Real-Life Algorithms: Paper Airplanes

ACTIVITY OVERVIEW

STEM Focus Area: Robotics

Learning Goal: Demonstrate understanding of basic computational thinking concepts (sequence, algorithm)

Youth Learning Targets:

- "I can use steps in order to do things."
- "I understand that if I do steps out of order, you might not get the right result."

LEARNING ENVIRONMENT

Activity Duration: 45 minutes

Group Size: Large or Small

Age of Youth: Grades K-2

Guiding Question - What is the question to explore OR the problem or challenge to solve?

How can you guide a robot to complete a task by using computational sequences (called algorithms)?

Throughout this activity, youth will:

- Use their understanding of how daily activities can be broken down into smaller events and how that is analogous to creating a sequence of commands for a robot.
- Create an "algorithm" designed to complete a specific task – making a paper airplane
- Develop an understanding and observe how robots respond only to the commands given to them

Facilitator Prep

- Facilitators will need to prepare materials before the activity and develop an understanding of basic computational concepts.
- Know that accurate folding may be challenging for younger youth and you may need to adjust or assist.
- Watch Real-Life Algorithms: Paper Airplanes

Literacy Connection: Great books to get youth support learning about robotics (available on Amazon).

- *Gabi's if/then Garden*
- *How to Code a Sandcastle*

DoS: Authentic Stem Practices

- ✓ Predict and hypothesize
- ✓ Develop and use models
- ○ Measure materials
- ○ Observe
- ✓ Investigate

- Record observations
- Analyze and infer
- Share and communicate data
- Interpret data
- Test and revise
- ✓ Draw conclusions and relationships
- Have voice and agency, make decisions and guide their own learning

PREPARATION

Materials

Per Participant:

- Paper for folding into airplanes
- Paper for assembling "code"
- Real Life Algorithms: Paper Airplane Worksheet (page 4)
- Daily Algorithms: Assessment Worksheet (page 5)
- Scissors (share if needed)
- Glue (share if needed)
- Pens/Pencils
- White board (optional)

Room

No particular room setup is most-optimal. Avoid lecture-style/other formal room setups. Ensure all youth can see facilitator. Ensure all youth have enough space to write, cut, glue, and assemble airplanes

Content

Key concepts:

- **Robots**: a machine that carries out a series of actions automatically, especially one programmable/programmed by a computer.
- **Computational Thinking**: a problem solving process that involves logically ordering and analyzing data to create solutions to problems using a series of ordered steps.
- **Algorithms**: a sequence of instruction intended to complete a particular task.
- **Debugging**: correcting a part of an algorithm to better complete its goal.

Inquiry

Your primary goal as facilitator is to encourage youth to explore and observe ways to make more efficient code. You can prompt those discussions with questions like the following:

- How did you know that the code needed debugging?
- What would you need to do in order for the robot to correct its own code?
- How do you know if you have written the right code? Is there more than one correct way to write a code to complete a particular task?
- How do you know if you have written the right code?
- What would happen if you changed the order of commands in the algorithm?

DoS:

- ✓ Organization: I practiced the activity/technology, prepared materials/extras/place to record youth ideas, and completed an activity (including timings).
- ✓ Materials: Materials are appropriate for teaching the learning goals; youth will be able to use them and will think they are appealing.

- ✓ Space Utilization: The space is set up appropriately for the activity and there will be no safety issues or distractions.
- ✓ Relevance: I have researched why the content matters to youth's everyday lives.
- ✓ Content Learning: I have become familiar with the content.
- ✓ Inquiry: I have become familiar with how authentic, age-appropriate inquiry practices look in this activity.

