Data to the Rescue

Visualizing water quality in your community

Data to the Rescue contains five 15-30 minute mathematics activities designed for grades 4-8. This series of activities aims to teach students about statistics while encouraging them to become water stewards! Based on different types of graphs and tables, students will interpret water quality parameters like temperature and dissolved oxygen, analyze changes over time, and explore the main factors impacting water quality! The water quality data was collected by community scientists at Sharbot Lake, Ontario. Activities can be completed over five consecutive days, or they can be extended into a longer period of time. Extension activities are appropriate for students in grades 8-10 or for advanced students in earlier grades.

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Part 1	Introducing Sharbot Lake
Guiding Question	How is water affected by human activity?
Time	20 minutes or more
Prior Knowledge	Students will need to have some understanding of how to interpret data in graphs, understanding of people and their environments, how different groups of people respond to industrial pressure, impacts of industry on environment
Learning Skills	Initiative, Independent work, Collaboration
Strategies	think-pair-share, exit card
Assessment	Oral and written responses

Introduction (5-10 minutes)

Teachers will introduce students to Sharbot Lake by discussing the region around the water. **Work through the slides provided and use the speaker notes below each slide as guiding prompts for discussion.**

- If you would like study a water body in your local community, check our data platform to see if anyone has been testing near you https://app.waterrangers.ca/

For the activity, teachers will focus on three communities around the lake:

1. The town & cottages
2. The provincial park
3. The Shabot Obaadjiwan First Nation

Body (10-15 minutes)

Continue with the slides. Expand on each community with pictures and some background.

1. The town of Sharbot Lake was built around an old railway, the cottages use water for fishing and leisure.
2. The Provincial park has been around since the 1950s, protection and conservation of land.
3. The Shabot Obaadjiwan, part of the Algonquin Nation, have been around since at least 3000 BCE. They successfully opposed a uranium mining venture in 2008.

Distribute one page handout for part 1. Question to students: How could each community negatively or positively affect the water of sharbot lake? Some prompts for the students are written on the slides and on their handout.

- Students will think-pair-share in groups of 2-3, then join another group to compare answers (written on their handout)
- Students can share their results with the class if comfortable.

Next, show the graph of water temperature in Sharbot Lake (West basin) to students, point out features including x and y axis and units, etc. Ask the next question set to student groups:

1. What are some things you notice about the graph?
2. What is something you are wondering about the data you see?
3. What do you think the data may look like in 5 years? Why?

Conclusion (5 minutes)	**Extension** (Grade 8+)
Wrap up the activity by explaining that we will go into more detail about the data tomorrow. Collect written answers from groups and use these as an exit card to inform the discussion with students for the next few parts.	Looking at the graph, do you notice any trends (i.e., change over time) in the data? What factors may have affected the temperature of Sharbot Lake since 2001?

Part 2	Describing data with statistics
Guiding Question	How can we describe data by using statistics like mean and range?
Time	20 minutes or more
Prior Knowledge	Understanding and calculating mean and range of a given data set. For upper grades: calculating mean and median of decimal numbers. Making observations about data trends.
Learning Skills	Initiative, Independent work, Collaboration
Strategies	Whole class instruction, Structured activities, reading and interpreting
Assessment	Oral and written responses

Introduction (5 minutes)

Refresh students on part 1's material briefly and respond to any questions or ideas in their notes from the part.

"Today we will be using water quality data to see how Sharbot Lake has changed over time". Show students the temperature bar graph from part 1 again (**refer to the slides for part 2**). Ask class verbally:

1. How can we learn more details about the temperature of Sharbot Lake?
2. What is the time range of the data?
3. How many observations are there?

"Time for calculations! To learn about how the temperature data at Sharbot Lake are changing, we need to use math"!

Body (5 - 10 minutes)

Hand out worksheets for part 2; make sure that the graph and water temperature tables are visible on a projector for students to refer to (see the slides for part 2).

Break students into 3 groups. In the interest of time, doing so by where students are sitting in the class may be easiest, but note that some groups will have to do a few more calculations. In these three groups, students will calculate the mean or the range of data within three sets of years (2001-2011, 2017-2018, 2019-2022). The data tables have been presented in the interest of time and to simplify the process.

- Suggestion: remove decimals from the tables for grades who have not tackled decimal numbers yet.

Be prepared to take more time here, given the amount of values that students will be working with, and encourage group mindset where students help each other with the calculations.

Conclusion (5 minutes)	**Extension** (Grade 8+)
Wrap up instruction by working with students to develop conclusory statements with students, such as: 1. "Therefore, the mean of the water temperature at Sharbot Lake between 2001-2011 is 19.4 degrees Celsius". 2. "Therefore, the range of water temperature data at Sharbot Lake from 2017-2018 was 18.2 degrees, which is 2.8 degrees greater than the range from 2001-2011".	1. Do you notice any outliers (data points that are very different from the others) in the tables? What may have caused them? 2. How would the mean change if we removed these outliers? 3. How would the range change if we removed these outliers?

Part 3	Interpreting graphs and trend lines
Guiding Question	How can we visualize changes over time in data?
Time	15 minutes or more
Prior Knowledge	Understanding multiple types of graphs. Understanding a line of best fit, or trend line. Being able to make observations about trends of data, as well as simple predictions about the future of the data based on the trend line. Ideas about the cause and consequence of climate change over time.
Learning Skills	Initiative, Independent work, Collaboration
Strategies	Whole class instruction, reading and interpreting, use of visuals
Assessment	Oral and written responses

Introduction (5 minutes)

Begin by returning to the mean and range calculations from part 2. Draw attention to the answers that students found, particularly if there are changes happening over time, such as:

“From 2001-2011, the mean (average value) of the water temperature at Sharbot lake was 19.4 degrees celsius. From 2019-2022, the mean is now 21.4 degrees. What has happened here?”

