LONGER DAYS, SHORTER SHADOWS & EVEN SMALLER BAR GRAPHS

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"Education is all a matter of building bridges." ~ Ralph Ellison

This unit is designed to supplement the Light Up section of the 9 Applied Design, Skills and Technology (ADST) Lessons found at https://digmore.prn.bc.ca/helpful-resources/adst/. *ADST support exists for SD60 teachers, including materials, tools and training. Please contact your administrator if you'd like to access this support.*

ABOUT THIS LESSON: STUDENTS WILL REPRESENT DATA ON GRAPHS THAT SHOW ONE-TO-ONE AND MANY-TO-ONE CORRESPONDENCE.

LESSON TITLE	LITERACY/ NUMERACY TASKS	BRIEF OVERVIEW OF LESSON
Longer Days, Shorter Shadows & even smaller Bar Graphs! Supports the "Light Up" ADST Project Grade 5	Numeracy Task: measuring student shadows as the days get longer/shorter - comparing and ordering of fractions and decimals and/or - and/or comparing cm vs m) Curricular Competency (Gr. 5): Develop and use multiple strategies to engage in problem solving Engage in problem-solving experiences that are connected to place & story. Big Idea: Data represented in graphs can be used to show many-to-one correspondence	After making a light up wand, students will further develop their understanding of how solar light impacts our northern place. They will measure their shadows each week, graph their data and better understand how Data represented in graphs can be used to show many-to-one correspondence.

TARGET AUDIENCE: Grade 5 students (data represented in graphs can be used to show many-to-one correspondence).

PREP WORK:

- **Print out the bar graph template**. **Double side with "Sample Shadow-Data Bar Graph."** Print at least 1 for yourself (and one for each student, if your students don't have their graph paper).
- Get a Calendar. Choose a "Shadow Measuring" date each month (for at least 3 months, but you could do all 10 months if you wanted!) *Pro Tip: Do it on your mid-month Payday. Getting paid is a good way to remember that the kids need to do this!*
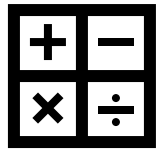
- Get a [long measuring tape](#) like the ones they use at track meets. Your P.E. office should have one.
- Get graph paper @ 1 page per student (Students usually supply their own, but [here's a free downloadable bar graph template](#))
- Get butcher string or yarn
- Identify a south-facing area of the school ground that is readily accessible and free of obstacles. Wintertime shadows can be longer than 15 meters, so make sure you have a clear space that doesn't involve too much hiking through the snow when it's really cold!
- Get a set of clipboards for the class; one per pair.
- *It's assumed that the students in your Grade 5 class will explore power and solar power at some point during the school year.*
- *It's assumed that you've made [Moneca Conway's Light Up Project](#) at some point before this lesson.*

MATERIALS LIST:
- 1 Bar Graph paper per person (see sample below)
- 1 Class Calendar
- 1 pencil per pair.
- Yarn (Cut into enough 15 m lengths for each pair; label the names of the pair with masking tape)
- Markers (2 different colours per pair. For example - 1 red, 1 blue)
- 1 Clipboard per pair
- Flashlight
- Metre stick
- Chair
- Rulers
- Pencil Crayons

QUESTION:
- In what different ways can we represent many-to-one correspondence in a graph?
- Why would you choose many-to-one correspondence rather than one-to-one correspondence in a graph?

GRADE # CURRICULUM:
- **Big Idea:** Data represented in graphs can be used to show many-to-one correspondence.
- **Curricular Competencies:**
  - Represent mathematical ideas in <u>concrete, pictorial, and symbolic forms</u>.
  - Engage in problem-solving experiences that are <u>connected</u> to place, story, and the local community
- **Content:** one-to-one correspondence and many-to-one correspondence, using double bar graphs

VOCABULARY:
o **Solstice**: the dates marked by the longest & shortest days (usually June 21 & December 22).
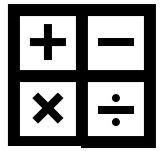
- o **Equinox**: The dates when day and night are of about equal length (usually September 22 and March 20).
- o **The angle of incidence**: the angle that a line (such as a ray of light) falling on a surface or interface makes with the normal drawn at the point of incidence (Taken from Study.com)
  - o For more information on how the seasons affect our shadows, check out this resource:
    - ▪ Shadow Season, by Dylan James Amick
- o **Many to one correspondence:** Many-to-one correspondence is a representation of many objects by one object or interval in a graph. For example, in a pictograph, one happy face can represent 5 people, and in a bar graph, one rectangle on the graph paper can represent 10 years.
- o **One-to-one correspondence:** A representation of one object by one interval in a graph. For example, in a bar graph, one meter can represent 1 square on the graph paper.

