

Name: _____

Summer 2020

How Do We Choose?

Rising 7th Grade Mini-Project

Directions: Using your knowledge of what you have learned throughout the year, complete the following tasks at your own pace.

Throughout the completion of these tasks, you will explore the mathematics of voting: democratic processes for making decisions. The activities in these tasks are about voting on issues where there are two choices. You will use proportional reasoning concepts and skills developed throughout sixth grade to compare voting results of two groups, to determine whether an issue wins an election with a supermajority rule, and discover that a few people can determine the results of an election when very few people vote.

Parental Support: To assist your student in their work throughout the summer, visit www.openupresources.org and create a free account. View Grade 6, Unit 9, Lessons 4-6 to read a “teachers guide” to these tasks. These include task syntheses and anticipated student responses!

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Part 1: How Do We Choose?

1.1: Which was “Yessier”?

Two sixth-grade classes, A and B, voted on whether to give the answers to their math problems in poetry. The “yes” choice was more popular in both classes.

	Yes	No
Class A	24	16
Class B	18	9

1. Was one class more in favor of math poetry, or were they equally in favor? Find three or more ways to answer the question.

1.2: Which Class Voted Purpler?

The school will be painted over the summer. Students get to vote on whether to change the color to purple (a “yes” vote), or keep it a beige color (a “no” vote). The principal of the school decided to analyze voting results by class. The table shows some results.

	Yes	No
Class A	26	14
Class B	31	19

1. In both classes, a majority voted for changing the paint color to purple. Which class was more in favor of changing?

1.3: Supermajorities

1. Another school is also voting on whether to change their school's color to purple. Their rules require a $\frac{2}{3}$ supermajority to change the colors. A total of 240 people voted, and 153 voted to change to purple. Were there enough votes to make the change?

2. This school also is thinking of changing their mascot to an armadillo. To change mascots, a 55% supermajority is needed. How many of the 240 students need to vote "yes" for the mascot to change?

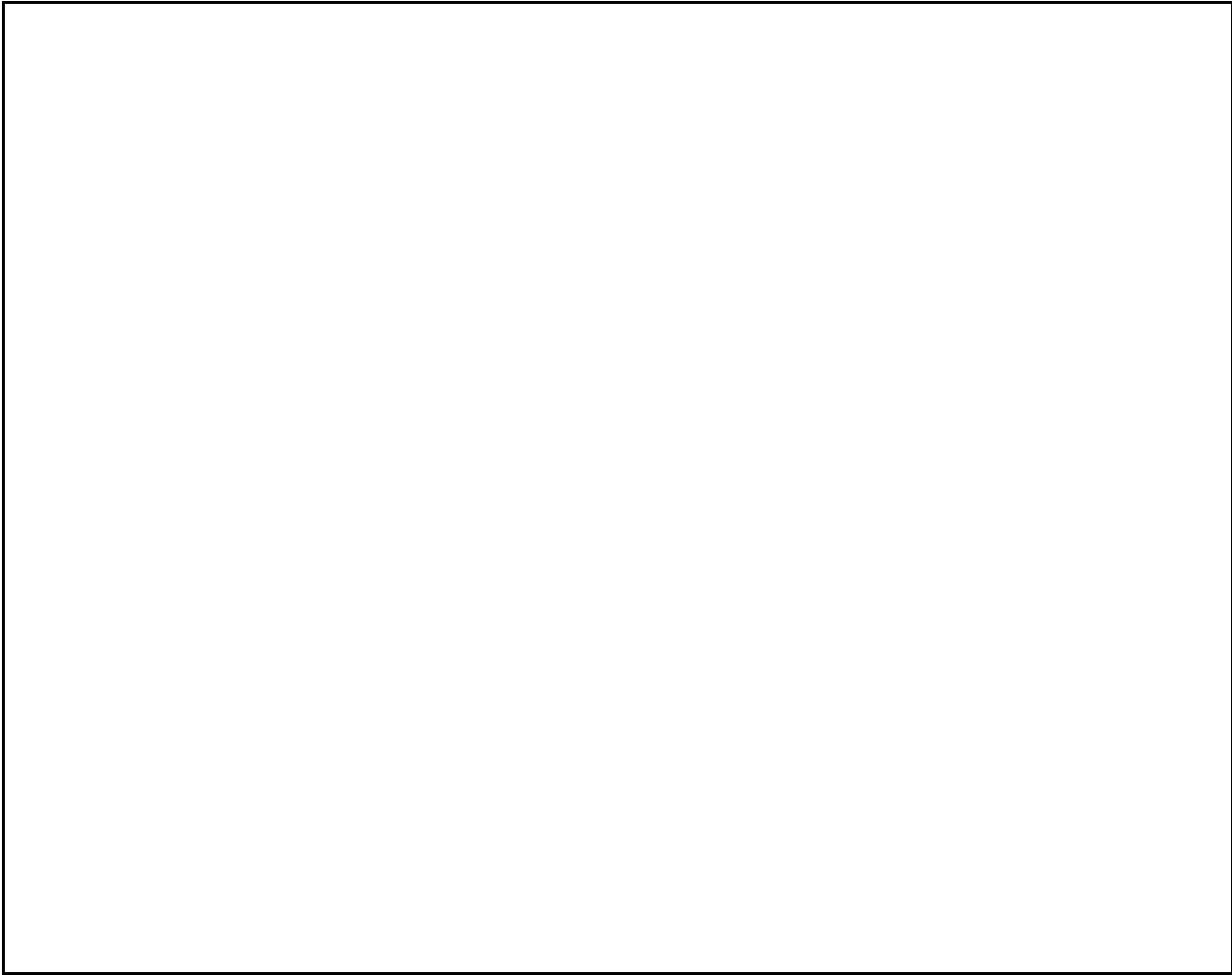
3. At this school, which requires more votes to pass: a change of mascot or a change of color?