INTRODUCTION TO ACTIVITY (15 MINUTES)

Start with a discussion the participants' experiences with computers and robots

- "Has anyone here seen or interacted with a robot? How do you interact with a robot? Does the robot really "hear" you speak? Does it "understand" what you are saying?"
- "Robots don't hear and understand the same way people do. They operate off "instructions," specific things they're preprogrammed to do. In order to accomplish a task, they need to have a series of instructions (called an **algorithm**) that they can reference."
- "We rely on algorithms in our everyday lives to complete tasks."
    - Ask youth what they did to get ready for school in the morning.
    - Write answers on the board
    - If possible, put numbers next to their responses to indicate the order that they happen.
        - If youth give responses out of order, have them help put them in some kind of logical order.
        - Point out places where order matters and where it doesn't.
    - Introduce youth to the idea that it is possible to create algorithms for the things that we do every day.
        - Try to come up with examples as a group. If struggling, try to come up with a list of events that are needed to brush teeth, make breakfast, get dressed, etc.
    - **Inquiry**: By outlining a sequence of events to complete a task or goal and reflecting on alternatives to the sequence, youth are carrying out a practice analogous to creating an algorithm for a robot to follow.
- "Let's try doing this with a fun activity, like making paper airplanes!"

DoS:

- ✓ Space Utilization: I will use the space informally avoiding the lecture hall format.
- ✓ Purposeful Activities: This intro section gets youth on track for the learning goal.
- ✓ Content Learning: If age appropriate, I will accurately present content.
- ✓ Inquiry: In this or another section of the activity, youth carry out one or more inquiry practices.
- ✓ Relationships: I will make each youth feel welcome.
- ✓ Relevance: In this or another section, I will guide the youth in a sustained discussion of how the activity relates to their everyday lives.
- ✓ Youth Voice: In this or another section, I will allow youth the opportunity to make decisions about their learning experiences.

ACTIVITY ENGAGEMENT (20 MINUTES)

Explain the activity

- Each participant will be a coder trying to make a code for our paper-airplane making robots.
- Cut out the steps for making a paper airplane provided worksheet (page 5).
- Each coder will select six of the nine steps.
- Each participant will glue their six steps, in order, onto a separate piece of paper and label them Step 1, Step 2, etc.

- Trade the finished algorithm with another person.
- Once they have another person's code, they are now a robot. Use the code to put together an airplane
    - **Rule**: robots are only interact with the paper and the code. **No talking!**
- Safety: If you are concerned about injury when the youth begin flying their paper airplanes, have them blunt the tip of the plane by either folding it inward or ripping it off and covering the ripped edges with tape.

- **Participation**: Ensure each participant fulfills each role (coder & robot).

FINAL REFLECTION & RELEVANCE (5 MINUTES)

- Hold a discussion on their experiences during the activity:
    - "Was this easier or harder than you anticipated? What made it challenging/easy?"
    - "How many of you were able to follow the code to make an airplane?"
    - Have everyone share their algorithms. As people share their codes, ask "Does anyone else have this same code?"
        - "Are these codes the same or different? What does this mean? How do you know if a code is correct? Is there more than one way to write correct code for this task?"
    - "What could have made this easier for the coder? What about for the robot?"
    - "What would happen if there were more steps? 10, 25 or 100 steps?"
    - "Do you ever use algorithms in your everyday life? What are some examples?"
        - *Brushing teeth, making breakfast, taking a shower are all processes that use a sequence of step to accomplish a goal.*
    - "What are some jobs or times you can see algorithms being useful?"

DoS:

- ✓ Space Utilization: Again, I will use the space informally.
- ✓ Participation: I will prompt youth who do not have access to the activity to participate.
- ✓ Purposeful Activities: The closing section helps youth to reach the learning goal.
- ✓ Content Learning: I will help youth make connections between different ideas. I will create opportunities for youth to ask questions/provide ideas that show a deeper level of understanding.
- ✓ Inquiry: In this or another section of the activity, youth carry out one or more inquiry practices.
- ✓ Reflection. I will provide youth with a sustained opportunity to make sense of their learning.
- ✓ Relevance: In this or another section, I will guide the youth in a sustained discussion of how the activity relates to their everyday lives.
- ✓ Youth Voice: In this or another section, I will allow youth the opportunity to make decisions about their learning experiences.