INTRODUCE THE LESSON:

1. WARM UP MATH ACTIVITY. "Let's get you thinking about bar graphs with this slow reveal bar graph "I don't think we're in Kansas Anymore" conversation c/o *by Jenna Laib (@JennaLaib)."* Follow the prompts on the slide deck.
2. CONNECT THE DOTS: "We've been studying solar energy and sunlight in Grade 5 science. In our ADST lesson, we made Moneca Conway's Light Up Project. Now we're going to go a little further and shed some light on Math. Every month we're going to stand in the same place and notice how long our shadows are. We're going to measure those shadows and use bar graphs to represent the data.

Let's do a quick survey.
- - Who thinks their shadow in December is the same length as their shadow in June? Hands up for the same length in June and December!"
  - o Count the number of "hands up" for "the same length" and jot #/the same length onto the whiteboard.
- - Prompt: "OK, who thinks their shadow is longer in June vs December?"
  - o Count the number of "hands up" for "longer in June" and jot #/longer June onto the whiteboard.
- - Prompt: "OK, who thinks their shadow is shorter in June vs December?"
  - o Count the number of "hands up" for "shorter in June" and jot #/shorter June onto the whiteboard.
- - Prompt: "Graphs are fast ways of showing people information. Let me show you how to quickly graph what we think we know about shadows. Let's look at the Rules about graphs handout (see below)."
  - o Grab the bar graph template (below), project it onto your whiteboard and quickly plot your classroom data for the above survey.
  - o Prompt: "Let's see if my graph meets the criteria for a good grade 5 bar graph. Does it follow the Bar Graph rules?
    - ▪ Title
    - ▪ Legend
    - ▪ Spaces between data sets
    - ▪ A labelled X-Axis (the line that goes ACROSS the page)
    - ▪ A labelled Y-Axis (the line that goes UP & DOWN the page)
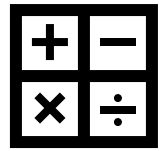
- Colours or patterns to differentiate data
- Accurate Data is presented on the graph in 1:1 correspondence.
- Units of measurement are included (for example, centimetres or meters)
- And most importantly – they're always done with a ruler or on an application like Microsoft Excel. No freehand scribbles!
  - Yep. I meet the criteria. See how one square = 1 meter? Awesome! That there is 1:1 correspondence. 1 square:1meter. But wait! There's more! Now I'm going to show you how to do ONE-TO-MANY-CORRESPONDENCE!! (Insert thunderous applause here).
  - 1:2 Correspondence is easy. Just divide everything by 2. I'll put this information next to my original data, but I'll make sure I leave a big space between the two sets of data.
  - Now Let's take a look at the sample data graph (below) before we head outside to measure our shadows. If the September shadow was 8 meters long, we divide by 2 (we half the data). Now 1 square has to equal 2 meters. See how the blue line in the 1:2 data set is only half as long as the blue line in the 1:1 data set?
  - What if we decided to do 1:10? Then we'd divide 8 by 10 and we'd draw a bar graph that was .8 (8/10) of a bar high. Boy, those would be tiny bars on our graph. Should we bar graph that? Why or why not?"
    - *(We could – but it isn't very visually appealing and we'd need a magnifying glass to see it. Later on, we can play with different one-to-many correspondences, but for now, let's just focus on 1:2).*

TEACH THE LESSON:

