SCIENCE NORTH SCIENCE NORD
SUDBURY, ONTARIO, CANADA

Exploring Colour-Coding using Ozobots	Gr. 7 - Understanding Structures & Mechanisms: Form & Function

NOTE: If students are familiar with colour coding Ozobots, start with Lesson 2 (block coding)

Ozobot Colour-Coding

Coding Tool	Markers, Ozobot Evo
Cross-curricular	Math, Science

Big Ideas

Science

- Structures have a purpose
- The form of a structure is dependent on its function
- The interaction between structures and forces is predictable

Math

- Mathematical Process
- Number Sense - operational sense (bisecting)
- Measurement - area, real-life application of measurement
- Geometry & Spatial Sense - angles, lines, bisectors, properties

Specific Expectations

Science

- **1.1** evaluate the importance for individuals, society, the economy, and the environment of factors that should be considered in designing and building structures and devices to meet specific needs
- **2.6** use appropriate science and technology vocabulary
- **3.1** classify structures as solid structures, frame structures, or shell structures

Math

- Number Sense
  - solve multi-step problems arising from real-life contexts and involving whole numbers and decimals, using a variety of tools (e.g., concrete materials, drawings, calculators) and strategies (e.g., estimation, algorithms);
- Measurement
  - research and report on real-life applications of area measurements
- Geometry & Spatial Sense
  - construct related lines (i.e., parallel; perpendicular; intersecting at 30º, 45º, and 60º), using angle properties and a variety of tools and strategies
  - construct angle bisectors and perpendicular bisectors, using a variety of tools and strategies, and represent equal angles and equal lengths using mathematical notation

Description

Students will create algorithms, colour-coding Ozobot movement to create specific angles, bisector(s), structures (shell, frame, solid), and show an area of 25cm^2; Students will combine these movements together rather than having them done independently. This lesson uses inquiry, along with a Knowledge Building circle to pull out Science and Math big ideas. Further integration of Language may also be applied. Prior experience with Ozobots, angles or structures is not necessary; prior learning through Knowledge Building is helpful. The purpose is to provide materials along with minimal guidelines, allowing students to build their own knowledge. The materials include Ozobots and corresponding markers. Explicit guidelines should include: to uncover the next Big Ideas they are focusing on, along with scientific and mathematical terminology will help to drive their thinking (e.g., reflex, 65°, bisect, shell, solid, frame, 25cm^2). If necessary, provide students with pre-drawn handouts for ease of exploration. Students will explore in pairs; teacher should take notes as terminology gets used. Culminate the activity in a Knowledge Build circle to pull out the next area of focus (e.g., Structures, Angles, Area).

Materials

- Ozobot Marker Kit, graph/1cm grid paper, or stack of GOOS (Good On One Side) paper
- 100 minute block
- **accommodations:** keep in mind anyone who may need vision or colour accommodations; scribe ahead of time; provide subject word bank for ESL students
- Handouts
    - Student Handout: Lesson 1 & 2 - Coding Goals
    - Teacher Handout: Lesson 1 - Teacher Colour Coding Information
    - Exit Pass: Lesson 1 - 321 Handout
- Knowledge Building Scaffolds: page 42
- Ozobot Basic Commands: https://storage.googleapis.com/ozobot-lesson-library/6-8-basic-training-color-codes/6-8-Basic-Training-Student-Handouts-Color-Codes.pdf

Computational Thinking Skills

Iterative Thinking
- through tinkering, students will be exploring a basic form of coding

Logic & Evaluation
- how to operate the tools

Algorithm
- making steps and rules to complete specific functions

Decomposition
- focusing on one aspect at a time

Debugging
- finding and fixing

Abstraction
- adding in additional functions/features (e.g., lights, sounds) when completing the task

Introduction & Minds On

If students are more familiar with Ozobots, or comfortable exploring new technology - start here:

