5E Arts Integrated STEM Lesson Plan

Lesson Title: Using Patterns to Send Information

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Topic: Patterns to transfer information, Coding, Digital Art

Targeted Grade Level: 4th

Time Needed: 1 hour

Subject Integration: Science NGSS 4-PS4-3 (generate and compare multiple solutions that use patterns to transfer information), Ky Academic Standards for Technology 4.CT1.D.1 (complete coding task with coded actions)

Justification: Binary code is a basis of modern computer coding. The science standard addresses using patterns to transfer information, and is often taught through binary coding or morse code. The technology standard is the a foundational standard which relies on basics of creating algorithms to to complete a task. In this lesson simple digital images will be created by using binary code as the presentation method.

Standards:

Visual Arts VA:Pr4.1.4a Analyze how past, present, and emerging technologies have impacted the preservation and presentation of artwork.

NGSS 4-PS4-3.Generate and compare multiple solutions that use patterns to transfer information.

Ky Technology standard 4.CT1.D.1 Complete a coding task with coded actions ex.: html, block-based coding, python

either collaboratively or independently.

NGSS Performance Expectations

4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.	PS4.C: Information Technologies and Instrumentation Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. ETS1.C: Optimizing The Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (secondary)	Patterns Similarities and differences in patterns can be used to sort and classify designed products. Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology Knowledge of relevant scientific concepts and research findings is important in engineering.

Common Core State Standards: *Use your state standards if Common Core is not applicable in your state. You are encouraged to list the CCSS and your state standards.*

Math: 4th grade Cluster Operations/Algebraic Thinking, Math Practices: Generate and analyze patterns.

ELA: Interdisciplinary Literacy Practices: Recognize that text is anything that communicates a message.

ITEEA Standards

Ky Technology standard 4.CT1.D.1 Complete a coding task with coded actions ex.: html, block-based coding, python

either collaboratively or independently.

National Art Standards

Visual Arts VA:Pr4.1.4a Analyze how past, present, and emerging technologies have impacted the preservation and presentation of artwork.

Measurable Student Learning Objectives: Students will be able to create digital art using binary code.

Students will be able to list and explain a type of patten used to transfer information.

Nature of STEM: Communication, problem solving, pattens, and innovation/invention are all addressed as themes in this lesson. Students will see that patterns led to codes and coding as a way to communicate. In this lesson eh communication will be to communicate a picture which is also a piece of art. This will stretch their minds to think of art as a means of communication, and not just words. Also, binary code was a innovation, and that history we be touched on as a guiding principle in STEM, as well as solving problems because some students will have to persist in first reading and then creating the art with code.

Engaging Context/Phenomena: The phenomena examined will be that pictures can be presented and sent over long distances through simple use of 1s and 0s, or binary code. Present students with artwork on slide 2, then show close up on 3 of the entire work created with tiles in the mosaic. Proceed to sides 3-4, 5-6, 7-8 and have them guess what the picture is. Ask why this would be ever be necessary? Then use video to show how computers work with binary to send

messages, images, and sound. Teacher can also reference Morse Code to send messages, which will be addressed in later lessons.

Data Integration: Refer to NASA's use of morse code as types of hidden messages. Curiosity and Perseverance both have Morse Code Easter eggs.

Differentiation of Instruction: Often students who struggle in math reasoning will excel in code, so this might be a chance to let students who think differently succeed. Grids with less squares can be used for students with cognitive deficits. Also, students who excel in math can be shown how to convert numbers into binary and challenged to write number codes for words rather than pictures.

Real-life Connection: Computer programming and sending coded messages are real-life connections. The all female ENIAC programmers will be introduced in the course of the lesson, so that students see programming as a job and a job that both sexes are equally capable of doing. Often students want to send coded messages to friends and also write their own simple codes after this unt.

Possible Misconceptions: Students often do not have prior knowledge of the actual workings of a computer, so the pictures of the inside of a computer and the explanation of how to wires transmit on/off for binary code is discussed. Students may also struggle to understand that images transmitted digitally are in pixels, but the with the popularity of MineCraft which shows the large pixels, this has been less of a problem.

Lesson Procedure:

5E Model	5E Objectives
Engage	**Procedure:** The phenomena examined will be that pictures can be presented and sent over long distances through simple use of 1s and 0s, or binary code. Present students with artwork on slide 2, then show close up on 3 of the entire work created with tiles in the mosaic. Proceed to sides 3-4, 5-6, 7-8 and have them guess what the picture is. Ask why this would be ever be necessary? Then use video to show how computers work with binary to send messages, images, and sound. Teacher can also reference Morse Code to send messages, which will be addressed in later lessons.

