Coding and Inequalities

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Task Description
In this task students will extend prior learning about inequalities (solving and graphing on a number line with one variable) to graphing inequalities on a Cartesian Plane with two variables. They will read code in Scratch that involves variables and inequalities to predict the outcome, and alter the code to create a new outcome.

The task is available to be used as a Desmos Activity or in slides.

This task has been adapted from - 4 Inequality Puzzles

Big Idea
- Inequalities are similar to equations but different
- Inequalities with two variables can be graphed on a Cartesian Plane
- There are a whole bunch of points in a certain area on a Cartesian Plane that satisfies an inequality
- Coding can be used to represent mathematical concepts

Duration
1 or 2 periods (75 -150 minutes)

Recommended Materials
- A device or Chromebook for each student (phones are not recommended)
- Access to any of the following applications:
  Google Sheets
  Desmos (free web based program, no sign in required; Students can create an account to save their work)
  Scratch (free web based program, no sign in required; Students can create an account to save their work)

Learning Goal(s)
- Students will read code to predict an outcome
- Students will alter code to change an outcome
- Students will learn how coding can be used to demonstrate an understanding of algebraic concepts
- Students will learn how an inequality is represented on a Cartesian Plane

Sample Success Criteria
- I can read code to predict an outcome
- I can alter code to represent a similar mathematical situation
- I can graph an inequality using technology and explain why a region of the graph is shaded

Overall Expectations

AA1. Social-Emotional Learning Skills
develop and explore a variety of social-emotional learning skills in a context that supports and reflects this learning in connection with the expectations across all other strands

A1. Mathematical Processes
apply the mathematical processes to develop a conceptual understanding of, and procedural fluency with, the mathematics they are learning

B1. Development of Numbers and Number Set
demonstrate an understanding of the development and use of numbers, and make connections between sets of numbers

C2. Coding
apply coding skills to represent mathematical concepts and relationships dynamically, and to solve problems, in algebra and across the other strands

C4. Characteristics of Relations
demonstrate an understanding of the characteristics of various representations of linear and non-linear relations, using tools, including coding when appropriate

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Social-Emotional Learning (SEL) Skills

- Recognizing and Identifying Emotions That Support Mathematical Learning
- Recognizing Sources of Stress That Present Challenges to Mathematical Learning
- Identifying Resources and Supports That Aid Perseverance in Mathematical Learning
- Building Healthy Relationships and Communicating Effectively in Mathematics
- Developing a Healthy Mathematical Identity Through Building Self-Awareness
- Developing Critical and Creative Mathematical Thinking

** This overall expectation is to be included in classroom instruction, but not in assessment, evaluation, or reporting. See **further information** about approaches to instruction that support all students as they work to apply mathematical thinking, make connections, and develop a healthy identity as mathematics learners to foster well-being and the ability to learn mathematics.*

Mathematical Processes

There are opportunities for students to engage in the **mathematical processes** throughout this task. For example:

- **Problem Solving:** critical thinking, math identity, knowledge, collaboration, lived reality, creative thinking, confidence
- **Reasoning and Proving:** justification, algebraic reasoning, spatial reasoning, numbers, operations
- **Reflecting:** identify what is working, what isn't working, appropriate strategy
- **Connecting:** connect different mathematical concepts
- **Communicating:** share ideas, understandings and solutions, provide feedback, pose questions
- **Representing:** represent math relationships using pictures, diagrams, numbers and symbols
- **Selecting Tools and Strategies:** test, revise, confirm reasoning, remembering how they solved a problem

Prior Learning and Placement of Task during Semester

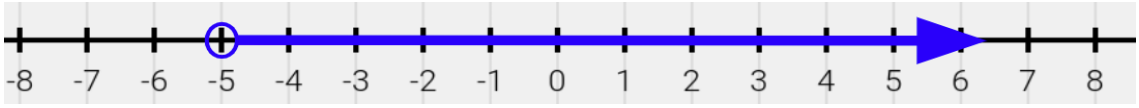
This task should come later in the semester when students have experienced some introductory coding in Scratch as well as learning around linear relations.

Diagnostic Task & Look fors

Diagnostic Questions*

Click here for the following questions in Google Docs. Click here for the questions in Google Slides.