- In a circle, snowball understanding from the following provocations: reflex, 65°, bisect, shell, solid, frame, 25cm^2.
    - every student writes an idea on a piece of paper, crumples it up, and throws it in the middle (in a box, or on the floor), then each student receives a different snowball to share the idea written
- Discussion with students (e.g., no right or wrong; they will build their knowledge)
    - Provocation - “using this word list, these markers and the Ozobot - you are going to try and uncover the next Big Ideas we will work through with this inquiry”

- They may use a different colour-code for each, or combine a few

If students are less familiar with Ozobots - start here (provide 30 minutes to explore): https://storage.googleapis.com/ozobot-lesson-library/6-8-basic-training-color-codes/6-8-Basic-Training-Student-Handouts-Color-Codes.pdf

- have one copy available for each pair
- this is a basic introduction in calibrating, using the markers, and having additional movements
- Build success criteria together prior to beginning, as well as during their build (e.g., working document)
  - terminology used
  - factors and considerations kept in mind
  - use of computational skills

Action

- Groups of 2, 3 max
  - circulate to prompt or guide learners if needed
- Tips
  - make sure the Ozobot is calibrated
  - use the wide end of the marker for better movement
  - black = drives the Ozobot
  - intersections (breaks in the black) = commands from other colours are given
  - the marker colour coordination and movements are patented
- Goals
  - students will create algorithms, colour-coding Ozobot movement to create specific angles, bisector(s), structures (shell, frame, solid), show area of 25cm^2; combine these movements together rather than independent
- Connection
  - pause for informal discussion; what do you notice? Have you noticed what the colours do? What algorithms are you creating?
  - circulate to have conversations specific to coding: how have you been debugging? What algorithm works best to find the area?

Consolidation/Extension

- Purpose of the lesson brought out in a discussion and Knowledge Build
  - Provocation: what was the structure involved in this, and what was its function?
    - Ozobot, to carry out code
  - Purpose: to learn how to colour-code
  - New terminology
    - What is an angle bisector?
    - What is a frame, shell, solid?
  - When coding, what factors and considerations were kept in mind?
  - Provocation: “what are the Big Ideas” (let the students try to run this using the stems,

"my theory is… I respectfully disagree…", making sure they provide specific examples from the task)
    - Math (angles, area, solving real-life problems), Science (structures)
- Introduce the culminating task: physically building a structure that can withstand a force - the force being a robot which has been coded (e.g., as an external force - wind, earthquake. Or as an internal force - torsion, compression, tension
- Handout: Lesson 1 - 321 Exit Pass
    - 3 new terms I learned
    - 2 things I learned about coding
    - 1 question I still have
- Take Home
    - read into shell, frame and solid structures

Assessment

- Observation & Conversations - anecdotal from their exploration
    - learning skills
    - computational thinking
- 3, 2, 1 Exit Pass
    - see how to adjust for the next lesson which uses Block-coding
    - if more time was needed to explore movement of the Ozobot, go through this lesson once more to help consolidate subject specific information

Additional Resources

- Terminology
    - Reflex - angle greater than 90° and less than 360°
    - Bisect - angle divided exactly in half (e.g., 60° bisects into two 30° angles)
    - Shell - structure which is a hollow or curved shape; tunnel, roof
    - Solid - structure which typically supports loads; concrete foundation of house, dam, telephone pole, statue
    - Frame - structure which is a network or skeleton which supports one another and work together to resist forces; house frame, tent frame, goalie net
- Additional Links
    - Ozobot Basic Training - Educator
        - https://storage.googleapis.com/ozobot-lesson-library/6-8-basic-training-color-codes/6-8-Basic-Training-Educator-Version-Color-Codes.pdf
    - Ozobot Student Handout
        - https://storage.googleapis.com/ozobot-lesson-library/6-8-basic-training-color-codes/6-8-Basic-Training-Student-Handouts-Color-Codes.pdf
    - Knowledge Building Scaffolds
        - http://thelearningexchange.ca/wp-content/uploads/2017/04/Knowledge-Building-Booklet-Accessible-1.pdf