	Modifications Allow students to think-pair-share other examples of pictures like above so to ensure they understand and connect to the material. **Standards Addressed** Science and Technology **Formative/Summative Assessments** Participating in whole group questions and partner talk **Resources** Slides with images from general image searches and Code.org video
Explore	**Procedure:** Students will color the first image that has 0s and 1s already filled in to make a picture. Then, teacher will stop class to check for understanding. Then, students will create their own codes 1 at a time and trade with a partner to see if they can decode to make an image. Teacher will see if students can plan in their minds and make the code first as spatial practice, but additional copies will be there for those that can not plan in their heads. Also, slides have some ideas for those that can not come up with any original ideas on their own. Teach will circulate and track students for assessment listed below. **Modifications** Provide 2 copies for students who have cognitive deficits so that they can plan on one and then make the code on another for their partner. 12X12 grid can be used for those who understand the activity quickly. **Standards Addressed** Science and Art **Formative/Summative Assessments** Teacher will observe for 1 correctly completed picture and one correctly decoding from each student. **Resources** Grid templates - several copies for each student in case they want to do multiple images, also includes 8X8 and 12X12 grids for more detailed pictures.

Explain	**Procedure:** After a few times training teacher will stop class, and ask if they are having any problems getting their partners to see their image? The computer reads on/off so teacher can ask if there are any other ways besides coloring on paper that they could show on/off. Teacher could flip classroom light on and off in a pattern for students to see. Also, teacher will also use button batteries and LED lights to have students represent on/off. This will also connect closely to the science standard that electricity is used to transmit patterns. Things like color and detail may arise. Class can discuss to come up with solutions like using more cells in the grid or multiple colors. Teacher will ask if students can create their own code and look at examples on slides 15-16 of codes not made with 1s and 0s to explain. This will prepare them for the segway into Morse Code which uses 26 characters, not 2. Students will then make a coded picture with something other than 1s and 0s and trade with the same procedure as before. Students might choose to use Xs and Ox, or letters of the alphabet. They may also want to use more than 2 options to get color variations. Teacher should allow, but explain that binary means 2 so they are not longer creating binary code but a different system which is acceptable. Teach will circulate and track students for assessment listed below. Teacher will stress that as long as their is a pattern followed throughout that it is acceptable, and can ask why would it be a problem if your image and code is not consistent?

Modifications Provide 2 copies for students who have cognitive deficits so that they can plan on one and then make the code on another for their partner. 12X12 grid can be used for those who understand the activity quickly.

Standards Addressed Science and Art

Formative/Summative Assessments Teacher will observe for 1 correctly completed picture and one correctly decoding from each student. Student should also be able to explain their code to teacher or partner in words, and persist in rethinking their code if it does not actually follow a pattern.

Resources Grid templates - several copies for each student in case they want to do multiple images, also includes 8X8 and 12X12 grids for more detailed pictures, button batteries and LED lights. |

Elaborate	**Procedure:** Show picture of ENIAC programmers on slide 17, and explain that the thing in the background was a codebreaking computer and a one of the first computers. Teacher asks if students think this sent codes of 1s and 0s. It is possible but they may have also sent more complicated codes. Also, ask what might people need to send beside images? Introduce Morse Code which used on/off binary, but had more patterns so they could show letters. Display slide 18 and handout Morse Code sheets to students. Then find pattern on slide 19 and corresponding letter of alphabet. Discuss to clarify, and ask how many cells did that take, and why that number. Use video on slide 20 and notes on 21 to explain 8 cell grouping and bits and bytes. Proceed to practice with additional slides 22-24. Then students will create their own messages using Morse code starting with their names. Students may also want to use LEDs and batteries again - they can do this but they will have to take into account how they will show breaks in between letters, words, sentences and come up with a plan for that. Teacher will circulate and ask to see their names in Morse code, then allow them to make a short message to trade with a partner to decode.

Modifications If needed students can do initials instead of name. Also, provide colored slips of paper so students can cover up sections of code, as seeing the whole Morse code chart at once is visually overwhelming for some students and they lose track on the page.

Standards Addressed Science and Technology

Formative/Summative Assessments Use Morse code to write name - will be marked off for accuracy, or redone until correct.

Resources Slides, copies of Morse code on paper, scratch paper, LEDs and batteries |
| **Evaluate** | **Procedure:** Teacher will ask whole class to list the types of patterns they created and what they created today. List of what they created would include: images, written messages. List of how would include: binary code, Morse code. Discuss as many possible types of information and methods for these as class can come up with and put on a T chart like below. Vocabulary was not the focus of |

this lesson, so much of the example will not be correct. The big ideas was to get students to understand they could transmit information in multiple ways with patterns.

Information	Method
art	tiles, mosicas
digital art	pixels, binary code, lights
messages	Morse Code, lights
computer programs	binary code, on/off

Modifications During assessment go to students who have deficits in written expression to write for them, or let them explain verbally. Also, if amount of choices from chart is too much pick one for them to explain based on what seemed most comfortable with them during class.

Standards Addressed Science

Formative/Summative Assessments Written response to question below.

How are patterns used to transmit messages? Provide one example and explain.

Use binary rubric below to asses, 1 means student did it, and 0 means they need to reteach and a chance to redo.

1		0

		Student uses word pattern in explanation	
		Students provides an example from class off of chart or one that is correct from their own knowledge	
		Student explain how information is transmitted.	
	Resources Rubric		

Teacher Background: This lesson is adapted from Code.Org which not only does a great job with videos that explain in an engaging way, but can also serve as background knowledge for the teacher to teach themselves prior if they are not comfortable in their computer science knowledge. https://studio.code.org/s/course4/lessons/17/levels/1