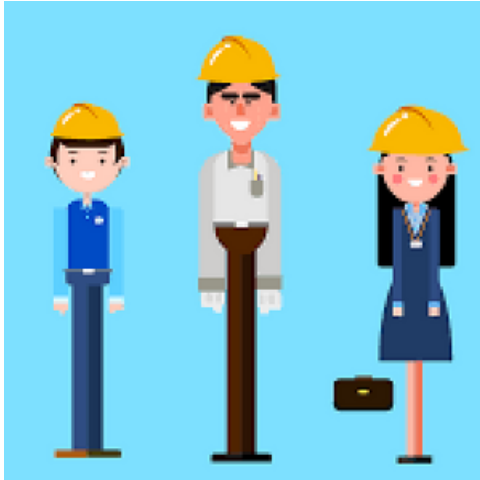


Exploring the Engineering Design Process

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Grades:

2—5

Subject(s):

Engineering/Tech

Pre-Reader/ESL-Friendly?

No

Compatible Bot(s):

Evo

Coding Method:

Color Codes

Quick Summary:

Students will construct a model of the steps of the engineering design process and use ozocodes to represent each step in the process. Students should have some knowledge of the engineering design process prior to this lesson being completed.

Duration: 45 min

Objectives & Outcomes

- 1 Student will understand the steps of the engineering design process
- 2 Student will use basic ozocodes to represent each step in the engineering design process

Preparation

Teacher Materials & Digital Resources

- [EDP circles](#)
- [Design Process Paper](#)
- [Ozobot-Color-Codes-Chart](#)

Student Materials

- 1 Evo or Bit per group

Background Knowledge

Ability to

- draw ozocodes using markers

Knowledge of

- the engineering design process

● Teacher Tips

It is beneficial that students have worked through the engineering design process in previous projects.

Each pair needs 1/2 of the EDP Circles page.

Print the Design Process on larger paper to allow student more room when creating their design process models.

This lesson can be used as a review or a checkpoint to determine students understanding of the steps in the process.

● Direct Instruction

- ① The engineering design process is a series of steps engineers follow to help them answer questions about problems around them. Today, you will work in pairs to construct a model of the engineering design process that the Ozobot can follow.
- ② What do we know about the shape of the engineering design process? Consider that shapes as you brainstorm your Ozobot path.
- ③ Your Ozobot should read a code as it reaches each step in the design process to show it has:
 1. Reached a step
 2. Corresponds to what happens in that step

For example, at the plan step you could have your Ozobot zigzag like a pencil on paper to signify that you create a plan.

Final constraints:

1. Your final product should include at least 5 codes.
 2. Your engineering design process steps should be the correct order
 3. Your path should represent that of the engineering design process.
- ④ You will work in pairs to complete the project.

Please collect the following items and begin working:

1. Pencil
2. Engineering Design Process step circles
3. Ozobot and markers
4. Large piece of paper

Supplements

● Lesson Closure

The engineering design process involves the following steps:

ASK - We ask a question to guide our problem solving. As we ask we conduct research to learn more about the problem.

IMAGINE - We work independently to get our own ideas on paper.

PLAN - We bring our ideas together to settle on a final plan. All materials are listed for this plan.

CREATE/TEST - We build our solution and test it against the constraints.

IMPROVE - We improve our designs.

** Your design process should resemble a circular shape to signify that it is a process we repeat over and over again with continued growth.

● Academic Standards

- NGSS.1-ETS1-1

Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

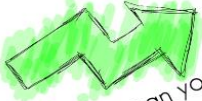
- CCSS.ELA-LITERACY.CCRA.L.6

Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

THE ENGINEERING DESIGN PROCESS STEPS

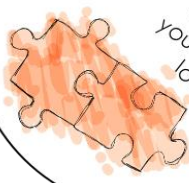
Cut out the circles below.

IMPROVE



How can you make your solution better?

CREATE



What does your solution look like?

ASK



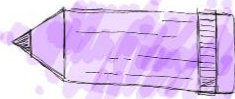
What is the problem you need to solve?

IMAGINE



What solutions can you think of?

PLAN

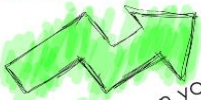


How has your team decided to solve the problem?

THE ENGINEERING DESIGN PROCESS STEPS

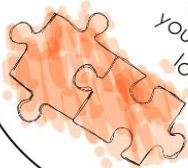
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IMPROVE



How can you make your solution better?

CREATE



What does your solution look like?

ASK



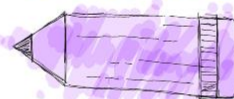
What is the problem you need to solve?

IMAGINE



What solutions can you think of?

PLAN



How has your team decided to solve the problem?

The Engineering Design Process

Directions:

1. Use a pencil to draw out the shape of the design process.

2. Plan out the code you will use for each of the 5 steps.

3. Then glue down the circles on the outside of your path.

4. Add the path and color code colors using markers.

























5. Then run the Ozobot over the path to demonstrate the design process.

Color Codes | Chart



Speed

					
Short Super Slow	Slow	Cruise	Fast	Turbo	Nitro Boost
					
R G B	R BK R	G BK G	B BK B	B G B	B G R





Direction & Special Moves

					
Left at Intersection	Straight at Intersection	Right at Intersection	Line Switch Left	Line Switch Straight	Line Switch Right
					
G BK R	B BK R	B R G	G R G	G B G	R G R
					
U-Turn	U-Turn (line end)	Tornado	Zigzag	Spin	Backwalk
					
B R B	B R	R G R G	B BK G R	G R G R	R G BK B













Timers

		
Pause (3 sec.)	Timer on (30 sec. to stop)	Timer off
		
R B R	R BK B G	G B BK R

Wins/Exits

	
Win/Exit (Play Again)	Win/Exit (Game Over)
	
G B	G R

Counters See reverse for definitions

					
Enable X-ing Counter	Enable Turn Counter	Enable Path Color Counter	Enable Point Counter	Point +1	Point -1
					
G R B G	R B G B	R G B R	R B R G	R B G	G B R

Speed

Speed codes change your Ozobot's velocity from Short Super Slow (slowest) to Nitro Boost (fastest).

