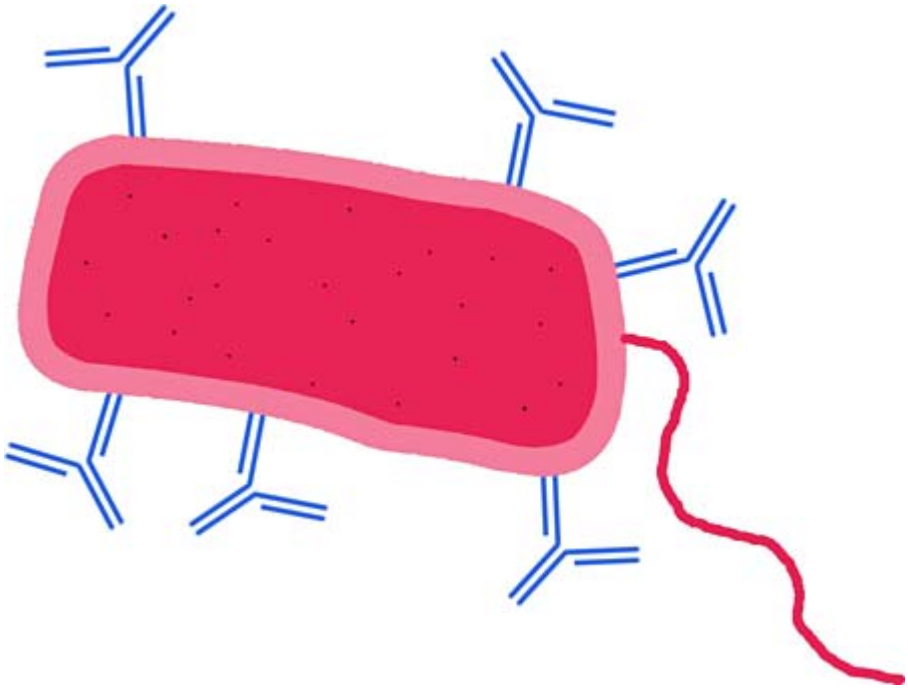


**Figure 1.** During the immune response, antibodies (shown in blue) bind to a pathogen (a bacterium here, shown in red). Once bound to the pathogen, the antibodies often then get help from white blood cells to destroy the pathogen. *Note:* These are simplified drawings that are not to scale.

So what do autoimmune diseases have to do with the immune system? As mentioned earlier, self/non-self recognition is very important. This is so that the immune system does not accidentally make an antibody that binds to its own healthy human cells. When this happens, it is called **autoimmunity** or an **autoimmune response**. Autoimmunity is common and usually not serious. It can also seem somewhat **random**, probably because the causes are usually not well understood. However, if an autoimmune response is not stopped by the body, it can turn into an autoimmune disease. In an **autoimmune disease**, the immune system attacks healthy cells in the body (instead of attacking a pathogen). How this happens is different for different autoimmune diseases. For example, in *celiac disease*, the immune system attacks the intestines after a series of events that starts when antibodies accidentally bind to a part of food that the person is eating (specifically gluten, a protein found in wheat).

As another example, in *type 1 diabetes*, an autoimmune response destroys the cells that make *insulin* in a person's body (which can cause the person to have too much sugar in their blood). Before the effects of type 1 diabetes are visible, autoimmune antibodies (antibodies that bind a person's own healthy cells) can be detected. Even if a person has autoimmune antibodies, they are not guaranteed to get type 1 diabetes; however, they do have an increased chance of developing diabetes over their lifetime. The more types of autoimmune antibodies that they have, the greater their risk.

Several factors affect whether a person gets an autoimmune disease. A person's **genetics**—which are the traits they got from their parents—is one factor. In other words, a person's genetics can make them **genetically predisposed**, or more likely, to get an autoimmune disease than someone with different genetics. A person with genetics that makes them more likely to get an autoimmune disease is said to have an **increased risk** or **higher risk** of getting an autoimmune disease. In other words, they are more likely to get, or have a higher **probability** of getting, an autoimmune disease than the average person. Another factor that can affect whether a person gets an autoimmune disease is their **environment**, which includes where they live, what they eat, and things they are exposed to.