1.4: Best Restaurant

A town's newspaper held a contest to decide the best restaurant in town. Only people who subscribe to the newspaper can vote. 25% of the people in town subscribe to the newspaper. 20% of the subscribers voted. 80% of the people who voted liked Darnell's BBQ Pit best.

Darnell put a big sign in his restaurant's window that said, "80% say Darnell's is the best!"

1. Do you think Darnell's sign is making an accurate statement? Support your answer with:
- Some calculations
 - An explanation in words
 - A diagram that accurately represents the people in town, the newspaper subscribers, the voters, and the people who liked Darnell's best

A large, empty rectangular box with a black border, intended for the student to provide their answer, including calculations, an explanation, and a diagram.

Part 2: More than Two Choices

2.1: Field Day

Students in a sixth-grade class were asked, “What activity would you most like to do for field day?” The results are shown in the table.

Activity	Number of Votes
Softball Game	16
Scavenger Hunt	10
Dancing Talent Show	8
Marshmallow Throw	4
No Preference	2

1. What percentage of the class voted for softball?

2. What percentage did not vote for softball as their first choice?

2.2: School Lunches (Part 1)

Suppose students at our school are voting for the lunch menu over the course of one week. The following is a list of options provided by the caterer.

Meat Lovers:	Vegetarian:	Something for Everyone:	Concession Stand:
<ul style="list-style-type: none"> - Meat Loaf - Hot Dogs - Pork Cutlets - Beef Stew - Liver and Onions 	<ul style="list-style-type: none"> - Vegetable soup and peanut butter sandwich - Hummus, pita, and veggie sticks - Veggie burgers and fries - Chef's salad - Cheese pizza every day, double desserts every day 	<ul style="list-style-type: none"> - Chicken Nuggets - Burgers and Fries - Pizza - Tacos - Leftover day (all the week's leftovers made into a casserole) - Bonus side dish: pea jello (green gelatin with canned peas) 	<ul style="list-style-type: none"> - Choice of hamburger or hot dog, with fries, every day

- To vote, draw one of the following symbols next to each menu option to show your first, second, third, and last choices.