Next, show the temperature over time graph again (**refer to slides for part 3**). Ask a repeat question verbally to the class: “What did you see changing as time goes on?”

Body (5-10 minutes)

“Let’s explore a way that we can better see change over time in the temperature of Sharbot Lake”.

Now, show the same temperature graph, but with an added trend line (slides for part 3). Ask students what they think this line means. Clarify and expand upon their answers.

Now, **distribute the student handouts for part 3**. Have students work through the handouts either independently or in small groups, as you see fit.

Conclusion (5 minutes)	**Extension** (Grade 8+)
Once again, collect student handouts and use students’ answers to inform your thinking going forward. The activity asks students to think about future consequences of gradual climate change. With time, explore causes and consequences of climate change within freshwater bodies. Perhaps loop back in prior knowledge students may have about climate change in previous grades. Connect climate change with local and national issues, such as mining, industrialization, and pollution.	1. What can we learn from the trend line in the graph above that we couldn’t learn from the bars? 2. Given the trend line above, what water temperature would you expect to observe in 1995? In 2030? 3. How do you think outliers affect the trend line?

Part 4	Comparing two sets of data
Guiding Question	What patterns can we see by comparing two sets of data?
Time	20 minutes or more
Prior Knowledge	Understanding multiple types of graphs, including bar graphs. Understanding a line of best fit, or trend line. Being able to make observations about trends of data, as well as simple predictions about the future of the data based on the trend line.
Learning Skills	Initiative, Collaboration
Strategies	Whole class instruction, think-pair-share.
Assessment	Oral and written responses.

Introduction (5-10 minutes)

See the slides for part 4.
"Today we are working with a new type of water quality parameter: dissolved oxygen". If students need additional understanding of dissolved oxygen, visit our page on it here: https://waterrangers.ca/testkits/tests/dissolved-oxygen/. Highlight that as dissolved oxygen drops, life in fresh water will struggle to cope. Fish spawn will be unsuccessful, competition for resources more difficult, and in extreme cases, fish and other animals will suffocate and die.

Body (5-10 minutes)

Distribute handouts for part 4. Show students the dissolved oxygen graph**.** Ask questions 1 and 2 verbally to the whole class.

1. In the graph below, when is the lowest recorded dissolved oxygen reading? When is the highest?
2. What do you think will happen by the 2030's? What is the lowest value that dissolved oxygen might reach? What might the consequences of this be for aquatic life?

After hearing out and prompting for responses from students, have them write a few of their own answers, or their peer's answers down.

Next, show students the double bar graph on the slides. Have students think-pair-share with a partner for questions 1 and 2.

1. In the graph below, how are water temperature and dissolved oxygen changing over time? Why do you think that might be?
2. What does the graph below suggest about the relationship between water temperature and dissolved oxygen? Do you think one may influence the other?
    - You can explain that warmer water retains less oxygen (because warmer water molecules move faster, thereby letting oxygen escape). Warmer water can also lead to algal blooms, which in turn consume more oxygen.

Conclusion (5 minutes)	**Extension** (Grade 8+)
Finish up by collecting handouts. Inform students that tomorrow, they will be creating their own graphs given a set of real, scientific data from Sharbot lake.	See: Slides for part 4. This activity involves interpreting a scatter plot, and is more complex than previous parts. Leave the scatter plot up on the slides for students to work with.

Part 5	Building our own graph
Guiding Question	What can we learn about displaying data by creating our own graph?
Time	25 minutes or more
Prior Knowledge	Selecting from among a variety of graphs, including histograms and broken-line graphs (grade 8+), the type of graph best suited to represent various sets of data Creating an infographic about a data set, representing the data in appropriate ways
Learning Skills	Initiative, Organization, Collaboration, Self-regulation
Strategies	Partner activity, exit card, whole class instruction.
Assessment	Graphs will be collected and marked for accuracy and adherence to the structure provided.

Introduction (5-10 minutes)

"Today is the final part of our case study on Sharbot Lake"! **Refer to slides from part 5**. To wrap up these activities, students will be creating a graph of water temperatures on Sharbot Lake's *east* basin, given a set of values.

The goal of this activity is to help build students' comfort with creating graphs, and to help them see the process that we must go through to make data easier to interpret.

Body (10-15 minutes)

Distribute handouts for part 5 to get students started with graph creation. Leave the table of values up on the board for students to work with.

"Based on the information in the table, make a bar graph using graph paper and a ruler.You need to choose what will go on the x and y axis, and to plot each bar correctly. Remember to label your x and y axis, and include a title.To make it easier, you can round table values to the nearest whole number".

If time requires, or if students would work well together, partner students up with their think-pair-share partners from part 4. If possible, work with other grades on the extension activity at the same time, perhaps in a corner of the classroom.

Conclusion (5 minutes)	**Extension** (Grade 8+)
Wrap up the session by gathering handouts and having students return to their desks. Use the graph on slide 28, for part **5** as an example for the activity. Ask students some final prompts about any visible trends. "What have you learned this week"? 1. Make it clear that there **is a real issue** facing water in Canada: warming temperatures leading to drops in oxygen. Also highlight that there are things we can do to alleviate this, such as taking action to promote positive change. 2. Highlight how citizen/community science gathered by individuals can lead to change. All the activities of the week were based upon the work of citizen science.	See: slides for part 5. "Based on the information in the table, make a histogram of water temperature at Sharbot Lake (West basin) from 2019 to 2022".