| Scientific Inquiry - Gathering Data Using Input/Output Code | Grade 8 Systems in Action |
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| Lesson Plan | **Coding Tools** Scratch.mit.edu or CSFirst (https://csfirst.withgoogle.com/login?continue=/project/editor) Google Forms https://docs.google.com/forms/u/0/?tgif=d |
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| | **Cross-curricular Connections** Science - inquiry, system input/output, and coding Math - data collection and coding |

**Description**

This lesson shares two different ways to code for data collection when surveying larger groups as part of scientific inquiry projects. The first is using Google Forms and the second is using Scratch block coding. During the lesson, students will explore the importance of input/output coding for both the person developing the code and as feedback for the end users who are being surveyed.

**Learning Outcomes**

- Create a data collection tool using the coding principles of if/then and input/output.
- Provide feedback to users by coding specific output responses.
- Conduct data collection using student-generated codes.
- Assess the effectiveness of different data collection tools (Scratch versus Google Forms) from the perspective of the code developer and the end user.
- Describe the impact of automated feedback on the data collection process.

**Specific Expectations**

**Structures and Mechanisms: Systems in Action**

**D2.2** describe the purpose, inputs, and outputs of various systems.

**STEM Investigation and Communication Skills**

**A1.3** use an engineering design process and associated skills to design, build, and test devices, models, structures, and/or systems.

**Coding and Emerging Technologies**

**A2.1** write and execute code in investigations and when modelling concepts, with a focus on automating large systems in action.

**Introduction**

In this lesson, students will participate in a full-class data-gathering activity using a Scratch program. Using the results of that activity, as well as two Google Forms, the teacher will lead a discussion about the differences between different data collection tools (paper and pencil survey, Scratch survey, and Google Form). Students will experience and discuss the effect of feedback which can be coded into the survey tools, and how it might help or hinder research.

After the slide presentation and group surveys, students will then modify existing code (provided with each survey in the slides) or create unique code to create their own data collection tool using the Scratch block-based coding program and/or Google Forms.

Note: This can be done with Microsoft Forms as well. They have a similar conditional statement that can be used.

**Action**

- Lead the lesson on coding using the slide deck.
  **NOTE: There are two links where you will need to make your own copy of the material and share your link with the students to have access to the class survey results.** These are on slides 9 and 15.
- Whole class survey (slide 2): Load https://scratch.mit.edu/projects/882878108/ on your screen. You can either use your computer as a polling station, giving each student a chance to select their own response, or poll the class using a show of hands and then enter the results on your screen. Switch your display to the Scratch page so students can see live results.
- Coding Examples, if/then statements and inputs/outputs (slides 4-8): these slides can be extended by having students brainstorm other examples which would fit into each category.
- Your Turn (slide 9): First, *make a copy of the Google Form survey* by clicking the link and then the blue button.
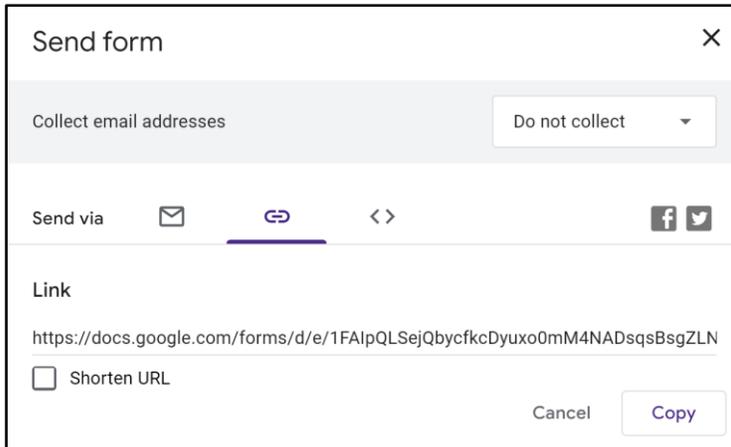  https://docs.google.com/forms/d/1c0PvlAs1FjvvD3kJ625v9nSu44p_LL1kNIMEB4M2VQc/copy

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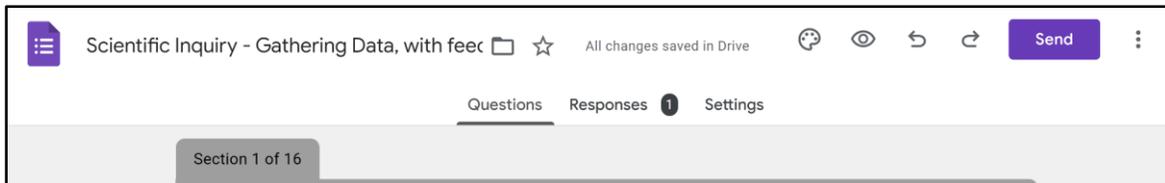Then, share the survey with students by clicking the purple send button.



In the popup window, click the paperclip link icon in the middle.



Then click "Copy" at the bottom right. Share this link with students.
Click the x to exit.

To see the student answers, go to the "Responses" tab in the centre of the main screen on the form.



Students will answer the individual survey using the link you share. If you have 1:1 devices in your class, this can be done all at once. If not, they can take turns on devices in groups of 2-3 students.

