Analyzing & Communicating Data: Telling the Story

Students will analyze and communicate conclusions about the data gathered through the project using a digital format. Supplemental/alternative tasks are included in the Extensions section.

Suggested Timing: Science: 30 - 50 min. + time to prepare and present results

Success Criteria:

Students will:

- Represent data using numerals, symbols and images
- Use critical and creative thinking to assess and communicate data
- Communicate information in a digital format
- Work collaboratively and productively with others

Student Prior Skills and Knowledge:

- Have some familiarity with digital presentation formats
- Have some familiarity working with digital media (e.g. image resizing, adding/editing text, audio/video recording)
- Have familiarity with Scratch program (Extension 1)
- Can confidently use sensor technology (Extension 2)
- Can confidently create electrical circuits (Extension 2)
- Are able to work collaboratively in a small group setting

Computational Thinking

Practices:

- Pattern Recognition
- Decomposition
- Abstraction
- Testing & Evaluating
- Logical Thinking
- Data Analysis
- Data Representation

Approaches:

- Reusing & Remixing (Extensions)
- Making (Extensions)

Materials:

- O Access to data from Action 1 and Action 2
- O Devices with internet access
- O **BLM C1.1**: Scratch Project Assignment [.doc] [.pdf] - 1 per student (Extension 1)
- O **BLM C1.2**: Scratch Project Rubric [.doc] [.pdf] - 1 per student (Extension 1)
- O **Temperatue in the Classroom: Code Explained** [.pdf] (Extension 1)
- O **Scratch Tips and Hints** [.pdf] - 1 per student (Extension 1)
- O **BLM C1.3:** Model Life Support System Assignment [.doc] [.pdf] - 1 per student (Extension 2)
- O **BLM C1.4:** Design & Build Template [.doc] [.pdf] - 1 per group (Extension 2)
- O Materials to create a closed system (no larger than 30 cm x 30 cm x 30 cm) (e.g., cardboard, plastic wrap, wooden skewers) (Extension 2)
- O Live plants - 1 per group (Extension 2)
- O Microcomputer/microprocessor (e.g., micro:bit, Arduino, Raspberry Pi) with sensors (Extension 2)
- O Devices (e.g., fans, buzzers) that can be connected to microcomputer/microprocessor (Extension 2)

Preparation:

- Print copies of the Black Line Masters (BLMs) if planning to use or have students use the digital version in the Student Module.
- Students will need access to certain types of equipment (e.g., fan, buzzer, LED lights, microcomputer/processor, sensors and peripherals) and software compatible with the microcomputers/microprocessors (see Materials).
- Assign students to small groups.

Implementation Options:

- The extension projects could be used as independent study projects.
- This extension projects could be done over several science units (e.g., ecosystems, electricity, chemistry, space) and used as a culminating assessment task.

Consolidation1.1: Data Analysis and Reflection

Educators

Step 1

Using their completed Action Plans and the data from the two collection periods, have students determine whether or not the class met their goal. Questions for discussion can include:

- *How successful were you in terms of meeting the goal?*
- *How did the classroom feel to you - mentally and physically - after making the change?*
- *Were other environmental conditions affected by the changes made? If so, how?*
- *Were there factors that affected the plan that were beyond our control? If so, what were they?*
- *What most influenced your ability to carry out the plan?*
- *If the class goals were not met, what else could you try to meet the goal?*
- *What would you do differently next time?*

Students

Look at the Action Plan and the data that was collected during the first and second data collection periods. Be prepared to answer the following questions:

- *How successful were you in terms of meeting the goal?*
- *Did you notice a difference in how the classroom felt after making the change? If so, describe what you noticed.*
- *Were other environmental conditions affected by the changes made? If so, how?*
- *Were there factors that affected the plan that were beyond your control? If so, what were they?*
- *What most influenced your ability to carry out the plan?*
- *If the class goals were not met, what else could you try to meet the goal?*
- *What would you do differently next time?*

Step 2

As a class, discuss some of the potential consequences of the changes made. Questions for discussion can include:

- *Will we need to continue (or repeat) this change year-round? Why or why not?*
- *Do you think other classrooms in our school are affected in a similar way? How could we find out?*
- *Who else would benefit from learning what we have learned about our environmental conditions?*

Be prepared to discuss the following questions as a class:

- *Will we have to keep our change up all year round? Why or why not?*
- *Are there certain times of year when this change makes sense?*
- *What changes might we try at other times of year?*
- *Do you think students in other classes feel the same way you do? Why or why not? How could you find out?*

Did you know?