1. Go outside on a sunny day.
2. Stand students in AB pairs at the "starting point" of their shadow measurements
3. Have A partner hold the end of the string – the sun should be to their back. You should try to measure at the same time each day (10:45 am on or near the 15th, for example).
4. Have B Partner walk to the end of A's shadow and mark the string with a marker where the shadow ends (with a red marker, for example).
5. Switch places. Repeat process but have A mark the string with the blue marker.
6. Return to class. Spool measuring tape out in the hallway and have students measure their strings against the measuring tape. Position yourself in the doorway of your class so you can monitor the pair in the hallway while the class eats their snack until it's their turn to measure their string.
7. When all students have a measurement in feet or meters (your choice), refer them back to their graph paper.
   i. Using your projector, model the creation of a bar graph with your shadow data, including:
      1. Name
      2. Title
      3. Legend
      4. Spaces between data sets
      5. A labelled X-Axis (the line that goes ACROSS the page)
   6. A labelled Y-Axis (the line that goes UP & DOWN the page)
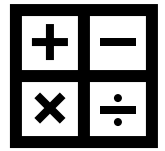
7. Colours or patterns to differentiate data
8. Accurate Data is presented on the graph in 1:1 correspondence.
9. Units of measurement are included (for example, centimetres or meters)
10. And most importantly – they're always done with a ruler!

8. Then make the second set of data with a 1:2 correspondence.
9. Ask for questions and help small groups as needed.
10. Students should then complete their bar graphs with 1:1 and 1:2 correspondence.
11. Do a self/peer assessment using the Bar Graph Rules.

a. All the criteria completed accurately = A
b. All the criteria are completed, but there may be some minor errors with data = B
c. Most of the criteria are completed for both 1:1 and 1:2 correspondence. There may be some errors with data (student may not have plotted some of the data correctly and may have forgotten to space or neglected to use a ruler) = C
d. The student is unable to show 1:2 and/or 1:1 correspondence without support = I (offer small group support next month and repeat until student is independently able to complete the bar-graphing).

REPEAT THE LESSON:

- Each month (for at least three months).
- Keep the bar graphs, markers and strings on clipboards for easy access.

EXTEND THINKING IN CLASSROOM DISCUSSION:

- How does the angle of incidence affect our shadows?
- What do we notice about our shadows during winter/summer solstice?
- What do we notice about our shadows during the fall/spring equinox?
- Why do we do one-to-many correspondence? Why not just put our strings on the wall?
- Feel free to write poetry inspired by Light. Here's one for inspiration!
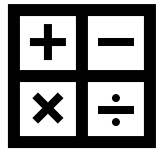
NAME: _____ DATE: _____

BAR GRAPH INSTRUCTIONS

On Graph Paper, create 2 bar graphs that show how long your shadows are each month. Plot data at a correspondence of 1:1 and 1:2.

CRITERIA FOR SUCCESS:

Each month, add new shadow data to your 2 bar graphs.

1. The first set of data is to be done with 1:1 correspondence.
2. The second set of data is to be completed with 1:2 correspondence.
3. Ensure you follow the 10 rules of bar graphs on both data sets!
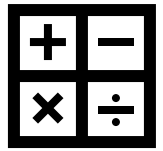
ASSESSMENTS

A note about assessments: Your classroom observations and exit slips are more than enough fodder for assessment. The rubrics are optional and are provided for your convenience.
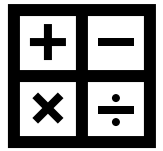
	I'M **EXPLORING** WITH SUPPORT	I NEED A LITTLE HELP TO **DEVELOP** SKILLS	**PROFICIENT** - I CAN DO IT ON MY OWN	**EXTENDING** – INDEPENDENT & FLEXIBLE
I THINK I AM				
MY TEACHER THINKS I AM				