Even though autoimmune diseases are common, the immune system actually has several checkpoints to stop an autoimmune response so that it does not turn into an autoimmune disease. Three main checkpoints are listed below. Note that these are simplified versions of what the immune system actually does.

1. *Checkpoint 1:* Sometimes white blood cells (specifically B cells, which are made in the bone marrow, or **T cells**, which are made in the thymus) are made that have autoimmunity, meaning their antibodies bind human cells. The body must destroy them before they escape from the bone marrow or thymus, or they can cause an autoimmune disease.

2. *Checkpoint 2:* Right before an immune response is triggered to fight an infection, certain white blood cells (called *regulatory T cells*) make sure that other white blood cells are not accidentally attacking the body's own cells. They have to do their job correctly to prevent an autoimmune disease from happening.
3. *Checkpoint 3:* After a pathogen is destroyed in the body, white blood cells (specifically, activated T cells and B cells) must destroy themselves (through a process called *apoptosis*, pronounced a-pop-toh-sis) to stop the immune response, or it could lead to an autoimmune disease.

Autoimmune diseases are often treated by suppressing, or stopping, the immune system, but this can have a lot of undesirable side effects. By better understanding the immune response, scientists and doctors can make better treatments for autoimmune diseases.

In this science project, you will use M&M's candies and a six-sided die to make a model of the immune system (using the three checkpoints listed above) to find out how a person's genetics and other environmental factors affect whether they get an autoimmune disease or not. A **model** is something that engineers and scientists build to represent an object or process in nature, which makes it easier to study. It is usually a simplified version of that object or process. For example, sometimes engineers build small model bridges that are easy to hold and examine so they can study it before they build the real bridge. In your model, you will compare people who have a higher risk of getting an autoimmune disease to people who do not have this higher risk. To model the occurrence of an autoimmune response, you will pick M&M's candies from a bowl and look for matches between their colors. Whether or not an autoimmune response develops into an autoimmune disease is affected by somebody's genetic predispositions, making some people's bodies less likely to stop an autoimmune response. In your model, you will roll a die (representing a random event) to check if an autoimmune response turns into an autoimmune disease. Will you find that if someone is at a higher risk of getting an autoimmune disease, they will definitely get an autoimmune disease? If someone is less likely to get an autoimmune disease, based on their genetics, could they still get an autoimmune disease? Break open a package of M&M's candies and grab a die to find out!

## Terms and Concepts

- Immune system
- Microorganism
- Pathogen
- Infection
- Immune response
- White blood cell or leukocyte
- Self/non-self recognition
- B cells
- Antibody
- Autoimmunity or autoimmune response
- Random
- Autoimmune disease
- Genetics
- Genetically predisposed
- Increased risk or higher risk
- Probability
- Environment
- T cells
- Model

## Questions

- In the immune response, what do antibodies do?
- What happens in the body that can lead to an autoimmune disease?
- What factors can affect whether someone gets an autoimmune disease?
- What are three big checkpoints that the immune system has in order to prevent an autoimmune disease?

## Bibliography


- American Autoimmune. (n.d.). *Autoimmune Disease List* (https://www.aarda.org/diseaselist/). Retrieved March 21, 2018.
- KidsHealth. (n.d.). *Your Immune System* (http://kidshealth.org/kid/cancer_center/HTBW/immune.html). Retrieved May 7, 2013.
- American Autoimmune. (n.d.). *Autoimmune Statistics* (https://www.aarda.org/news-information/statistics/). Retrieved March 21, 2018.
- KidsHealth. (n.d.). *Movie: The Immune System* (http://kidshealth.org/kid/htbw/ISmovie.html). Retrieved May 7, 2013.


For help creating graphs, try this website:


- National Center for Education Statistics, (n.d.). *Create a Graph* (https://nces.ed.gov/nceskids/createagraph/). Retrieved June 25, 2020.