The carbon dioxide sensor that was used in this project (COZIR) is the same sensor they use on the ISS to monitor the carbon dioxide levels for astronauts.

(NASA) International Space Station (ISS) Mission Control Center in Houston, Texas. (Source: Canadian Space Agency)

Step 3

Referring back to the information from the Backgrounders used in Minds-On 2, discuss whether the changes made in the classroom could be made aboard the ISS. Answers are below:

- Astronauts always make sure they have fans blowing on their faces when they sleep.
- The water is condensed by the heat exchanger then collected so that it can be reused.
- Most of the ISS is coated with blankets of Multi-Layer Insulation (MLI), which are made up layers of Mylar and Kapton. These lightweight materials are also used to make emergency blankets on Earth.

Answer and be prepared to discuss the following questions:

- *What do astronauts do to keep CO_2 from building up near them when they sleep?*
- *What do they do with extra water from the air? Could we do that too?*
- *Do we use the same insulation in our school as the ISS uses?*

Consolidation 1.2: Project Wrap-Up

Educators

In this final part of the project, students will apply what they have learned about the environmental conditions in their classroom and/or the environmental conditions on board the ISS in the creation of a culminating digital presentation.

Students

In this final part of the project, you will present what you have learned about the environmental conditions in your classroom and/or the environmental conditions aboard the ISS. Your teacher will provide you with more details.

There are many formats that students may choose given their proficiency in various digital media. The presentations may include:

- A PowerPoint presentation
- A presentation using Google Slides
- A short YouTube video
- A presentation using Prezi - an interactive text and images tool
- An animated cartoon video using PowToon (which can be used for free). Students can use templates or create one from scratch
- An infographic using an online tool such as Canva, Piktochart or Visme

Access the Infographic Creator Learning Strategy on the Tomatosphere™ website. It includes templates, a rubric and links to free infographic programs.

- Students could give presentations to other classes about the project, including sharing their data and explaining how they worked to improve their classroom environment.
- Students could present their findings to the principal, a school/parent council or even the school board/district if the students have recommendations that could improve the conditions in other classrooms or the school as a whole.
- Students could write articles about the project and their findings for a class or school blog or a community newspaper.

Two other supplemental/alternative culminating activities are also provided. One has a coding and digital art focus while the other has a science and technological problem-solving focus.

Consolidation 1.3: Extension 1 - Scratch Project (Optional)

Educators

Assignment

In this supplementary/alternative culminating task, students apply what they have learned about environmental conditions and coding to the creation of a project in [Scratch].

This project is best done by students who already have some experience using Scratch, but it could also be used as an introductory Scratch activity with educator support.

Instructions for this space-related project is provided in **BLM C1.1**. In this project, students will remix the **Temperature in the Classroom** Scratch project so that the classroom becomes the International Space Station, and the Inspector becomes an astronaut who is communicating with Mission Control on Earth.

For an explanation of the coding involved in the Scratch project, see the [Temperature in the Classroom: Code Explained] document.

A sample rubric (**BLM C1.2**) has also been provided. Feel free to customize it to meet the needs of the students.

Ideally, students will work in pairs to complete this task.

Students can access this project by going to https://scratch.mit.edu/projects/236845556/

At this point students will either need to:

A) Sign in

B) Create an account and sign in

For information about how to create a Scratch account, see [Scratch Tips and Hints].

Students

The task for you and your partner is to remix the [Temperature in the Classroom Scratch project] and change it so that it takes place on board the ISS and that an astronaut communicates the data about environmental conditions to Mission Control on Earth.

