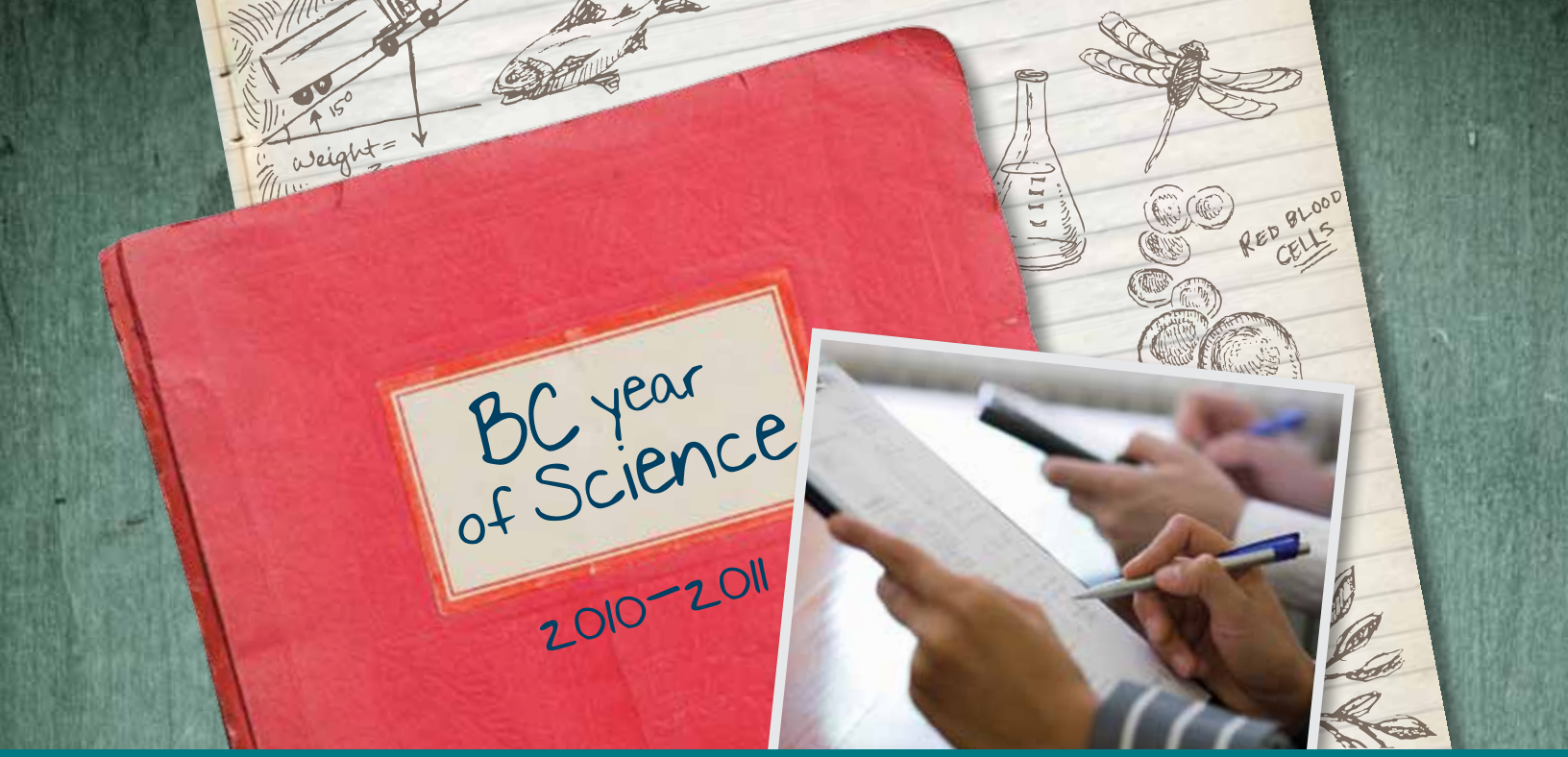


January | Activity of the Month

Mathematics and Society: Exploring how voting systems can impact election results

What's it about:

We live in a democracy. This means that pretty much everything, from whether a country goes to war, to how much doctors are paid, to which film wins an Oscar, to whether students should be allowed cell phones in school, to who our next leaders will be, is voted on. There are many different systems for voting and running elections. Mathematician **Anthony Quas** at the University of Victoria researches the impact of voting systems on election outcomes. Let's check out how different voting systems might influence who gets elected in an election you run with your friends.

