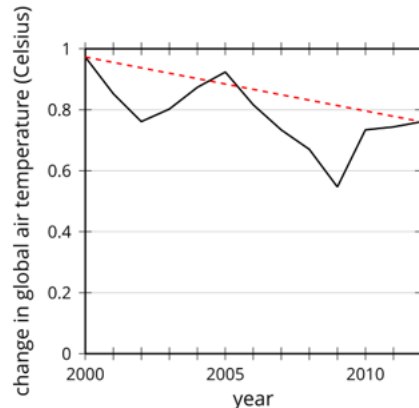Name: _____   Date:_____

The Mathematics of Voting

Diagnostic Assessment

A graph and 2 headlines from a website are shown.

"80% of Dentists Recommend Acme Toothpaste"
"Pythagoras Brand Rulers Measure 20% Better"

1. What do you notice? What do you wonder?

Consider the following results from the elections for student body president.

Candidate	A	B	C	D	E
Number of 1st Place Votes	80	98	94	76	102

Notice there are a total of 80 + 98 + 94 + 76 + 102 = 450 votes.

E should win right? Notice no candidate has a majority or more than 50%. A majority would require a count of more than 225 votes, more than half the votes cast. This situation is, however, a win by plurality. When three candidates or more are in the race, the person who wins the *plurality* of votes receives more than any of the other candidates but not necessarily the *majority*.

Now let's assume that the voters ranked the candidates from their first choice through their fifth choice.

Votes	80	98	94	76	102
1st Choice	A	B	C	D	E
2nd Choice	B	A	B	B	B
3rd Choice	C	C	D	C	A
4th Choice	D	D	A	D	D
5th Choice	E	E	E	E	C

Notice except for the 102 who voted for E, most voters really seem to dislike the candidate because Candidate E is ranked 5th by everyone else. Also, everyone that didn't vote B first, ranked B second. Candidate B is not disliked by anyone. Should B win?

This leads to an interesting discussion about voting theory and voting methods.

2. Who do you think should be the winner? Why? Support your opinion.

3. What is a "fair" method to elect a candidate?

4. Who decides what method of voting is used?

5. What is the likelihood that you would vote if there was a run-off? The majority of people do not return to the polls to vote in a run-off.

Engage

Register To Vote In Your State By Using This Postcard Form and Guide

Voter Registration

1. How many of you are 18 and older?

2. Have you registered to vote?

3. Display the voter registration card.

4. Do you know where voting facilities are located?

Explore

Your teacher will assign you to a group. Your group will be responsible for learning about one of four voting methods: Plurality, Plurality with runoff, Borda Count, majority method

Your group will need to define the method as well as research strengths and weaknesses of your type of voting.

Once your group is finished, place your findings on the large sheet of paper provided by your teacher. You will complete a gallery walk to learn about the other types of voting.

Apply

Select 4 candidates from your class to "run for office."

Now, rank the 4 candidates in order. For example: Candidate A, Candidate C, Candidate D, Candidate B.

Your teacher will collect the results.

1. How many total votes were cast?

2. How many votes would a candidate need to win by majority?

3. Is there a majority winner?

4. Calculate who won the election using plurality.

5. Do you think that candidates are similar?

6. Who won our election? Why?

7. Is there anything undesirable about the results?

Now let's look at Plurality with Elimination. This type of voting would be used when no one wins the majority. Ask the groups to find the winner using this method.

8. Who won your election by Plurality with runoff?

9. Is it the same candidate that won by plurality?

10. Are you happier with this result?

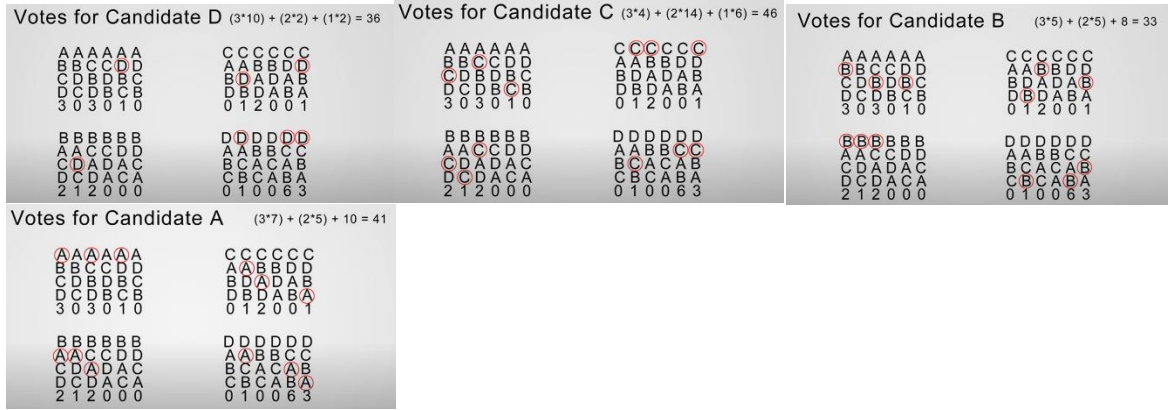Let's examine another way of voting: The Borda Count

Each place is assigned point values.

1st place: 3 points
2nd place: 2 points
3rd place: 1 point
4th place: 0 points

See example below, then answer the questions according to the example.

Votes for Candidate D (3*10) + (2*2) + (1*2) = 36

```
A A A A A A        C C C C C C
B B C C D D        A A B B D D
C D B D B C        B D A D A B
D C D B C B        D B D A B A
3 0 3 0 1 0        0 1 2 0 0 1

B B B B B B        D D D D D D
A A C C D D        A A B B C C
C D A D A C        B C A C A B
D C D A C A        C B C A B A
2 1 2 0 0 0        0 1 0 0 6 3
```

Votes for Candidate C (3*4) + (2*14) + (1*6) = 46

```
A A A A A A        C C C C C C
B B C C D D        A A B B D D
C D B D B C        B D A D A B
D C D B C B        D B D A B A
3 0 3 0 1 0        0 1 2 0 0 1

B B B B B B        D D D D D D
A A C C D D        A A B B C C
C D A D A C        B C A C A B
D C D A C A        C B C A B A
2 1 2 0 0 0        0 1 0 0 6 3
```

Votes for Candidate B (3*5) + (2*5) + 8 = 33

```
A A A A A A        C C C C C C
B B C C D D        A A B B D D
C D B D B C        B D A D A B
D C D B C B        D B D A B A
3 0 3 0 1 0        0 1 2 0 0 1

B B B B B B        D D D D D D
A A C C D D        A A B B C C
C D A D A C        B C A C A B
D C D A C A        C B C A B A
2 1 2 0 0 0        0 1 0 0 6 3
```

Votes for Candidate A (3*7) + (2*5) + 10 = 41

```
A A A A A A        C C C C C C
B B C C D D        A A B B D D
C D B D B C        B D A D A B
D C D B C B        D B D A B A
3 0 3 0 1 0        0 1 2 0 0 1

B B B B B B        D D D D D D
A A C C D D        A A B B C C
C D A D A C        B C A C A B
D C D A C A        C B C A B A
2 1 2 0 0 0        0 1 0 0 6 3
```

11. How did C win our Borda Count election?

12. How would you describe support for C and D? Which one has broad support? Which one is liked by some and disliked by most others?

13. Who won your election by Borda Count?

14. What do you like/dislike about the Borda Count method?

Test and Reflect

1. Which voting method makes the most sense to you?

2. Do you know which method is used most often in the United States?