Reef Rescue: Coding for Coral Conservation

A 1-Week Lesson Plan

Authors

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Materials

- Computers with Internet access
- Access to VEXcode VR platform: VEXcode VR
- Projector and screen for video demonstration
- Notebooks or digital devices for documentation

SUBJECT/GRADE LEVEL

Subject Area: Science / Computer Science

Grade Level: Middle School

STANDARDS

Next Generation Science Standards

- MS-ETS1-1 - Engineering Design: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2 - Engineering Design: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3 - Engineering Design: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- MS-ETS1-4 - Engineering Design: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Mathematics | Common Core State Standards

Middle School (Grades 6-8)

- CCSS.MATH.CONTENT.7.RP.A.2: Ratios and Proportional Relationships: Recognize and represent proportional relationships between quantities.
- CCSS.MATH.CONTENT.8.EE.C.7: Expressions and Equations: Solve linear equations in one variable.
- CCSS.MATH.CONTENT.8.SP.A.1: Statistics and Probability: Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities.

English Language Arts (ELA) | Common Core State State Standards

Middle School (Grades 6-8)

- CCSS.ELA-LITERACY.RST.6-8.1: Reading for Literacy in Science and Technical Subjects: Cite specific textual evidence to support analysis of science and technical texts.
- CCSS.ELA-LITERACY.RST.6-8.3: Reading for Literacy in Science and Technical Subjects: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- CCSS.ELA-LITERACY.RST.6-8.7: Reading for Literacy in Science and Technical Subjects: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

LESSON OBJECTIVE(S)

Students will learn to use VEXcode VR to code a VR Ocean Cleaning Robot to collect trash in a coral reef environment. This activity helps students understand basic programming concepts, the use of sensors, and the impact of automation on environmental conservation.

CAREER CONNECTION(S)

Mentor Background: Dr. Benjamin Nye is the Director of Learning Sciences at USC-ICT. Ben's major research interest is to identify best-practices in advanced learning technology, particularly for frontiers such as distributed learning technologies (e.g., cloud-based, device-agnostic) and socially-situated learning (e.g., face-to-face mobile use).

STEM Careers: The STEM careers associated with ocean cleanup using autonomous robots include a wide range of fields, blending robotics, environmental science, and engineering. Including:

Robotics Engineer

- Designs and builds robots that can perform tasks in aquatic environments.

Marine Biologist

- Studies marine ecosystems and the impact of pollution, providing crucial data for the design of cleanup robots.

Environmental Engineer

- Develops systems and technologies to solve environmental problems, including ocean pollution.

Oceanographer

- Studies the physical and biological aspects of the ocean to understand where and how to deploy cleanup efforts.

ENGAGEMENT

Brief Description: Capture students' interest and introduce the concept of using technology for environmental conservation.

Lesson Introduction

Get ready to dive into an extraordinary adventure where technology meets environmental conservation! Today, we are thrilled to introduce an exciting, hands-on activity that will have you coding your way to a cleaner ocean.

Imagine the thrill of programming your very own VR Ocean Cleaning Robot, navigating through a vibrant coral reef, and collecting trash to protect marine life. With VEXcode VR, you will step into the shoes of an environmental hero, learning essential programming concepts and the power of sensors, all while making a positive impact on our planet.

This isn't just a lesson—it's an immersive experience that blends cutting-edge technology with real-world environmental challenges. Students will master the art of coding as they control their robots to clean up the ocean, demonstrating the incredible potential of automation in conservation efforts.

So, prepare to be amazed as we embark on this journey together, turning the virtual into reality and learning how we can all contribute to a cleaner, greener world. Let's harness the power of technology to inspire the next generation of coders and environmentalists. Join us now and become a part of the change!

Procedures:

Show a short video or discuss the importance of coral reefs and the impact of pollution on these ecosystems.

Video: What are coral reefs?

Video: How We Can Keep Plastics Out of Our Ocean **-**
https://www.youtube.com/watch?v=HQTUWK7CM-Y

Video: Amazing Teenager Builds Robot to Fight Ocean Pollution
https://www.youtube.com/watch?v=iDml4OsHLuY

Video: Impact of plastic waste on Marine Life

Discussion: (These can be done as a class discussion, on a discussion board in a learning management system, or using an online collaboration space.)

- Ask students why it is important to clean up coral reefs and how technology can help in this effort.
- How do you think coding a robot to clean up trash can benefit the environment?
- What are some other applications of robots in environmental conservation?

EXPLORATION

Brief Description: Allow students to familiarize themselves with the VEXcode VR platform.

Welcome to the first day of our thrilling adventure into the world of VEXcode VR! Today marks the beginning of an incredible journey where you'll transform from curious learners into adept coders and environmental champions.