- **Short Super Slow**
A three-second dose of super slow speed.
- **Slow**
A slow speed command effective until the bot reads a new speed code or is turned off.
- **Cruise**
The default speed command.
- **Fast**
A high speed command effective until the bot reads a new speed code or is turned off.
- **Turbo**
An extra high speed command effective until the bot reads a new speed code or is turned off.
- **Nitro Boost**
A three-second dose of Ozobot's highest speed.

Short Super Slow (slowest) > Slow > Cruise (default)
> Fast > Turbo > Nitro boost (fastest)

Cool Moves

Cool Move codes tell your Ozobot to bust a move!

- **Tornado**
A command to spin around twice at increasing speed, then continue following the line in the same direction.
- **Zigzag**
A command to sway right-left-right-left while moving forward, then continue moving straight.
- **Spin**
A command to spin around twice at a consistent speed, then continue following the line in the same direction.
- **Backwalk**
A command to quickly turn 180 degrees, wiggle backwards for one second, then turn 180 degrees again and continue following the line in the same direction.

Timer

Timer codes tell your Ozobot to pause or count seconds.

- **Timer On (30 sec. to stop)**
A command to make your Ozobot countdown from 30 sec., but continue to move and read codes while counting down. Ozobot will flash its light(s) at a rate of one flash/sec., flash rapidly to signify time is up, then shut off.
- **Timer Off**
A command to stop counting down seconds and return to default behavior.
- **Pause (3 sec.)**
A command to stop moving for three seconds, then continue with default behavior.

Direction

Direction codes tell your Ozobot what to do at an intersection.

- **Left at Intersection**
A command to turn left at the next intersection.
- **Straight at Intersection**
A command to continue straight at the next intersection.
- **Right at Intersection**
A command to turn right at the next intersection.
- **Line Switch Left**
A command to immediately turn 90 degrees to the left, move forward to a new line, then make a random turn to follow along the new line.
- **Line Switch Straight**
A mid-line command to continue straight after the line ends. The code will not work if Ozobot encounters an intersection before the line ends.
- **Line Switch Right**
A command to immediately turn 90 degrees to the right, move forward to a new line, then make a random turn to follow along the new line.
- **U-Turn**
A mid-line command to turn around 180 degrees and follow the same line in the opposite direction.
- **U-Turn (Line End)**
A line-end command to turn around 180 degrees and follow the line in the opposite direction.

Ozobot's default intersection behavior is random. If a given turn, i.e. 'Go Left' is not possible, Ozobot defaults back to random behavior.

Counters

Counter codes tell your Ozobot to count five intersections, turns, or line color changes.

- **Enable X-ing Counter**
A command to make your Ozobot stop following lines after it crosses five intersections ('T' or '+' intersections). After the fifth intersection, Ozobot executes a "done" maneuver, stops following the line, and blinks red.
- **Enable Turn Counter**
A similar command to the Enable X-ing Counter, except that Ozobot only counts intersections where it makes a turn. It will not count intersections where it continues straight. Ozobot can randomly choose to go straight at an intersection, or be commanded to go straight with a "Straight at Intersection" code.
- **Enable Path Color Counter**
A command to make your Ozobot stop following lines after it reads five color changes in the line. If the line Ozobot is following transitions from red to green, it counts as one color change. Transitions to and from black lines are not counted, and color segments less than two centimeters in length are not counted.
- **Enable Point Counter**
A command that tells your Ozobot to count point codes down from five. Each time Ozobot reads a "Point -1" code it counts down. After the fifth "Point -1" code Ozobot will make a "done" maneuver, stop following lines, and blink red. You can add more to the total count (not to exceed five) with "Point +1" codes. You can reset Ozobot by turning it off, then on.

Wins/Exits

Win/Exit codes tell your Ozobot to celebrate its success, then either start over or stop.

- **Win/Exit (Play Again)**
A command to perform a "success" animation, then continue to follow the line.
- **Win/Exit (Game Over)**
A command to perform a "success" animation, then stop following the line.

Exploring the Engineering Design Process

What We'll Cover:

- ① We'll understand the steps of the engineering design process
- ② We'll use basic ozocodes to represent each step in the engineering design process

Materials:

- 1 Evo or Bit per group

Activity Instructions:

- ① Cut out your engineering design process steps.
- ② Decide on the shape of the path your Ozobot will follow.
- ③ Using the coding sheet decide on the code you will add for each step.
- ④ Use a pencil to mark out your path on paper. Be sure to make a mark where you will place each code.
- ⑤ Glue the engineering design process steps next to each corresponding code on your path.
- ⑥ Use your coding markers to complete the path and corresponding codes.
- ⑦ Run your ozobot around the path to create a model of the engineering design process.