My 1:1 Bar Graph has
1. Name
2. Title
3. Legend
4. Spaces between data sets
5. A labelled X-Axis (the line that goes ACROSS the page)
6. A labelled Y-Axis (the line that goes UP & DOWN the page)
7. Colours or patterns to differentiate data
8. Accurate Data is presented on the graph in 1:1 correspondence.
9. Units of measurement are included (for example, centimetres or meters)
10. And most importantly – they're always done with a ruler!
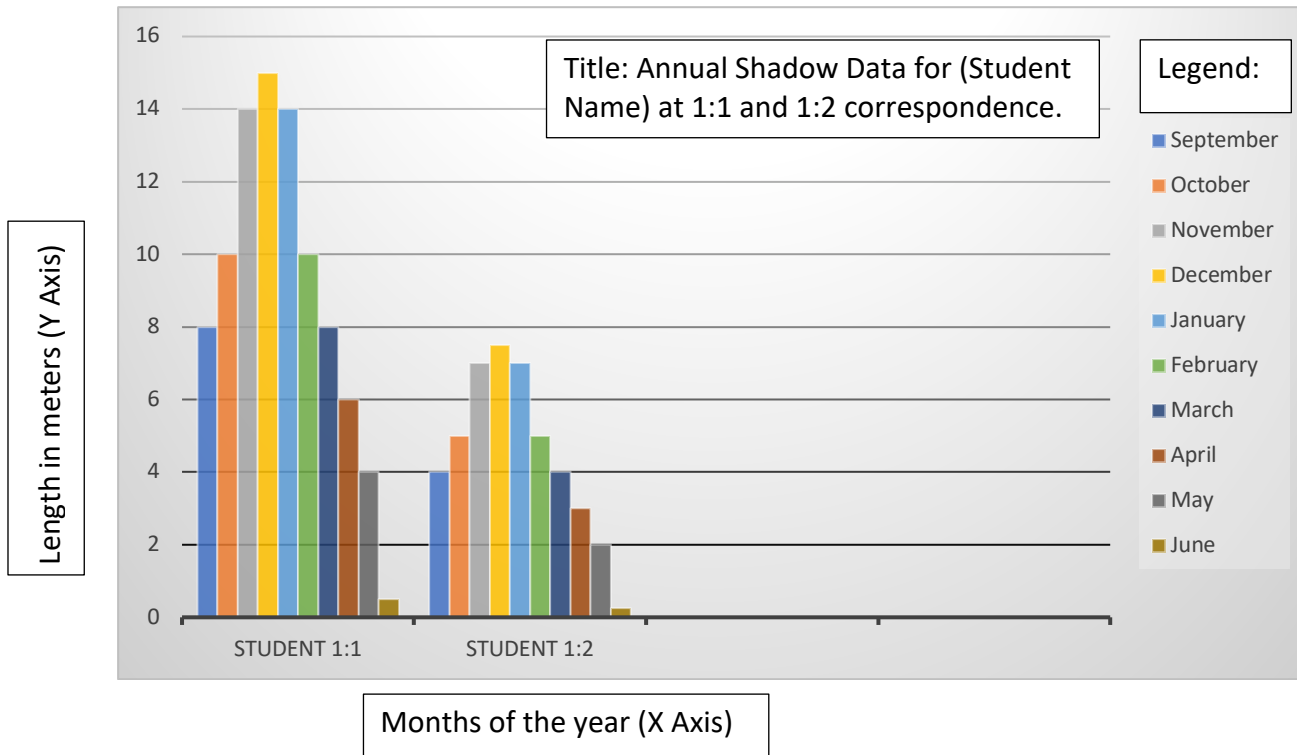
My 1:2 Bar Graph has
1. Name
2. Title
3. Legend
4. Spaces between data sets
5. A labelled X-Axis (the line that goes ACROSS the page)
6. A labelled Y-Axis (the line that goes UP & DOWN the page)
7. Colours or patterns to differentiate data
8. Accurate Data is presented on the graph in 1:1 correspondence.
9. Units of measurement are included (for example, centimetres or meters)
10. And most importantly – they're always done with a ruler!

SAMPLE SHADOW DATA BAR GRAPH

Title: Annual Shadow Data for (Student Name) at 1:1 and 1:2 correspondence.

Legend:
- September
- October
- November
- December
- January
- February
- March
- April
- May
- June

Length in meters (Y Axis)

Months of the year (X Axis)

RULES ABOUT BAR GRAPHS

Bar Graphs have
- Name
- Title
- Legend
- Spaces between data sets
- A labelled X-Axis (the line that goes ACROSS the page)
- A labelled Y-Axis (the line that goes UP & DOWN the page)
- Colours or patterns to differentiate data
- Accurate Data is presented on the graph in 1:1 correspondence.
- Units of measurement are included (for example, centimetres or meters)
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Our Shadow Bar Graphs must have one set with 1:1 Correspondence and one set with one-to-many correspondence. *Pro Tip: 1:2, 1:5 and 1:10 correspondences are usually the easiest many-to-one correspondences to make.*

Free downloadable bar graph templates (for kids that don't have their graph paper and/or need bigger squares to work on) can be found at template.net (PDF Version Below).