On this exciting day one, we will dive headfirst into exploring the VEXcode VR platform. Get ready to familiarize yourself with this cutting-edge tool that will be your gateway to coding your very own VR Ocean Cleaning Robot. You'll navigate through intuitive interfaces, discover the basics of programming, and see firsthand how simple commands can bring your robot to life.

This is your chance to unlock the mysteries of coding and set the stage for an epic mission to clean our virtual oceans. So, gear up, embrace the thrill of discovery, and let your imagination soar as we take the first steps into this captivating world of technology and environmental conservation. Let's embark on this adventure together and make day one unforgettable!

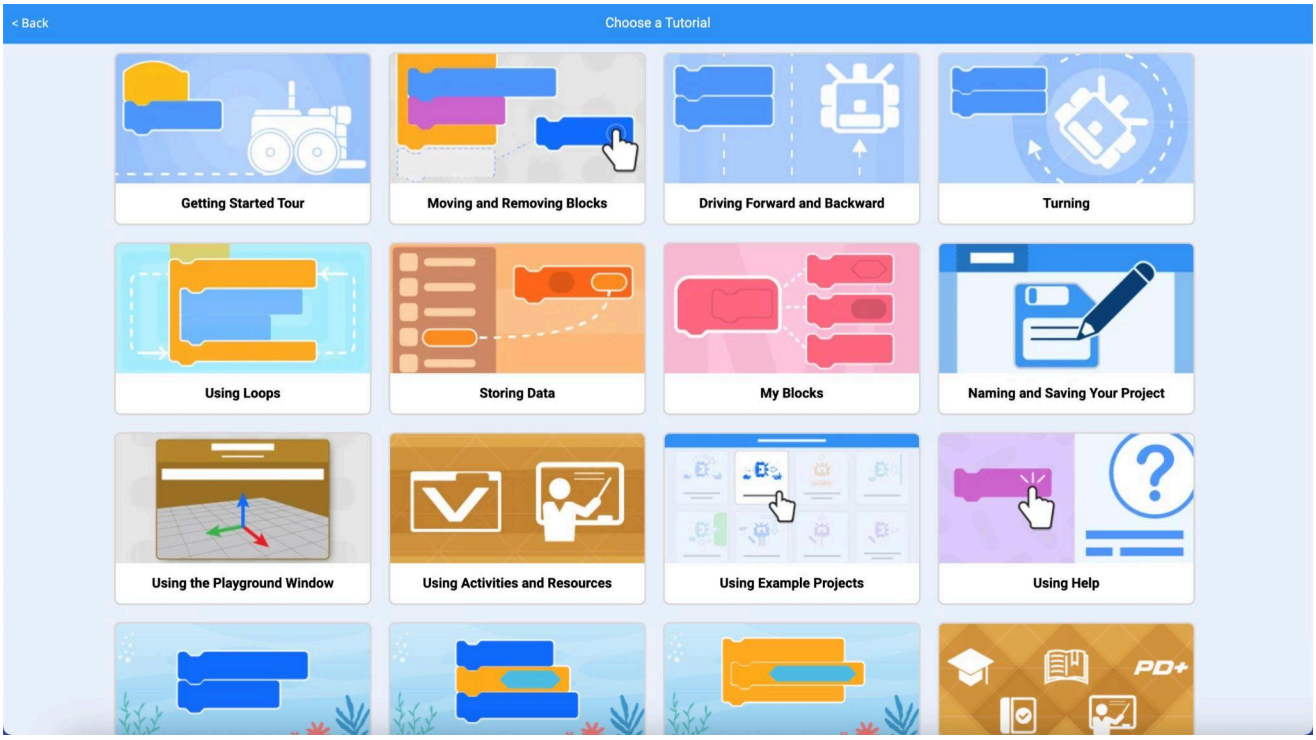
Procedures:
Thoroughly describe the procedures for the activity, including time frame. Be sure to include background information of the content, teacher and student actions, opportunities for formative assessment, hyperlinks, and possible adaptations for individual learners and/or virtual options.

EXPLANATION

Brief Description: Students will access the VEXcode VR platform using the provided link. For this lesson, we will use the FREE version. Students should complete the following tutorials on the website to get started:

Procedures:

- Have students access the VEX Code platform. https://vr.vex.com/
- We will be using the FREE version for this lesson.
- Students should complete the following tutorials - https://vr.vex.com/
    - **Getting Started Moving and Removing Blocks**
    - **Driving Forward and Backward**
    - **Turning**



ELABORATE

Brief Description: Provide a clear explanation of the coding concepts and strategies for effective trash collection. Review how the different blocks in VEXcode VR work, including drive, turn, set velocity, and sensor commands.