## Materials and Equipment

- M&M's (at least one of each color). One small, 1.69 oz. package of regular M&M's should be sufficient. Alternatively, other small objects that come in six different colors or shapes could be used, such as plastic pattern blocks, which are available from Amazon.com (https://www.amazon.com/gp/product/B00004WKPP/ref=as_li_ss_tl?ie=UTF8&tag=sciencebuddie-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=B00004WKPP).
- Bowl or cup
- Six-sided die
- Lab notebook


**Figure 2.** You will need some M&M's candies, a bowl (or cup), a six-sided die, and your lab notebook to do this science project.

## Experimental Procedure

### Testing the Immune Response Model

In this part of the science project, you will test a model of the immune response—including three checkpoints that are meant to prevent autoimmune diseases—to see how often different people might get an autoimmune disease. You will test the model with people who have different genetic predispositions to getting an autoimmune disease. Since you are using a model, you will not actually test real people, but instead will use M&M's candies selection to represent the random processes of an autoimmune response happening in people. You will roll a die to represent checking each checkpoint's effectiveness at preventing an autoimmune response from turning into an autoimmune disease. You will model different genetic predispositions in people and study how this affects their chances of getting an autoimmune disease.

1. In your lab notebook, create four data tables like Table 1.
    a. Each data table will represent a group of 20 people with a different genetic predisposition that gives them a different increased risk of getting an autoimmune disease.
    b. In each data table, make enough columns so that you can list the 20 people.

c. Label each data table one of the following: "Higher Risk at One Checkpoint Group," "Higher Risk at Two Checkpoints Group," "Higher Risk at All Three Checkpoints Group," and "Normal Chances of Autoimmunity Group."

| Step in the Model | | Person 1 | Person 2 | Person 3 | Etc. | Person 20 |
|---|---|---|---|---|---|---|
| **Setup** | **What color was picked?** | | | | | |
| Checkpoint 1 | Color match? (Yes/No) | | | | | |
| | If yes, what was the die number? (1 to 6) | | | | | |
| Checkpoint 2 | Color match? (Yes/No) | | | | | |
| | If yes, what was the die number? (1 to 6) | | | | | |
| Checkpoint 3 | Color match? (Yes/No) | | | | | |
| | If yes, what was the die number? (1 to 6) | | | | | |
| Did the person get an autoimmune disease? (Yes/No) | | | | | | |

**Table 1.** In your lab notebook, make four data tables like this. Each data table will represent a group of 20 people with a different genetic predisposition to autoimmune diseases.

2. For the "Higher Risk at One Checkpoint Group" and "Higher Risk at Two Checkpoints Group" data tables, pick any of the three checkpoints to represent people at higher risk.
    a. For the "Higher Risk at One Checkpoint Group" data table, pick any one of the three checkpoints.
        i. Circle or highlight that checkpoint on the data table, or make a note of it in your lab notebook.
    b. For the "Higher Risk at Two Checkpoints Group" data table, pick any two of the three checkpoints.
        i. Again, circle or highlight the checkpoints on the data table, or make a note of them.
3. Open the package of M&M's. In a bowl, place three M&M's candies of each color (red, green, yellow, brown, blue, and orange).
    a. If your package does not have at least three of each color, you could use fewer M&M's candies, as long as there is an equal number of each of the six colors.
4. Have the data table you titled "Normal Chances of Autoimmunity Group" ready. You will fill this one out in the next step.

5. Follow the directions in Figure 3—the "Autoimmunity Model" flowchart—. Use the explanations in steps a–f of this step to help guide you through the process, particularly step 5.d. for when you have a color match and then need to roll a die.
    a. Whenever you randomly pick a candy, look away from the bowl and mix the candies a little so you do not know which color you will pick. No peeking!
    b. In the "Setup" row, write the color of the candy you picked in your data table.
    c. Be sure to write your results in the data table as you do your testing.
        i. If you do not have to roll a die when testing the checkpoints, skip the "If yes, what was the die number?" row for that person.
    d. If you pick matching colors and roll a die when testing the checkpoints, testing should end for the person only if a 6 is rolled on the die. This means the person got an autoimmune disease.
    e. Be sure to read the blue "What it represents" boxes so you know what you are modeling.
    f. At the beginning of the "Setup" and each checkpoint, make sure that all candy has been returned to the bowl and there is still an equal number of each color.