1. How would you describe the numbers shown on the number line graph below?



2. The following number line graph represents the inequality $2n > 12$, where n is a whole number.

- Explain why this is the correct graph for the inequality.

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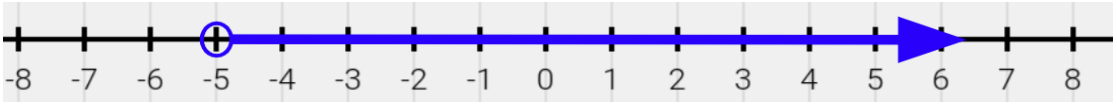
3. The following number line graph represents the inequality $2x - 3 > -13$, where x is a real number.



- Explain why this is the correct graph for the inequality.
- Test an integer, rational number and irrational number from the number line to show that the solution is true.

Look Fors

- Is able to identify different types of numbers (integer, rational number, irrational) on a number line
- Can select a value from number line that holds true for an inequality and input the value for the variable to show it satisfies the inequality
- Can read the inequality symbol correctly as “greater than” or “less than”
- Has a strategy to solve an inequality (guess and check, reverse flow chart or balance)
- Can make connections between solving inequalities and solving equations
- Understands an inequality has a range of solutions, where as an equation has one solution

**Solving inequalities is new to the 2020 elementary math curriculum (starting in grade 4) so students may or may not have prior learning with this concept. Grade 6’s will solve inequalities that involve two operations and whole numbers up to 100, and verify and graph the solutions. Grade 7’s with multiple terms whereas Grade 8’s will solve and graph inequalities containing integers.*

Also, subsets of the real number system (rational numbers for grade 7 and irrational numbers for grade 8) are new to the 2020 elementary math curriculum. Students should have familiarity with describing, comparing, ordering these different types of numbers, however the terminology may not be familiar. Teachers may have to review types of numbers.