- Meat Lovers _____
- Vegetarian _____
- Something for Everyone _____
- Concession Stand _____

Here are two voting systems that can be used to determine the winner.

Voting System #1. Plurality: The option with the most first-choice votes (stars) wins.

- If there were 25 people in a class voting, how many votes does it take to win a majority?

2. The top option, "Meat Lovers", received 12 votes. Was this a majority of the votes?

3. People tend to be more satisfied with election results if their top choices win. For how many, and what percentage, of people was the winning option:

- a. Their first choice? (12 people)
- b. Their second choice? (7 people)
- c. Their third choice? (3 people)
- d. Their last choice? (3 people)

Voting System #2. Runoff: If no choice received a majority of the votes, leave out the choice that received the fewest first-choice votes (stars). Then have another vote. In this case, "Something for Everyone" received the fewest first-choice votes and is no longer in the running.

If your first vote is still a choice, vote for that. If not, vote for your second choice that you wrote down.

After the second round of voting, "Meat Lovers" received 16 first choice votes, "Vegetarian" received 6 first choice votes, and "Concession Stand" received 3 first-choice votes.

4. After the second round of voting, did any choice get a majority? If so, is it the same choice that got a plurality in Voting System #1?

5. How satisfied were the voters by the election results? For how many, and what percentage, of people was the winning option:
- Their first choice? (16 people)
 - Their second choice? (8 people)
 - Their third choice? (1 person)
 - Their last choice?

6. Compare the satisfaction results for the plurality voting rule and the runoff rule. Did one produce satisfactory results for more people than the other?

2.3: School Lunch (Part 2)

Let's analyze a different election. In another class, there are four clubs. Everyone in each club agrees to vote for the lunch menu exactly the same way, as shown in this table.

	Barbecue Club (21 members)	Garden Club (13 members)	Sports Boosters (7 members)	Film Club (9 members)
A. Meat Lovers	★	✕	✕	✕
B. Vegetarian	😊	★	☹	☹
C. Something for Everyone	☹	☹	😊	★
D. Concession Stand	✕	😊	★	😊

Figure out which option won the election by answering these questions.

1. On the first vote, when everyone voted for their first choice, how many votes did each option get? Did any choice get a majority?

2. Which option is removed from the next vote?

3. On the second vote, how many votes did each of the remaining three menu options get? Did any option get a majority?

4. Which menu option is removed from the next vote?

5. On the third vote, how many votes did each of the remaining two options get? Which option won?

Estimate how satisfied all the voters were.

1. For how many people was the winner their first choice?

2. For how many people was the winner their second choice?

3. For how many people was the winner their third choice?

4. For how many people was the winner their last choice?

5. Compare the satisfaction results for the plurality voting rule and the runoff rule. Did one produce satisfactory results for more people than the other?

2.4: Weekend Choices

Clare, Han, Mai, Tyler, and Noah are deciding what to do on the weekend. Their options are cooking, hiking, and bowling. Here are the points for their instant runoff vote. Each first choice gets 2 points, the second choice gets 1 point, and the last choice gets 0 points.

	cooking	hiking	bowling
Clare	2	1	0
Han	2	1	0
Mai	2	1	0
Tyler	0	2	1
Noah	0	2	1

1. Which activity won using the instant runoff method? Show your calculations and use expressions or equations.

2. Which activity would have won if there was just a vote for their top choice, with a majority or plurality winning?

3. Which activity would have won if there was a runoff election?

4. Explain why this happened.

Part 3: Picking Representatives

3.1: Computers for Kids

A program gives computers to families with school-aged children. They have a certain number of computers to distribute fairly between several families. How many computers should each family get?

1. One month the program has 8 computers. The families have these numbers of school-aged children: 4, 2, 6, 2, 2.

- a. How many children are there in all?

- b. Counting all the children in the families, how many children would use each computer? This is the number of children per computer. Call this number A .