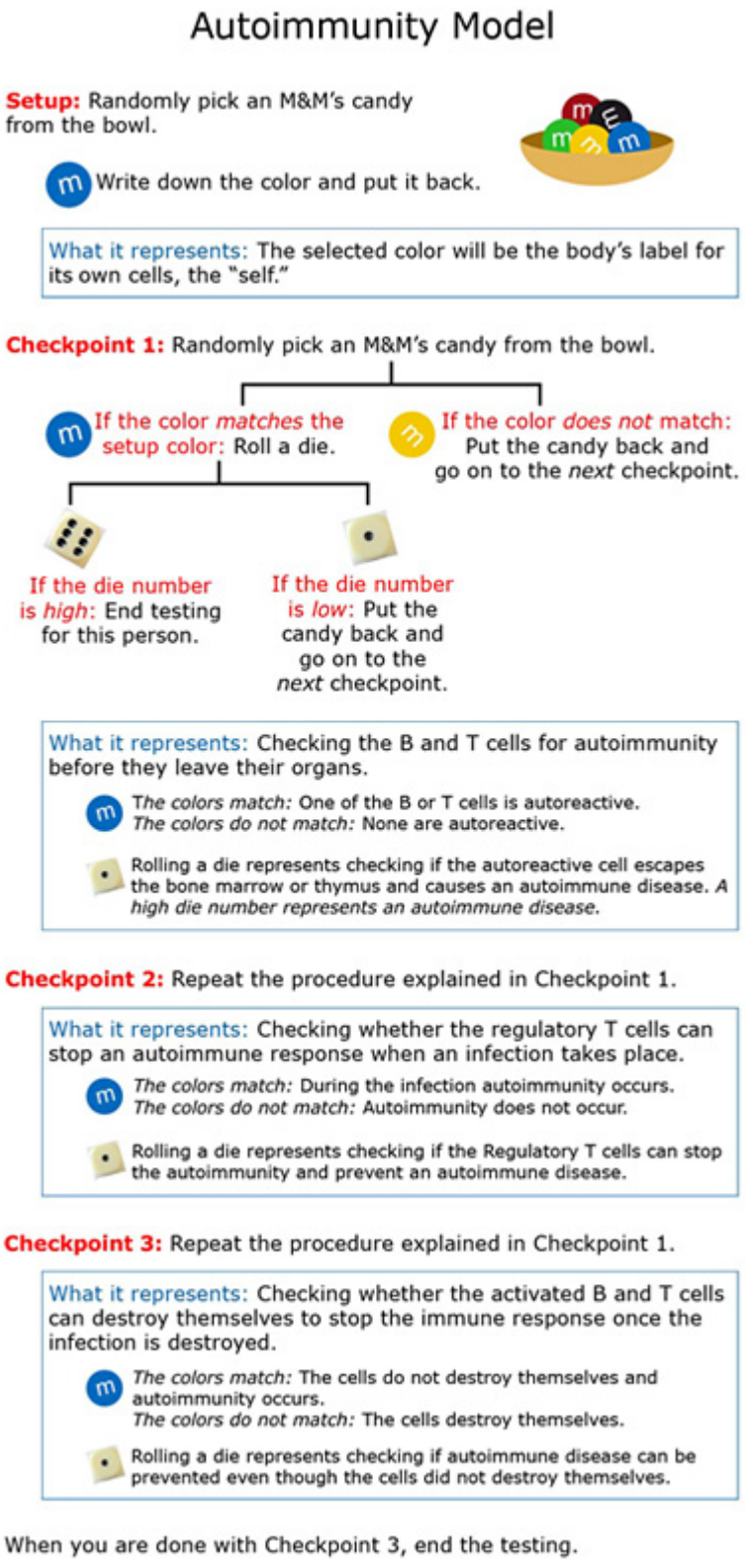



**Figure 3.** This is a flowchart of the model you will use in this science project. The blue boxes explain what each part of the model represents. As you follow the steps in the model and fill out each data table, keep in mind the blue "What it represents" boxes.