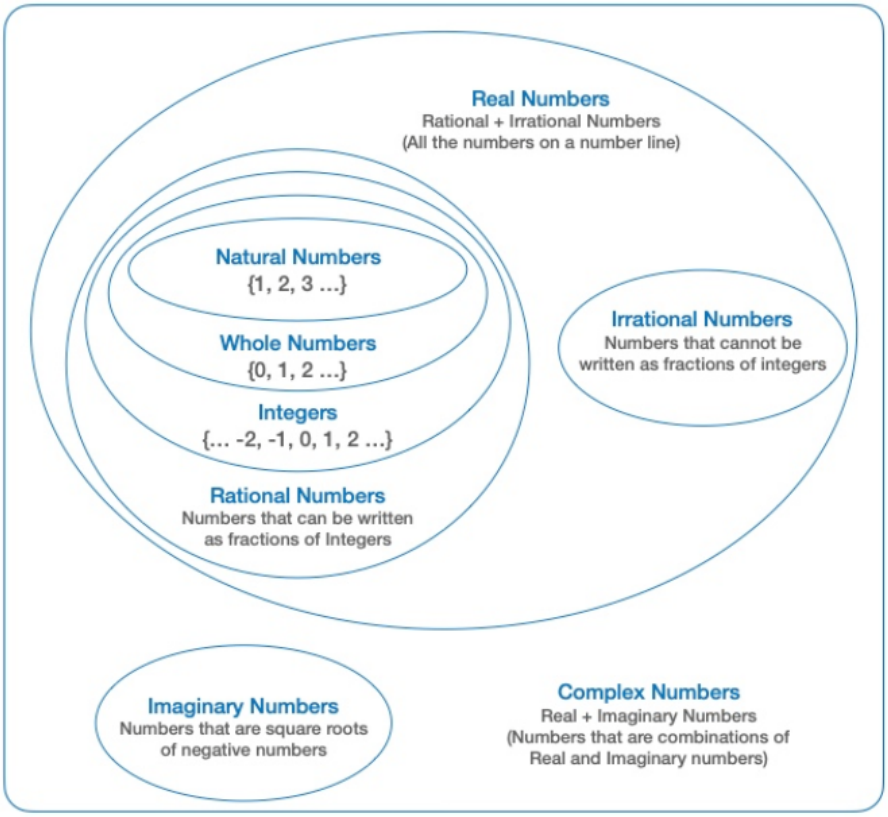


Image from learnx.ca

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Task

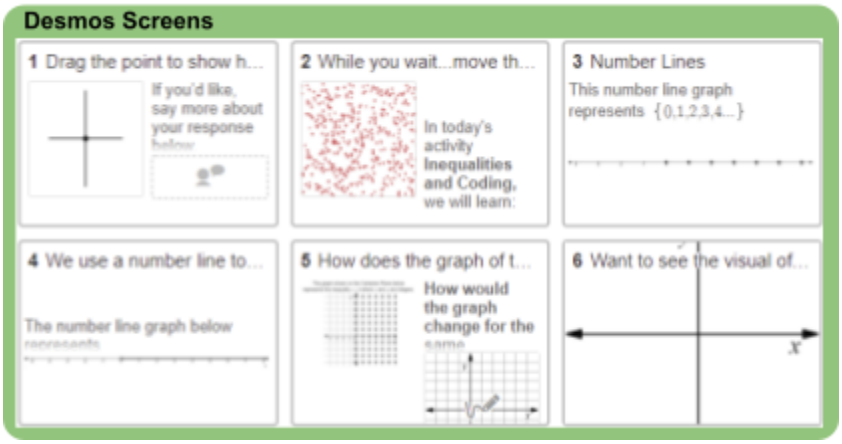
Introduction - Ask students: What is an inequality and an equality? Can you think of where you may have heard these words and in what context?

What might students say:

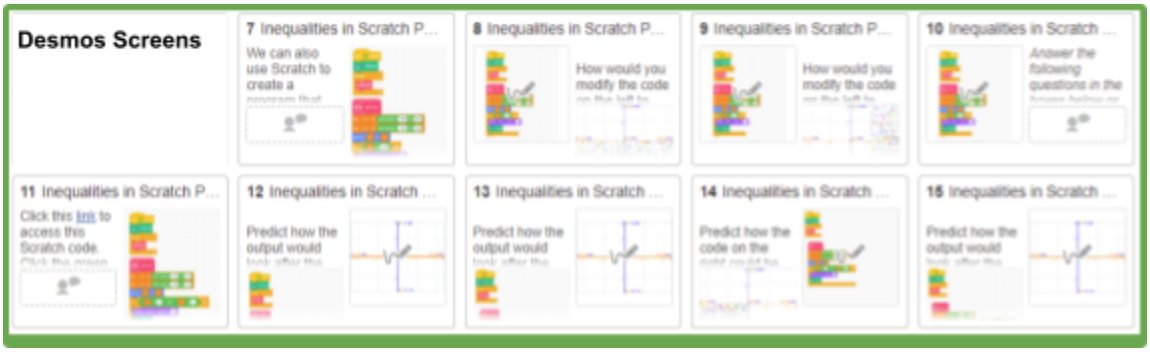
Equality - equal, fair, the same
Inequality - not equal, not fair
Contexts - gender equality/inequality, pay equality/inequality, inequalities in society (access to green space, technology, low cost housing, food)
In math - equal or equivalent, greater than/less than

The task is set up as a ***Desmos Activity*** which you can find here. Alternatively in ***Google Slides*** found here.

The task starts with some brief learning around inequalities with 1 variable and how these are graphed on a number line vs inequalities with 2 variables and how they are graphed on a Cartesian Plane.



The task then invites students to complete a number of inequality challenges using Scratch (to plot points on a grid when certain conditions are met) which requires them to read code and then modify the code to change the output. Lastly, students connect their learning about inequalities to a Desmos graph.