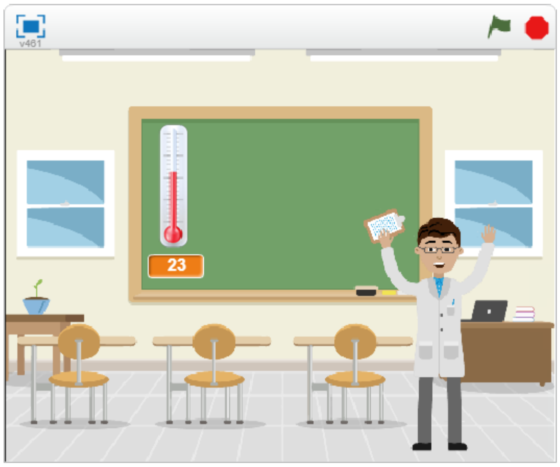
The instructions for the task are in BLM C1.1 (on paper and online).

To save your work, you will need to either need to:

A) Sign in

B) Create an account and sign in

For ideas and help, see [Scratch Tips and Hints]. There are also many good tutorials online.



Concluding

- Encourage the student groups to share their Scratch projects with the class.
- Have each group share reflections about the project.
- Discuss how creating a Computation Product, such as a Scratch simulation, can help others make meaning from data.
- Have students explain how this activity includes all aspects of STEM (science, technology, engineering and math).
- Have students fill out the boxes on the Scratch project page for their projects. This can include adding instructions as well as notes, including a description and credits.
- Students can add additional environmental conditions, such as temperature and relative humidity, to the initial Scratch project. Encourage students to consider how they would represent different levels of temperature (e.g., thermometer, sprite wears different clothing such as a winter coat or shorts) and relative humidity (e.g., more or fewer water droplets, look of a tomato plant - wilted, normal with no fruit, or large with lots of fruit).
- Students can create artwork for the backdrop and sprites offline and upload them to their projects. See Scratch Tips and Hints for more about importing artwork.
- Students can also create artwork for the backdrop and sprites in Scratch itself. See Scratch Tips and Hints for more about creating images in Scratch.
- Students can do research into the roles of people who work at Canadian Mission Control.

Consolidation 1.4: Extension 2 - Design & Build Project (Optional)

Educators

Step 1

Explain to students that for this project they will be designing and constructing a model closed ecological system. If necessary, review/discuss what a "closed ecological system" (CES) is and have students identify examples, such as:

- International Space Station (most of the time)
- Submarines (when underwater)
- Biome in a bottle (aquarium, terrarium)
- **The Earth** (the only true CES)

Students

Answer the question:

- *How would you describe a "closed ecological system?"*
- *Where can we find examples of closed ecological systems*

Closed ecological systems (CES) are ecosystems that do not involve matter exchange outside of the system.

Step 2

Discuss the potential challenges of creating a closed ecological system. Use prompting questions such as:

- *What do all living things need to survive?*
- *How would living things meet their needs in a closed system?*
- *Which do you think would be the greatest challenge to meet?*

List at least five potential challenges of a closed ecological system. Think about such things as:

- Food
- Water
- Air
- Protection from the elements
- Temperature

Step 3

Explain to students that they will be designing and constructing a model closed **Life Support System** that could be of use on the ISS or a future space colony.

The model must include a living plant and will be monitored using the humidity sensor only. The humidity sensor will need to trigger an alarm if the humidity goes outside of the 'optimum' range.

In this activity, your group will design and construct a model closed Life Support System (like the International Space Station) that will be monitored using the humidity sensor you used during the project. The model will need to include a live plant and the humidity sensor will need to trigger an alarm if the humidity goes outside of the 'optimum' range.

Assignment

The assignment for this science & technology-related project is provided in **BLM C1.3** and online. The task can be adjusted to meet the needs of your class.

Student groups are encouraged to follow a [Design & Build] process to plan, construct and test their models such as the one on **BLM C1.4** on paper or online.

You can read the assignment on **BLM C1.3** on paper or online.

Your group will need to follow a [Design & Build] process to plan, construct and test your model such as **BLM C1.4** on paper or online.

The Design & Build process is very similar to the **Computational Thinking** processes.