6. Go through the model for each of the 20 people listed in your data table.
    a. For each person, make sure to fill out the bottom row, "Did the person get an autoimmune disease?"
7. Once you have done steps 5 and 6 for the first data table, repeat steps 5 and 6 for your other three data tables, with the following small change to represent the higher risk factor of specific checkpoints. When you have picked two matching

colors during a checkpoint indicating a person at higher risk (the ones you circled or highlighted in step 2), use the following directions to determine if an autoimmune disease develops instead of the directions explained in 5.d.:

a. Testing should end for this person if a 2, 3, 4, 5, or 6 is rolled on the die (but not if a 1 is rolled). This means the person got an autoimmune disease. How do you think these people having a higher risk at this checkpoint affects whether an autoimmune response turns into an autoimmune disease?

8. When you are done, you should have tested what represents 20 people in each of the four data tables, for a total of 80 people represented.

## Analyzing Your Results

In this part of the science project, you will analyze your data and determine how genetic predisposition can affect a person's chances of getting an autoimmune disease.

1. In your lab notebook, make a data table like Table 2.

| | Normal Chances of Autoimmunity Group | Higher Risk at One of the Checkpoints Group | Higher Risk at Two of the Checkpoints Group | Higher Risk at All Three of the Checkpoints Group |
|---|---|---|---|---|
| Percentage of People Who Got an Autoimmune Disease | | | | |

**Table 2.** Make a data table like this one in your lab notebook. It will be used to summarize your results.

2. For each of the four data tables you filled out in the "Testing the Immune Response Model," calculate the percentage of people who got an autoimmune disease.
    a. To do this for one of the data tables, first count the number of times you wrote "Yes" in the bottom row ("Did the person get an autoimmune disease?"). Then divide that number by 20 and multiply by 100 to get the percentage of people who got an autoimmune disease.
        i. For example, if in a data table 3 people got an autoimmune disease out of the 20 tested, the percentage of people who got an autoimmune disease would be 3 divided by 20, which is 0.15 or 15%.
    b. Write your answers in the data table in your lab notebook that is like Table 2.
3. Make a bar graph of the data table you made that is like Table 2.
    a. You can make a graph by hand or use a website like Create a Graph (https://nces.ed.gov/nceskids/CreateAGraph/default.aspx) to make a graph on the computer and print it.
    b. Put the percentage of people who got an autoimmune disease on the y-axis (the vertical axis going up and down). Put the four different risk groups ("Normal Chances of Autoimmunity Group," "Higher Risk at One of the Checkpoints Group," etc.) on the x-axis (the horizontal axis going across). Make a bar for each risk group.
4. Look at your data tables and graph and try to draw conclusions from your results.
    a. Were there people with at least one higher risk checkpoint who did not get an autoimmune disease? What about people at higher risk at all three checkpoints who did not get an autoimmune disease?
        i. What does this tell you about someone in real life who has an increased risk of getting an autoimmune disease? Is there a chance they will not get the disease?
    b. Similarly, were there people with no higher risk checkpoints who still got an autoimmune disease?
        i. What does this tell you about people's risks in real life?
        ii. *Note:* In your model, the people in the "Normal Chances of Autoimmunity Group" are still genetically predisposed to getting an autoimmune disease, but they have a much lower risk compared to the other

groups you investigated. Technically, for most—if not all—autoimmune diseases, it is thought you cannot get the disease unless you have a genetic predisposition.

c. Did a group of people with more higher-risk checkpoints always have a higher percentage of people who got an autoimmune disease compared to a group with fewer higher risk checkpoints?
    i. *Tip:* Compare groups that were different by only one checkpoint, such as having one higher risk checkpoint versus two checkpoints, two checkpoints versus three checkpoints, or no higher risk checkpoints versus one.
d. Were there many times when the color of the M&M's candy matched the "Setup" color (representing an autoimmune response), but the roll of the die did not result in the person getting an autoimmune disease?
    i. If the colors matched, but the die roll did not result in an autoimmune disease, the person had an autoimmunity event that did not turn into a full autoimmune disease. What do you think this tells you about the occurrence of autoimmunity and autoimmune diseases in real people?
e. Overall, what do your results tell you about being genetically predisposed to getting an autoimmune disease, and the likelihood of actually getting an autoimmune disease? Was this what you expected? Can you explain your results after doing the experiment?