- Discuss the results (slide 10) with the students using the prompts. Be sure to show them the graphs which Google automatically generates as part of the "Responses" section.
- Looking at the code (slide 11). Students can make their own copy of the code for this survey for future use. It gives examples of different types of questions which can be used in Google Forms.
- Information about research, data collection, and giving feedback (slides 12-14).
- Google Form with Feedback (slide 15): First, *make a copy of the Google Form survey* https://docs.google.com/forms/d/1UYKPLkqDMUzA4JQw5dszfyfPY7rOthZydoieYlBelE8/copy following the same steps you used for slide 9. This survey has the same

questions, this time with added feedback in the form of words and pictures to confirm their choices. This feedback is from the if/then statements when making the form.

- Reflecting on feedback versus no feedback (slide 16), looking inside the code for the feedback survey (slide 17), exploring the code for the Scratch survey at the beginning (slides 18, 19), and class discussion (slide 20).

**Student Product**
- For students who are experienced with code and ready to create their own surveys using code, this is where you can give them the link to the slide show to give them full access to all links and materials and release them to work.
- For students who would benefit from step-by-step instructions, use the tools provided on slides 21 to 30 to guide them through the creation and sharing of their data collection survey.
- Use existing examples of code and have the students try changing the question, the choices, and/or the pictures. This is a good way to introduce students new to coding to this activity. *You can compare these source codes when looking at student work to see which coding is provided here and what they create on their own.*
    - The three example code links students can use:
        - Scratch survey https://scratch.mit.edu/projects/882878108/
        - Google form - no feedback https://docs.google.com/forms/d/1c0PvlAs1FjvvD3kJ625v9nSu44p_LL1kNIMEB4M2VQc/copy
        - Google form - with feedback https://docs.google.com/forms/d/1UYKPLkqDMUzA4JQw5dszfyfPY7rOthZydoieYlBelE8/copy
- Give the students at least one hour to work on coding their own data collection tool. They can start by remixing one of the sample codes or using a blank code template. You can have them do this alone, in partners, or in groups. Individual work is best here to give everyone coding time. Try making a shared group document where students can post their links to be tried and commented on by classmates.

## Consolidation/Extension
### Main Ideas

- Science experiments collect data to help answer questions.

- Coding is an effective way to create tools to collect data.

- Experimenters need to carefully choose or create their coding tools when conducting research and experiments. The use of if/then statements and input/output allow for flexible coding options.

- Giving participants feedback as part of your code can help them feel motivated and recognized.

## Accommodations/Modifications

- For modified or accommodated students, have them use Scratch OR Google Forms, not both.
- **Focus on creating one question with 3 multiple-choice answers.**
- Use existing examples of code and have the students try changing the question, the choices, and/or the pictures.
- In Scratch, have students "remix" a simplified code that is already written.
- In Google Forms, they can make a copy of a survey with one question, adding their own responses.
    - Suggested questions:
        - Which animal do you prefer?
        - What is your favourite day of the week?
        - How many siblings do you have?
        - What food would you select from these choices?

- For those students who need a challenge, you can try these extension prompts.
    - "Did you try making a survey in both Scratch and Google Forms?"
- Scratch:
    - "Add sound to each selection."
    - "Create a unique thank you message that pops up after each person makes their selection."
    - "Hide the scores and create a final scoreboard that appears after everyone has made their choices."
- Google Forms
    - "Change the banner at the top and the colour scheme".
    - "Illustrate your work. Add gifs or pictures to each question or answer."
    - "Add links to give participants additional information relating to each response."
    - "Sketch out a flow chart showing the input/output and if/then statements from your survey."

## Assessment

When assessing coding, the following rubric can be used. It is also on the last slide of the lesson materials. Consider the individual learning about code, how creative the product is compared to the example source code, and whether the program works as a data collection tool.

| | Level 4 Extending | Level 3 Proficient | Level 1-2 Approaching |
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| Programming with Scratch | Survey code includes a functional score display and feedback message for each option. | Survey code includes a score display and feedback for most of the options. A few small glitches. | Code needs work to become useable as a survey. Time to troubleshoot using the examples from class! |
| Programming with Google Forms | Code includes clear questions and feedback message for each option on the survey. | Code includes a question and feedback for most of those options.<br><br>Survey may have an option or two that needs editing. | Code has a question and needs answers added to become useable as a survey. Look at the examples from class for help! |
| Data Collection: Skill | Code is original, going beyond what is provided in the examples (several questions and answer options).<br><br>Performs data collection in a way that is clear to the end user. | Code shares some original ideas, building on the examples from class.<br><br>Performs data collection with a few questions from the end user. | Code uses the examples from class, changing some elements. Some parts of the code need work to make them functional or clear to the end user. |

## Additional Resources

Written instructions for making and sharing a Google Form
https://support.google.com/a/users/answer/9303071?hl=en

Video for creating a question in Google Forms https://www.youtube.com/watch?v=sP3lTgz2HkI
How to make a survey in Scratch https://www.youtube.com/watch?v=pMSjsC94Kf8
If/Then Conditions in Google Forms https://www.youtube.com/watch?v=6110yW7ovD4
Coding tutorials in Scratch https://scratch.mit.edu/projects/editor/?tutorial=all

**Extend your block-based learning:**
Minecraft Edu (accounts required) https://code.org/minecraft
Code.org https://code.org/student/middle-high

**Teacher Resources**

Science North Professional Learning: Coding Series

https://schools.sciencenorth.ca/professional-learning-coding-series

Canada Learning Code https://www.canadalearningcode.ca/teaching-code/

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