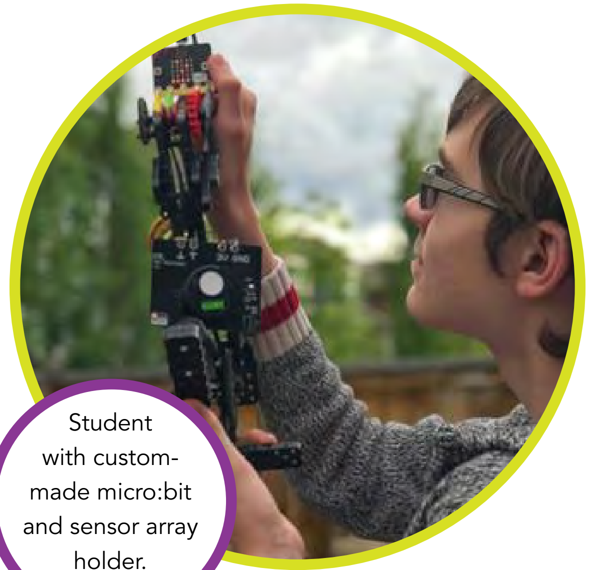
Using plants grown for the Tomatosphere™ program would be ideal for this activity.

Concluding

Set aside time for the groups to demonstrate their models to the class.

As a class, discuss how their closed systems are like an unlike the ISS. Questions for discussion can include:

- *How is your model like the ISS?*
- *How do astronauts know when the conditions are outside of optimal range?*
- *Why would it be important to monitor the humidity in a closed system like the ISS or a Martian colony?*
- *How can plants affect the humidity in a closed system?*
- *How could you create a closed system in which the humidity is always within an optimal range?*
- *What types of devices could you use to either add or remove humidity from your model?*


Student with custom-made micro:bit and sensor array holder.

- Have students explain how this activity includes all domains of science (biology, chemistry, physics, earth & space science). This could be a written activity or a class discussion.
- Students could monitor other conditions such as temperature and carbon dioxide to see how the conditions are similar to or different from their classroom as well as the ISS.
- Students could connect their models to create a larger closed system. How does this affect the humidity levels?
- Students could add a system for adjusting the humidity automatically within their models (e.g., ventilation system, adding absorbent materials such as sponges or paper towels).

Consolidation 1.5: Additional Resources

Background Information

- http://tomatosphere.letstalkscience.ca/
  Tomatosphere™ is a free program where Kindergarten to Grade 12 students across Canada use "space" tomato seeds to investigate the effects of outer space on seed germination. Follow the link to find out how you can register for the project and get seeds. The Tomatosphere™ website is also full of resources relating to space, plants and science inquiry, such as the ones that follow:

- http://tomatosphere.letstalkscience.ca/Resources/library/ArticleId/4660/destination-mars.aspx
  This page on the Tomatosphere™ website describes the challenges involved in getting to Mars.
- http://tomatosphere.letstalkscience.ca/Resources/library/ArticleId/4751/life-support-in-space-closed-systems.aspx
  This page on the Tomatosphere™ website describes life support systems used in space (closed systems).

Online Resources

- https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Water_Filtration_Challenge.html (Accessed July 16, 2018)
  This page in the NASA Education section has an education guide called Environmental Control and Life Support Systems Water Filtration Challenge Educator Guide. The challenge is to design and build a water filtration device using commonly available materials. To meet this challenge, students build, test and measure the performance of the filtration device, analyze the data collected, and use this information to work towards an improved filtration design.
- https://www.nasa.gov/content/life-support-systems (Accessed July 16, 2018)
  This page on, in the NASA media resources section, is all about how we sustain humans beyond Earth.
- https://www.nasa.gov/audience/foreducators/k-4/features/F_People_Behind_the_Astronauts.html (Accessed July 16, 2018)
  This web page, from the NASA website, explains the role of the NASA Mission Control Centre.
- http://www.asc-csa.gc.ca/eng/iss/controllers.asp (Accessed July 16, 2018)
  This web page, from the Canadian Space Agency website, discusses the work of Canadian Mission Controllers.
- https://scratch.mit.edu/studios/1817151/projects/ (Accessed July 16, 2018)
  This page, on the Scratch website, if full of Scratch tutorials created by Scratch users.
- https://makecode.microbit.org/projects/soil-moisture (Accessed July 16, 2018)
  This set of pages on the MakeCode website has instructions for building and coding the micro:bit so that it can be used monitor soil moisture.
- https://makecode.microbit.org/projects/plant-watering (Accessed July 16, 2018)
  This follow-up to the soil moisture project above has instructions to create a system that can water a plant automatically.