.

## If you like this project, you might enjoy exploring these related careers:

### Biochemist (http://www.sciencebuddies.org/science-engineering-careers/life-sciences/biochemist)

**Career Profile**

(http://www.sciencebuddies.org/science-engineering-careers/life-sciences/biochemist)

Growing, aging, digesting—all of these are examples of chemical processes performed by living organisms. Biochemists study how these types of chemical actions happen in cells and tissues, and monitor what effects new substances, like food additives and medicines, have on living organisms. Read more (http://www.sciencebuddies.org/science-engineering-careers/life-sciences/biochemist)

### Genetic Counselor *In Demand!* (http://www.sciencebuddies.org/science-engineering-careers/health/genetic-counselor)

**Career Profile**

(http://www.sciencebuddies.org/science-engineering-careers/health/genetic-counselor)

Many decisions regarding a person's health depend on knowing the patient's genetic risk of having a disease. Genetic counselors help assess those risks, explain them to patients, and counsel individuals and families about their options. Read more (http://www.sciencebuddies.org/science-engineering-careers/health/genetic-counselor)

## Physician (http://www.sciencebuddies.org/science-engineering-careers/health/physician)

**Career Profile**

(http://www.sciencebuddies.org/science-engineering-careers/health/physician) Physicians work to ease physical and mental suffering due to injury and disease. They diagnose medical conditions and then prescribe or administer appropriate treatments. Physicians also seek to prevent medical problems in their patients by advising preventative care. Ultimately, physicians try to help people live and feel better at every age. Read more (http://www.sciencebuddies.org/science-engineering-careers/health/physician)

## Variations

- In this science project, you modeled different parts of the immune response using *probability*, or the likelihood or chance that a certain event will happen, such as a person having an autoimmune response turn into an autoimmune disease. But what exactly was the probability of something happening at each part of the model you used? For example, the probability of rolling a 1 on a six-sided die would be 1 out of 6, since there are six different numbers on the die. 1 divided by 6 is 0.17, or a 17% chance of rolling a 1. What is the probability of picking a certain colored M&M's candy from a bowl that has six candies total, each a different color? Try to determine the probability of a certain outcome in different parts of your model, specifically when the M&M's candies are picked and when a die is rolled. How does it relate to the "What it Represents in the Model" part of Figure 2? Do the probabilities match the results you got? For help on probability, visit this webpage:
    - MathIsFun.com. (n.d.). *Probability.* Retrieved May 15, 2013, from http://www.mathsisfun.com/data/probability.html (http://www.mathsisfun.com/data/probability.html)
- Can you tweak the model used in this science project to model a greater range of genetic predispositions to getting an autoimmune disease? Would using a different kind of die, such as a four-sided die, an eight-sided die, a twenty-sided die, etc. help? Or would picking other numbers on the die to correlate with "higher risk" provide a greater range?
- How would the model change if, initially, you used more M&M's of one particular color in your bowl. For example, what if you had just one blue M&M's candy and two of all the other colors? Could you use this to represent people who have more or fewer autoimmune responses? Could this represent different environmental factors?
- Pick a specific autoimmune disease and do some research on it. You may want to ask an adult to help you do this. Try to find out what is known about the causes of the autoimmune disease and how often a person gets its. How can you model its causes using your model? Can you change your model so that it is a better model of the specific disease? *Tip:* One autoimmune disease that is fairly well understood is celiac disease. Note that models are simplified versions of the real thing; they behave like the real thing for the aspect you like to study.
- In this science project, you likely saw an autoimmunity event happen (when the M&M's colors matched) that did not lead to an autoimmune disease. How often did this happen? You can go back and analyze your results for the four different groups of people. Figure out how many times an autoimmunity event happened, how many times it turned into an autoimmune disease, and how many times it did not. Do you see a correlation with the different groups based on the number of checkpoints that are at higher risk?
- How could you model other aspects of the immune system? *Tip:* You will probably need to learn more about the immune system first and then try to figure out how best to model different parts of it. You could use die and candies again or other things to represent different processes or probabilities of events happening.
- You could try a different Science Buddies project idea that models a different part of the immune system:

- Fighting the Flu: How Your Immune System Uses Its Memory (http://www.sciencebuddies.org/science-fair-projects/project-ideas/HumBio_p036/human-biology-health/immune-system-memory)

## Ask an Expert

The Ask an Expert Forum is intended to be a place where students can go to find answers to science questions that they have been unable to find using other resources. If you have specific questions about your science fair project or science fair, our team of volunteer scientists can help. Our Experts won't do the work for you, but they will make suggestions, offer guidance, and help you troubleshoot.