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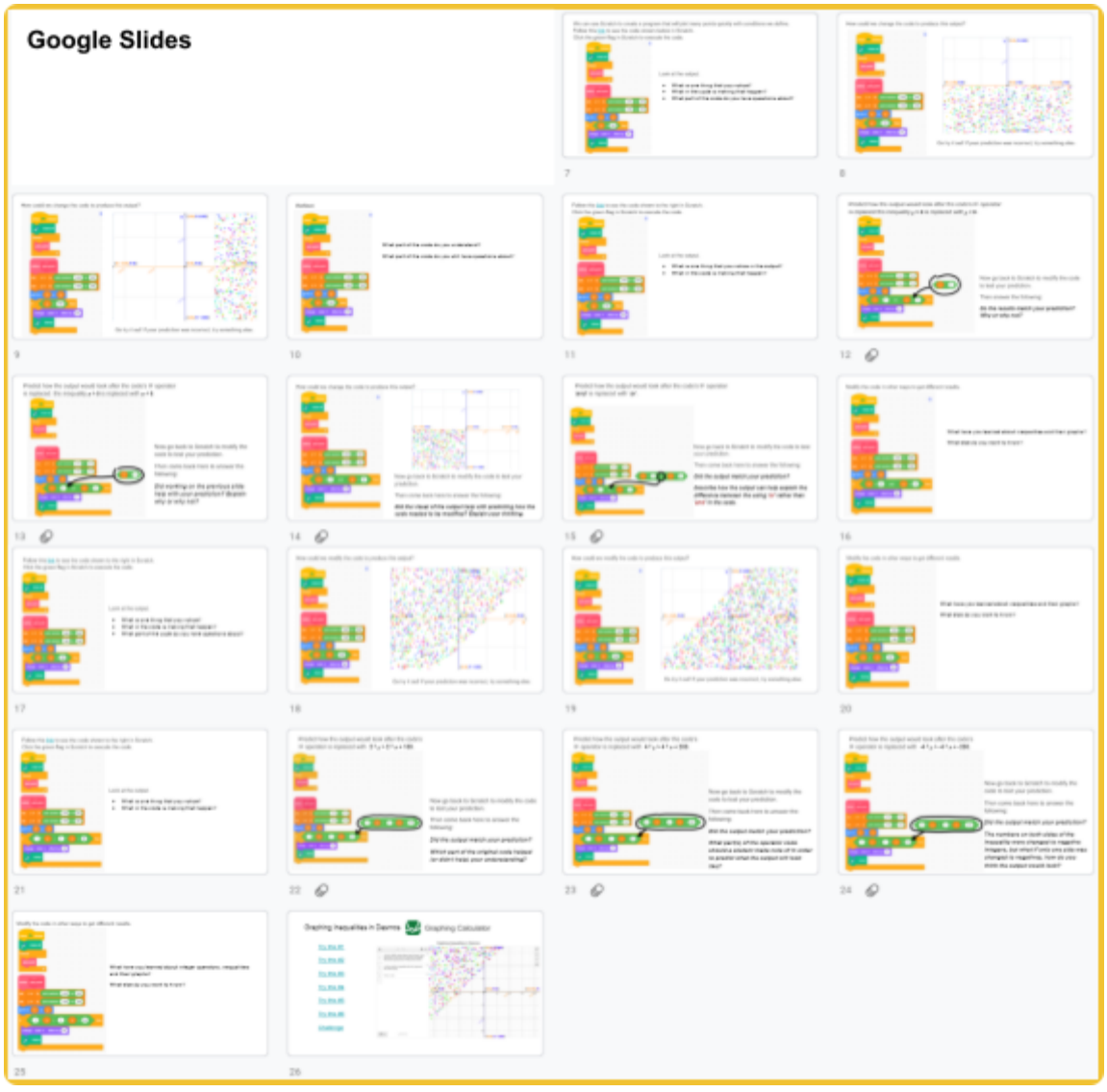

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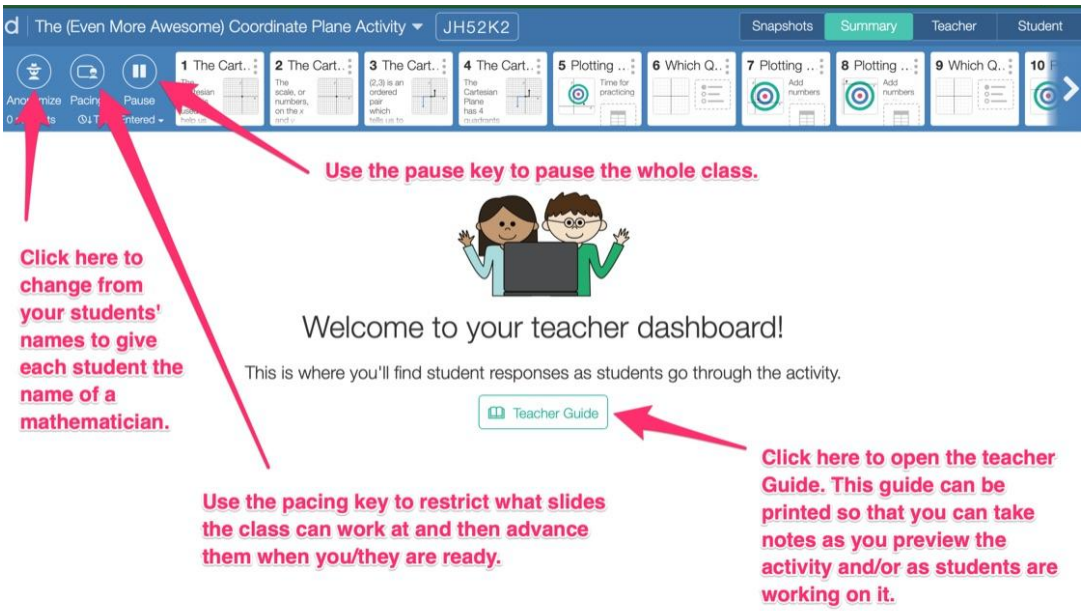
Teacher Notes

