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| **Blink, Beep, Move** | |
| Teacher: Dr. Jeffrey McCullough | |
| Subject/Grade: Middle School Science and Mathematics | |
| Lesson Title: Program an ActivityBot to blink, beep, and move | |
| **STANDARDS** | Tennessee State Standards effective fall 2018 |
| **Science**  6.ETS1.2 Design and test different solutions that impact energy transfer  8.PS2.3 Create a demonstration of an object in motion and describe the position, force, and direction of the object.  8.PS2.4 Plan and conduct an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.  8.PS4.3 Evaluate the role that waves play in different communication systems.  PSCI.PS3.3 Design, build, and refine a device within design constraints that has a series of simple machines to transfer energy and/or do mechanical work.  PSCI.PS4.3. Develop and use mathematical models to represent the properties of waves including frequency, amplitude, wavelength, and speed.  **Mathematics**  6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.  6.RP.A.3Use ratio and rate reasoning to solve real-world and mathematical problems (e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations).  7.RP.A.2(b) Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.  7.G.A.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.  8.EE.B.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.*  G.GPE.B.4 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.  **Language Arts**  6.RI.CS.4 (Informational Text) Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.  6.RI.CS.5 Analyze how a particular sentence, paragraph, chapter, or section fits into the overall structure of a text and contributes to the development of the ideas. | |
| **OBJECTIVE(s)/Sub-Objectives** | **Connect prior learning to new learning.** Clear, Specific, Observable, Demanding, High Quality, Measurable, Aligned to Standard(s), and Integrated with other subjects, build on prior student knowledge  Student-Friendly (I Can Statement) |
| I can program an ActivityBot to display lights  I can program an ActivityBot to make sounds  I can program an ActivityBot to move a given distance in a given direction  I can program an ActivityBot to perform a sequence of lights, sounds, and movements | |
| **MATERIALS AND RESOURCES** | **Content-related:** Clearly supports lesson objective(s); rigorous & relevant; Incorporates multimedia & resources beyond the textbook. |
| **Activities & Materials**   1. Smartboard / screen and computer to access internet to display instructions 2. Laptop or other device per robot on which to enter programs to control the robot. If only one computer is available, the entire group must work with one robot. 3. Internet Resource: <http://learn.parallax.com/tutorials/robot/activitybot/activitybot> 4. Assembled ActivityBot robot 5. 5xAA batteries.   **What if the technology is not working?**  It is possible to print the instruction manual to use if a classroom computer is unavailable. After assembly, if the robot is not working, move on to other tasks. Allow interested students to troubleshoot the robot during independent or small group study time. Trust them to figure it out. They can.  **Routine for distributing materials**  Each group of students should begin with an assembled ActivityBot, a set of batteries, and a laptop or other input device at a center for group work. | |
| **ACCOMMODATIONS/ADAPTATIONS** | **Learning styles and interests.** Anticipate learning difficulties, regularly incorporate student interests & cultural heritage; differentiate instructional methods. |
| **Modifications/Plans for Diverse Learners**  **Differentiation**  **Content.** Most students will work from the on-line instructions. Some students will benefit from teacher-made worksheets that provide the instructions in more accessible vocabulary.  **Process.** Some students will follow instructions in a literal, linear path. Students should be allowed to experiment as they program the robot, playing their own notes or songs and adjusting lights to colors of their own choice.  **Product.** Whatever experimentation process students choose, their programmed robot should make sound, make light, and move. Differentiation in the product comes with the level of complexity. Some students will have the robot play songs, create multi-colored light shows, and/or move in complex patterns.    **Accommodations**  **\_\_\_ Small Group** Groups have tasks involving sights, sounds, and motion. Most students should have a way to participate  **\_\_\_ Peer Tutoring** Students will help each other through the assembly process. Assign each student a role that he or she can perform.  **\_\_\_**    **Early Finishers**: Continue to program the robot to create more complicated sequences of sound, light, . | |