What you need:

- Any group of people (such as a school class)
- Small pieces of paper to use as voting cards

What to do:

1. Let's say your group would like to elect a youth leader to help make British Columbia more environmentally friendly. There are three candidates: Johnny Appleseed who supports Reduce, Juliet Bravo who supports Recycle and Jane Change who supports Reuse (let's call them A, B and C).

2. Imagine that the group has been surveyed (this is called a poll) before the election to find out what their orders of preference amongst the three candidates are. The results of that survey or poll are:

ABC	ACB	BAC	BCA	CAB	CBA
37%	2%	8%	22%	16%	15%

The first value means that 37% of the group think that A is the best, B is their second choice and C their third choice. Similarly the fourth value shows that 22% of the group have B as their first choice, C as their second, and A as their third choice.

Q. Figure out what total percentage of the group prefers candidate A as their first choice?

Q Now work out what total percentage prefers C first? And B first?

3. Let's use what you found out in Step 2 to propose different voting methods that favor individual candidates. Here's what to do:

- Divide into two groups. One will be the advisory group to Johnny Appleseed A; the other the advisory group to Juliet Bravo B.
- Each group uses the Step 2 polling results to think of possible voting systems that would work best to get their candidate elected.

4. Take turns presenting your voting systems, and discuss which system might be fairer.

5. Introducing a third Alternative!

The advisors to Jane Change (candidate C) are recommending using a third voting method called the Instant Runoff Voting (IRV) system. Let's try it out:

Step I: Give each person a voting card, and have them write on the card the candidates they would prefer in rank order e.g. someone who likes A first, then B, and lastly C would vote ABC

Step II: Add up all the first choice votes for each candidate (e.g. for A you count the total number of ABC and ACB votes) and write the number in the Round 1 column of the Voting Results Table opposite.

Step III: The one with the fewest votes is eliminated - write "eliminated" next to that candidate in the Round 2 column.

Step IV: Transfer the votes for the losing candidate to the next preferred candidate (for example if B is eliminated, a BCA vote becomes a vote for C whereas a BAC vote becomes a vote for A) and add these votes to the votes from Round 1.

Step V: Repeat Step III, writing eliminated beside the candidate with the least votes. The remaining candidate is the winner. Yeah!

Voting Results Table

Candidate	Round 1 votes	Round 2 votes	Round 3
A			
B			
C			

6. Why is the IRV a good voting system? Compare it to the systems you discussed earlier.

What else you can do:
Imagine that new polling data is now available. It looks like this:

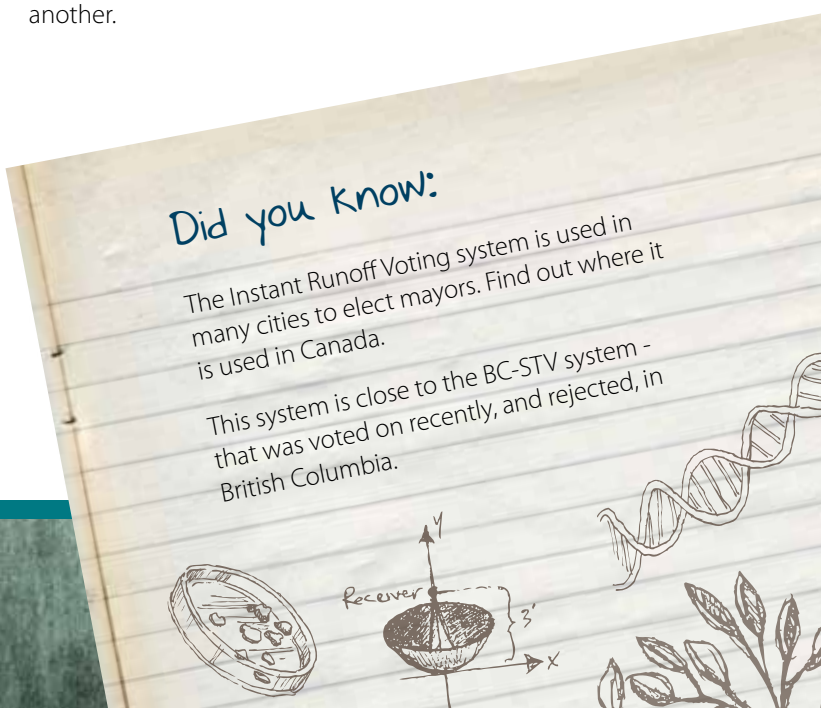
ABC	ACB	BAC	BCA	CAB	CBA
35%	2%	10%	22%	16%	15%

Q. What changed between the old poll data and the new poll data?

Q. Who would win using the IRV voting method if this new poll is correct?

Q. Do you see anything strange about this?

This is an example of a voting paradox. It turns out that all voting systems have paradoxes of one kind or another.



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