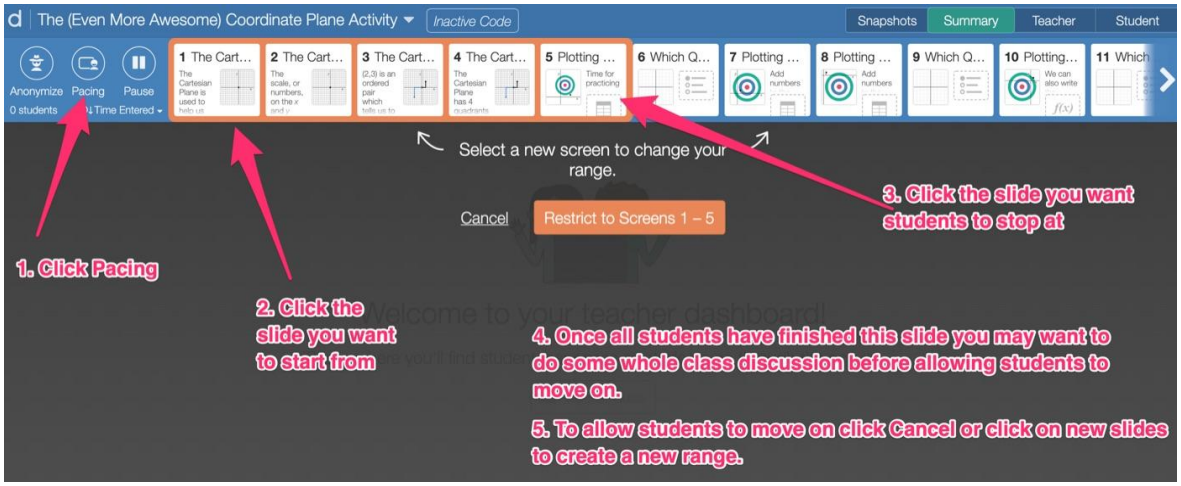
This task starts by giving students code rather than creating code. The focus is on reading, predicting and modifying. It is important for students to go through the cycle of predicting and testing, not only to help them gain an understanding of how the code works but also their understanding of the mathematical concepts. Also, predicting and testing are skills needed in any future career, and we need to work at helping students develop this as a part of their critical thinking.

If you are doing this task as a Desmos Activity: The ***Teacher Pacing*** option allows the teacher to control and limit the number of screens the students can interact with. A natural spot to have students stop is after slide 6. At this point you could facilitate a discussion around graphing inequalities before they start in Scratch. You may also want to stop after slide 7 to have a class discussion about the initial Scratch code given, and again after slide 10 once the students have had time to interact and modify the code.



Desmos Activity Teacher Dashboard

This screenshot shows how to do pacing on the Teacher Dashboard in Desmos



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Assessment
Reflection or Exit Card Questions *Thinking about what we have learned through this activity...* *What surprises you most mathematically? Why?* *What new ideas, concepts or relationships did you better understand? Explain.* This task can be included in the **Student Portfolio of Process Expectations** (Google Slides)
Additional Resources
Introduction to Scratch - See tutorials in Scratch Getting Started with Scratch Access: https://scratch.mit.edu/ How to use Desmos Elementary Math Curriculum - Strand C