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| **MOTIVATING STUDENTS/ANTICIPATORY SET** | **“Hook”: Engage students’ attention and focus on learning.** Personally meaningful and relevant. |
| Place the teachers’ preassembled and programmed robot at the front of the classroom. Have it drive, blink, play a song. Tell students that they are going to assemble and program a robot to do similar tasks.  Show a video of manufacturing robots.  <https://www.youtube.com/watch?v=sjAZGUcjrP8> | |
| **INSTRUCTIONAL PROCEDURES** | **Step-by-Step Procedures-Lesson Sequence: Basic to Complex.** Lesson includes visuals, modeling, logical sequencing and segmenting (beginning, middle, ending); essential information; concise communication; grouping strategies; differentiated instructional strategies to provide intervention & extension; seamless routines; varied instructional strategies; key concepts & ideas highlighted regularly. |
| ***Introduction***  Now that we have assembled a robot, we are going to program the robot to flash its lights, make sounds, and to move in a predefined way  During a later lesson, we will program the robot to react to environmental input and modify its actions based on what it senses in its environment  Use your computers to open the instructions <http://learn.parallax.com/tutorials/robot/activitybot/activitybot/software-and-programming>  In each group, identify some group roles:  Timekeeper/Group leader  Instruction Reader/Computer operator(s): Take turns with this role, switching off after every task (blink, beep, move)  Code writer: For each task, write (on a piece of paper) some variants of the code provided in the instructions. The group should try these variants to see what happens.  **Motivating Students**  Verbal Reinforcement. The teacher will continuously provide praise for accomplishment of intermediate steps. Also provide hints if necessary, particularly with syntax errors in computer code.  Relate to Real World. When do computers use sound? Cell phone ringingThe teacher will remind students of the effectiveness of robots in real world tasks such as manufacturing.  **Presenting Instructional Content**  Hands-On. This is a hands-on activity where student groups will work to assemble a robot. They will have to read and interpret the instruction manual to follow steps to complete the assembly.  ***Instructional strategies:***  ***Input -* Hook (Set)** Remind students that programming the robot is a problem that they can solve.  **Modeling and Guided Practice *–*** Show students a programmed robot which blinks, beeps, and moves. .  **Check for Understanding (CFU) –**  ***What am I doing for students that progress at different rates?***  Ensure that all students in each group are participating. Do not let group members exclude one of their partners.  ***What do I do if they get it?***  Allow robot assembly to continue, but ask students to program a song or a certain sequence of light flashes to make the project more challenging  ***What do I do if they don’t get it?***  Encourage students to read the instructions carefully. If they are stuck, have them consult with students in another group. As a last resort, show them how to type enough lines of code to get a tone, light, or motion to happen. | |
| **QUESTIONING/THINKING/PROBLEM SOLVING (embedded throughout)** | **Balanced mix of question types.** Utilizes Blooms Taxonomy/Webb’s Depth of Knowledge; high frequency; purposeful & coherent; require active responses; balance based on volunteers/non-volunteers, ability, & gender; lead to further inquiry & self-directed learning.  **Implement four types of thinking (Analytical, Practical, Creative, & Research-based) & Teach/Reinforce problem-solving types**. Provide opportunities for students to generate ideas & alternatives; analyze, evaluate & explain information from multiple perspectives& viewpoints. |
| **Questioning**  **Knowledge:**  What does the command freqout(4, 1000, 3000) make the Activitybot do?  **Comprehension:**  Point to the front of the robot. Point to the back.  What doe each of the three numbers in the command freqout(4, 1000, 3000) indicate?  What would you type to get the robot to play a C6 note for one second? ( freqout(4, 1000, 1046.5) )  **Application:**  Have the robot play the tones C6, D6, and C6 again, for one second each, in order.  Have the robot play the tone C6 for one second while displaying one light, then play the tone D6 for one half second while displaying two lights.  **Analysis:**  Place the robot at one end of a line segment drawn on the floor (or table). Have the robot move forward to a spot so that the portion of the line segment behind the robot is twice as long as the portion in front of the robot.  