Introduce this lesson with mission briefing video - https://youtu.be/_4xUoK2qCGc?si=GiE-7jS7Vm4nW9lU

Teacher Resources - Solution Files - Blocks and Python

https://drive.google.com/drive/folders/1j2ozlY1Qm3_8C_U5dzAGOC0N2xCDcxD_

Procedures:

Activity:

- Have students access the VEX site - https://vr.vex.com/ . Use the free version for this activity.
- Show the introductory video - VEX VR – Virtual Robot - Coral Reef Cleanup - Tutorial Level 1 - https://www.youtube.com/watch?v=TjQzsyxdA4s

- Students should complete the **Coral Reef Cleanup Level 1 Tutorial** and use the drive forward, Turning, and Stopping Blocks to see how much trash their robot can collect before the battery drains or time runs out.

  Level 1: Building on the Coral Reef Cleanup Level 1 Example Project in VEXcode VR, create an algorithm to navigate the robot to collect as much trash as possible **in 30 seconds**.

  - Continue to sequence behaviors to drive the VR Robot to collect the trash.
  - Use the timer and a conditional loop to control the robot to collect trash for 30 seconds.

  Helpful Hints:

  - Use the Front Distance Sensor to detect pieces of trash as objects.
  - Use the Down Eye sensor to detect the blue border to avoid falling off the side of the collecting area.

- Students should also complete the **Coral Reef Cleanup Level 2 Tutorial,** which includes using sensors and control blocks.

  Show the introductory video - VEX VR – Virtual Robot - Coral Reef Cleanup - Tutorial Level 2 - https://www.youtube.com/watch?v=2mPTKdCQuSs

  Level 2: Building on the Coral Reef Cleanup Level 2 Example Project in VEXcode VR, create an algorithm to navigate the robot to collect **approximately 15 pieces of trash** as fast as possible.

  - Continue to sequence behaviors.
  - Use the Front Distance Sensor to navigate the robot.
  - Create a variable to store the approximate number of pieces of trash collected.
  - Use the variable and a conditional loop to control the robot to collect approximately 15 pieces of trash.

- Print the timer value to the Print Console to report the number of seconds the robot took to complete the task.

Helpful Hints:

- In the level 2 project, the robot collects one piece of trash after detecting it in each iteration.

Discussion:

- How much trash did students collect?
- Have some students discuss the code they used to collect the trash
- Have students discuss how their code is different (yet may still accomplish the same thing)

Q&A:

- Answer any questions students have about the coding blocks and strategies for the task.
- Coding solutions are provided in a separate answer key document for teachers.

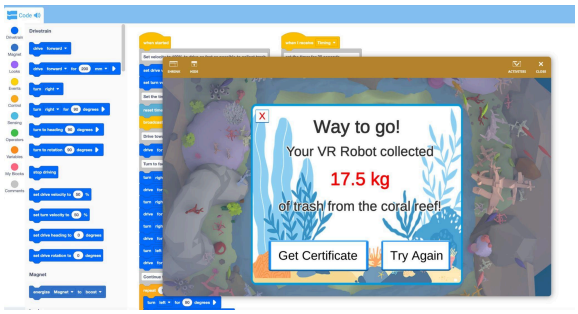
EVALUATION

Brief Description: Assess students' understanding and the effectiveness of their coding solutions.

Procedures:
Evaluate students based on their robot's performance (how much trash they collect and how quickly they collect it), their ability to explain their code, and their participation in the activity.

Deliverable:

- Students should screen capture their completion information and upload the image file to the correct assignment in the Learning Management System. They can also obtain a personalized certificate by clicking the "Get Certificate" button.



- Students should also Save the project file to their device named as LastName_CoralReef and upload the file it to the correct assignment in the Learning Management System.

Discussion Reflection: Students write a brief reflection on what they learned about coding, the use of sensors, and the impact of their work on environmental conservation.

Differentiation:

- **For students who need additional support**:
  - Provide step-by-step instructions and additional practice with basic coding commands.
- **For advanced students**:
  - Encourage them to incorporate more complex coding strategies or additional sensors to enhance the robot's capabilities.

REFERENCES

- VEX STEM Lesson Plans - https://docs.google.com/document/d/1AuEpdkTuG_RYOvTBjo7MlVyhqZWmn7YE0GTYCJ-NQ7s/edit#heading=h.1fob9te
- Trash Collection - https://docs.google.com/document/d/1w6qZ8IoyQea_7pLsR3VJ0Lew-E9ppG-kXTkJwHynzWI/edit#heading=h.1fob9te
- Teacher Answer Key

  coral_reef_answerkeys.docx
- Lesson Plan Explanation

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