Ask an Expert (http://www.sciencebuddies.org/science-fair-projects/ask_an_expert_intro.shtml)

## Related Links

- Science Fair Project Guide (http://www.sciencebuddies.org/science-fair-projects/project_guide_index.shtml)
- Other Ideas Like This (http://www.sciencebuddies.org/search?v=solt&pi=BioMed_p017)
- Medical Biotechnology Project Ideas (http://www.sciencebuddies.org/science-fair-projects/project-ideas/medical-biotechnology)
- Diabetes Project Ideas (http://www.sciencebuddies.org/science-fair-projects/project-ideas/diabetes)
- My Favorites (http://www.sciencebuddies.org/account/favorites)

## News Feed on This Topic

Free Lesson Plan to Model the Odds of Developing an Autoimmune Disease (http://www.sciencebuddies.org/news/article?id=404816), *Science Buddies Blog*, April 25, 2018

Body's 'safety procedure' could explain autoimmune disease (http://www.sciencebuddies.org/news/article?id=59041), *EurekAlert!*, September 5, 2013


Multiple sclerosis as the flip side of immune fitness (http://www.sciencebuddies.org/news/article?id=1011268), *EurekAlert!*, October 22, 2020

---

*Note:* A computerized matching algorithm suggests the above articles. It's not as smart as you are, and it may occasionally give humorous, ridiculous, or even annoying results! Learn more about the News Feed (http://www.sciencebuddies.org/news/learn-more)

## Looking for more science fun?

Try one of our science activities for quick, anytime science explorations. The perfect thing to liven up a rainy day, school vacation, or moment of boredom.

Find an Activity (http://www.sciencebuddies.org/stem-activities)

# Rising 8th Grade Social Studies

Welcome to 8th Grade! To prepare for 8th grade Social Studies, please complete parts 1 and 2 below. Completing these steps will make class easier and more fun. Each of these steps will prepare you to succeed in the first unit of the year!

Some activities require internet access. If you do not have internet access or want to enjoy screen-free time, you can skip Part 1 and move on to Part 2.

<table>
<tr><td colspan="2">Part 1—Geography: Please complete steps A, B, <u>or</u> C below. Completing these steps will make class easier and more fun. Each of these steps will prepare you to succeed in the first unit of the year!</td></tr>
<tr><td>A. Geography: Open a web browser and google search for “Seterra The U.S: Geophysical Regions - Map Quiz Game”. Complete the map quiz until you memorize different environmental regions in the US.<br>OR</td><td>What is the fastest time you can complete the quiz? Try to get 100% in less than two minutes!</td></tr>
<tr><td>B. Geography: Open a web browser and google “Seterra The U.S.: Major Cities -</td><td>What is the fastest time you can complete the quiz? Try to get 100% in less than two minutes!</td></tr>
</table>

| | |
|---|---|
| Map Quiz Game". Complete the map quiz until you memorize the locations of major US cities.<br>**OR** | |
| **C. Geography.** If you have a smartphone, download the "MapQuiz" app (pictured to the right.) Practice "US States and Territories" until you can locate all the states and territories on the first try! |  |