Have the robot travel a one meter path and measure the time that it takes. Place some steel weights on the robot’s chassis and time the one meter trip again. Does the robot move at a different speed? Produce a graph of the robot’s motion with time as the independent variable and distance travelled as the dependent variable.  Build a ramp for the robot. Time how long it takes the robot to travel one meter uphill. Does the robot move as fast uphill as it did on a level floor?    **Synthesis:**  **Evaluation:**  **Thinking**    \_\_ **Practical** –Do the robot’s encoder sensors detect rotation of the wheels?  \_\_ **Creative**– Students can program the robot to play a particular song, accompanied by blinking lights if they want.  \_\_ **Analytical** – How can the robot’s lights and/or piezo speaker help us program the robot?  \_\_ **Research-based** – Conduct time trials of the robot’s speed uphill, downhill, and on level ground. Is there a difference? If so, why. If not, why not.  **\*What am I going to do to give Students the opportunity to:**  **1. Generate variety of ideas:** After suggesting several blink, beep, move problems for students to solve with the appropriate code, have them create their own problems. They should then write the code and observe whether the robot achieves the task that they set.  **2. Analyze problems from multiple viewpoints:** One way to produce code for the robot is to write it. Another way is to look for code available in the manual or on the internet and use that code. What are the advantages and risks of each strategy?  **Problem Solving**  **\_\_\_ Categorization:** Which parts help the robot make sound? Which parts help the robot make light? Which parts help the robot move? Which parts allow the robot to communicate with a computer?  **\_\_\_ Drawing conclusions/Justifying Solutions:** After writing some code to control the robot, ask, “does the code work?”  **\_\_\_ Predicting Outcomes** If we connect the left servo cables to the right servo ports and vice-versa, what would happen? What if we swapped the encoder cables? What would happen?  What if we connected the left servo cables to the right servo ports AND connected the left encoder cables to the right encoder ports. Would that make everything work out OK?  Will the robot move faster or slower when we load its chassis with extra weight? | |

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| **GROUPING** | **Maximize student understanding & learning** Varied group composition (race, gender, ability, & age); clearly understood roles, responsibilities & group work expectations; accountability for group & individual work; student opportunities for goal setting, reflection & evaluation of learning. |
| * Use a number of groups equal to the available number of robots * Use heterogeneous groups * Group roles are: Timekeeper/Group leader, Instruction Reader, Computer operator, Robot handler, Reporter. Students should rotate roles after each task * The room will be arranged for group work as the students enter. The day before the lesson, the teacher will instruct students to enter the room and join groups in preparation for the robot assembly lesson. | |
| **ASSESSMENT** | **Formative and/or summative assessment.** A variety of assessments, including rubrics, measure achievement of objectives and informs instruction. |
| ***Assessments:***  **\_\_\_ Exit Ticket**  The exit ticket for the group is a robot which beeps, blinks, and moves  **\_\_\_ Questions/Answers** Keep students’ names on a clipboard and record satisfactory/unsatisfactory based on responses to questions asked during assembly.  **\_\_\_ Presentation** Have group reporters describe what problem(s) they solved and how they solved the problem(s). Which part of their code accomplishes which action by the robot? | |
| **CLOSURE** | **Reflection/Wrap Up.** Summarizing, reminding, reflecting, restarting, connecting. |
| * ***Review/Summary:*** Remove the batteries from the robots before putting the robots away. Do not store batteries in robots. We have looked at how to control our robots’ sounds, lights, and motion. However, for any of these things, we are telling the robot exactly what to do. The robot needs no input other than our instructions. * ***Preview for next lesson:*** What we will turn to next is programming the robot to interpret its environment. Specifically, we will program the robots to use sensors to follow a track. We will not tell the robot “turn left.” Instead, we will tell the robot “steer toward a dark line.” * ***Upcoming assignments:*** None   ***Let’s review our I Can statements……***  **Follow-up Activities/Extension** If time is left, students may write other programs.  ***Reflection: You must reflect on every lesson you teach.*** | |

**NOTES:**

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