- c. Fill in the third column of the table below. Decide how many computers to give to each family if we use A as the basis for distributing the computers.

family	number of children	number of computers, using A
Baum	4	
Chu	2	
Davila	6	
Eno	2	
Farouz	2	

- d. Check that 8 computers have been given to all.

2. The next month they again have 8 computers. There are different families with these numbers of children: 3, 1, 2, 5, 1, 8.

a. How many children are there in all?

b. Counting all the children in the families, how many children would use each computer? This is the number of children per computer. Call this number B .

c. Does it make sense that B is not a whole number? Why?

d. Fill in the third column of the table. Decide how many computers to give each family if we use B as the basis for distributing the computers.

family	number of children	number of computers, using B	number of computers, your way	number of children per computer, your way
Gray	3			
Hernandez	1			
Ito	2			
Jones	5			
Krantz	1			
Lo	8			

- e. Check that 8 computers have been given out to all.
- f. Does it make sense that the number of computers for one family is not a whole number? Explain your reasoning.

- g. Find and describe a way to distribute computers to the families so that each family gets a whole number of computers. Fill in the fourth column of the table.
- h. Compute the number of children per computer in each family and fill in the last column of the table.
- i. Do you think your way of distributing the computers is fair? Explain your reasoning.

3.2: School Mascot (Part 1)

A school is deciding on a school mascot. They have narrowed the choices down to the Banana Slugs or the Sea Lions. The principal decided that each class gets one vote. Each class held an election, and the winning choice was the one vote for the whole class. The table shows how three classes voted.

	banana slugs	sea lions	class vote
class A	9	3	banana slug
class B	14	10	
class C	6	30	

- 1. Which mascot won, according to the principal’s plan? What percentage of the votes did the winner get under this plan?

- 2. Which mascot received the most student votes in all? What percentage of the votes did this mascot receive?

The students thought this plan was not very fair. They suggested that bigger classes should have more votes to send to the principal. Make up a proposal for the principal where there are as few votes as possible, but the votes proportionally represent the number of students in each class.

- 3. Decide how to assign the votes for the results in the class. (Do they all go to the winner? Or should the loser still get some votes?)

4. In your system, which mascot is the winner?

5. In your system, how many representative votes are there? How many students does each vote represent?

3.3: Advising the School Board

In a very small school district, there are four schools, D, E, F and G. The district wants a total of 10 advisors for the students. Each school should have at least one advisor.

school	number of students	number of advisors, A students per advisor
D	48	
E	12	
F	24	
G	36	

1. How many students are in this district in all?

2. If the advisors could represent students at different schools, how many students per advisor should there be? Call this number A . Show your reasoning.

3. Using A students per advisor, how many advisors should each school have? Complete the table with this information for schools D, E, F and G.

Another district has four schools; some are large, others are small. The district wants 10 advisors in all. Each school should have at least one advisor.

school	number of students	number of advisors, B students per advisor	number of advisors, your way	number of students per advisor, your way
Dr. King School	500			
O'Connor School	200			
Science Magnet School	140			
Trombone Academy	10			

4. How many students are in this district in all?

5. If the advisors didn't have to represent students at the same school, how many students per advisor should there be? Call this number B .

6. Using B students per advisor, how many advisors should each school have? Give your quotients to the tenths place. Fill in the first "number of advisors" column of the table. Does it make sense to have a tenth of an advisor?

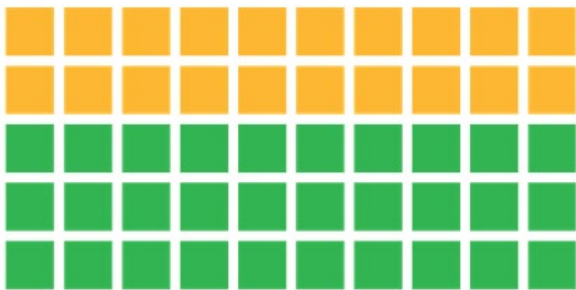
7. Decide on a consistent way to assign advisors to schools so that there are only whole numbers of advisors for each school, and there is a total of 10 advisors among the schools. Fill in the "your way" column of the table.
8. How many students per advisor are there at each school? Fill in the last row of the table.
9. Do you think this is a fair way to assign advisors? Explain your reasoning.