<table>
<tr><td colspan="2">Part 2—History: Please complete steps A, B, <u>or</u> C below. Completing these steps will make class easier and more fun. Each of these steps will prepare you to succeed in the first unit of the year!</td></tr>
<tr><td rowspan="3">A. Content Review: Use a web browser or a smartphone and go to YouTube. Search for “War & Expansion: Crash Course US History #17” Watch this short video on Westward Expansion in the US, then answer the questions to the right.<br><br>OR</td><td>1. Why did the United States go to war with Mexico?</td></tr>
<tr><td>2. What did the US gain after the war with Mexico?</td></tr>
<tr><td>3. How did the Mexican-American war lead to Westward Expansion?</td></tr>
</table>

| | |
|---|---|
| **B.** Open a web browser or a smartphone and go to YouTube. Search for "Westward Expansion: Crash Course US History #24" Watch this short video on Westward Expansion in the US, then answer the questions to the right.<br><br>**OR** | **4. What groups of people benefited from US Expansion into the West? Why?**<br><br>**5. How did Native Americans respond to white settlers moving onto their lands? Give 2 examples.** |
| **C.** Read the text below and answer the questions to the right. | **1. Why did white settlers moving into the west cause conflicts with Native Americans?** |

| | |
|---|---|
| | **2. How did the United States gain a large amount of territory from Mexico?**<br><br>**3. How do you think Westward Expansion affected each of the following groups of people: white farmers, enslaved Black people, free Black people, and Native Americans?** |


## Westward Expansion in North America

In less than 300 years, settlers spread across a vast area of land that covered the western United States. From the first landings in Virginia and Massachusetts in the early 1600s, American settlers kept pushing westward against an ever-moving frontier. Into wild country went hunters, trappers, fur traders, miners, soldiers, surveyors, and farmers. Every part of America had its pioneers.

The arrival of so many Americans on the western frontier sparked a war with Mexico over land. Americans who had settled in Texas had revolted against Mexico, formed an independent republic, and asked that Texas become part of the United States. America went to war with Mexico in order to incorporate Texas into the Union.

Many Americans also wanted to obtain more than just Texas. They sought to acquire, by purchase or conquest, other Mexican territories, including California. They believed that it was the destiny of the United States to span the continent from the Atlantic to the Pacific and from the Canadian border south to the Rio Grande, the river that is now the boundary between the United States and Mexico.

As pioneers demanded more land, problems with Native American tribes also increased. Between 1850 and 1880, numerous treaties were negotiated between whites and Indians in all parts of the West, from Nebraska to California. The original reason for these treaties was to separate the two groups and reduce the risk of war. But as the size of the settler population increased, the agreements gained a new purpose: to get good land for white settlers.

Indian tribes were restricted to reservations where their lives were controlled by unsympathetic government agents and many of their cultural traditions were forbidden. Many tribes resisted and fought back against the American government and settlers, but all of the tribes were defeated. In the 1860s and 1870s, this process of "clearing" the West for white settlement led to conflicts with the Navajos, Kiowas, Blackfeet, Comanches, Sioux, and Cheyennes.

Through their labors and accomplishments, pioneers helped define the character of America. Looking for opportunity and happiness, families risked their lives to build new communities far from the settled east coast. However, in the quest for a bigger America, Native American communities were destroyed and a war was fought with Mexico.

To learn more about the struggles and successes of pioneer life, read the journals of Augustus Pelletier, who explored with Lewis and Clark and Sarah Nita, a Navajo girl, as well as Susanna Fairchild, who participated in the Gold Rush.

Westward Expansion Timeline

**1836:** In the Texas War of Independence, Texans defeated at the Battle of the Alamo, but later defeat Mexicans at Battle of San Jacinto.
**1838:** Cherokees, forced to leave Georgia, set out for Oklahoma on "Trail of Tears."
**1842:** Settlers move west along the Oregon Trail.
**1845:** Texas admitted to the Union.
**1846:** War declared against Mexico; Zachary Taylor defeats Mexicans at the Rio Grande.
**1847:** Winfield Scott's troops take Mexico City. Mormons settle in Utah.
**1848:** Gold discovered in California.
**1853:** Gadsden Purchase establishes final U.S. boundaries in Southwest.
**1860:** Pony Express begins carrying mail.
**1867:** U.S. buys Alaska from Russia.

**1869:** Transcontinental Railroad completed. Wyoming becomes first state to allow women to vote.
**1889:** Oklahoma land rush.
**1890:** Battle of Wounded Knee kills over 300 Sioux Indians and ends the Indian Wars.
**1897:** Klondike Gold Rush begins.