3.4: School Mascot (Part 2)

The whole town gets interested in choosing a mascot. The mayor of the town decides to choose representatives to vote.

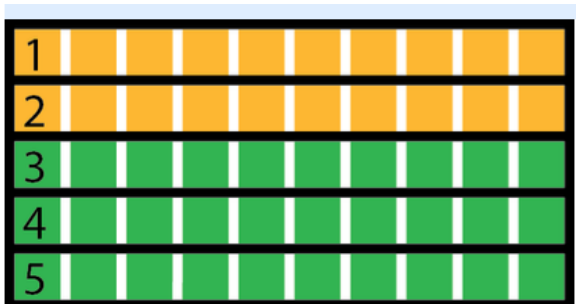
There are 50 blocks in the town, and the people on each block tend to have the same opinion about which mascot is best. Green blocks like sea lions, and gold blocks like banana slugs. The mayor decides to have 5 representatives, each representing a district of 10 blocks.

Here is a map of the town, with preferences shown.



1. Suppose there were an election with each block getting one vote. How many votes would be for banana slugs? For sea lions? What percentage of the vote would be for banana slugs?

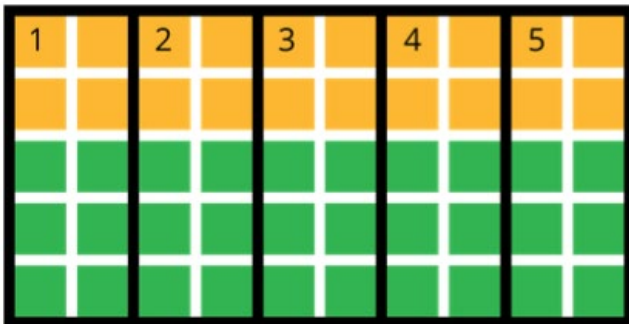
2. Suppose the districts are shown in the next map. What did the people in each district prefer? What did their representative vote? Which mascot would win the election?



Complete the table with this election's results.

district	number of blocks for banana slugs	number of blocks for sea lions	percentage of blocks for banana slugs	representative's vote
1	10	0		banana slugs
2				
3				
4				
5				

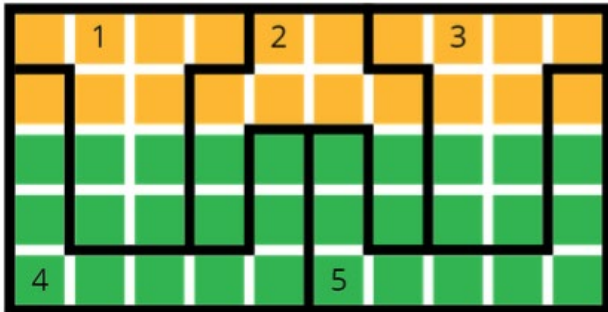
3. Suppose, instead, that the districts are shown in the new map below. What did the people in each district prefer? What did their representative vote? Which mascot would win the election?



Complete the table with this election's results.

district	number of blocks for banana slugs	number of blocks for sea lions	percentage of blocks for banana slugs	representative's vote
1				
2				
3				
4				
5				

4. Suppose the districts are designed in yet another way, as shown in the next map. What did the people in each district prefer? What did their representative vote? Which mascot would win the election?



Complete the table with this election's results.

district	number of blocks for banana slugs	number of blocks for sea lions	percentage of blocks for banana slugs	representative's vote
1				
2				
3				
4				
5				

5. Write a headline for the local newspaper for each of the ways of splitting the town into districts.

6. Which systems on the three maps of districts do you think are more fair? Are any totally unfair? Why or why not?