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LEGO-Based Underwater Robotics as a Vehicle for Science and Engineering Learning (Curriculum Exchange)

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Mercedes McKay is Deputy Director of the Center for Innovation in Engineering and Science Education (CIESE) at Stevens Institute of Technology. She has led several national and statewide K-14 teacher professional development and curriculum development programs in STEM education. McKay is co-PI and Project Director for the NSF-funded Build IT Scale Up project to develop and disseminate an innovative underwater robotics curriculum for middle and high school students. She is a former practicing engineer with high school science and mathematics teaching experience.

Mr. Jason Sayres, Stevens Institute of Technology (SES)

Jason Sayres is a Senior Curriculum and Professional Development Specialist at the Center for Innovation in Engineering and Science Education at Stevens Institute of Technology in Hoboken, NJ. He specializes in development of STEM-based curricula, web applications, and teacher training. His current project is WaterBotics—a program that guides students in the design, construction, testing and redesign of a fully-functional underwater robot, using LEGO Mindstorms materials and programming kits.

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Target Grade Level: Middle and High School **Contact:** Mercedes.McKay@Stevens.edu

WaterBotics® is a problem-based underwater robotics curriculum that can be used in classrooms, camps, or out-of-school programs. Designed to appeal to girls and boys, teams of middle or high school youth design, build, program, test, and redesign underwater robots made of LEGO® and other components.

Take robotics to new depths! Working through a series of four scaffolded missions set in real-world contexts, students ultimately produce a fully-functional underwater robot. Students learn about key science topics essential to their robot's operation, such as gears, buoyancy, stability, propulsion, and rotation. They are also introduced to the engineering design process, with each mission taking them through one or more iterative design cycles.

Designed for both new and experienced STEM educators. For those students who have participated in land-based robotics projects, the complexities of the underwater environment present unique demands that challenge even the most experienced robot designers.

For More Information

www.WaterBotics.org

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MISSION 1
RESCUE!

GOAL: CREATE A ROBOT THAT CAN RESCUE A DISTRESSED SWIMMER

THE PROBLEM

A person is enjoying a nice day at the beach. However, while swimming in the ocean, this unlucky individual is caught in a riptide and carried far away from the shore and the lifeguard station. If help doesn't arrive soon, the person will be in danger of drowning due to exhaustion.

YOUR MISSION

Create a robot that will be able to go from the beach to somewhere near the swimmer. Once the swimmer grabs onto the robot, it should back up and return to the shore, all the while holding the swimmer securely.

REAL-LIFE ROBOT

EMILY (Emergency Integrated Lifesaving Lanyard) is a swimming robot that can rescue people faster than a human lifeguard. It can zoom along at 22 mph, provide flotation, deliver life jackets and even pull a person back to the shore.

For more info real rescue robots, check out:
http://waterbotics.org/real-robots/rescue

PROCEDURE

A ping-pong ball will be used to simulate the drowning swimmer. It will be placed at one end of the pool, and your robot will be placed at the opposite end. The robot will go as straight as possible towards the swimmer, and when the robot reaches the other side and is somewhat close, the swimmer will be placed onto a holder or platform attached to the robot. This will simulate the person grabbing onto the robot. Finally, your robot will back up to the start, carrying the person with it to safety.

MISSION CONSTRAINTS

- ☐ Robot must float on the surface of the water
- ☐ Move forward and backward in a straight line
- ☐ Use only 1 motor
- ☐ Include as many small boat propellers as necessary
- ☐ Experiment with gears to change the robot's speed
- ☐ Allow each teammate to control the robot

MISSION ACHIEVEMENTS

- ☐ SUCCESSFUL SAVE
  Perform a complete rescue
- ☐ RAPID RESCUE
  Perform a complete rescue in 20 seconds or less
- ☐ CHEETAH OF THE SEA
  Perform a complete rescue in 10 seconds or less
- ☐ ROOM FOR MORE
  Rescue 5 or more ping-pong balls in one trip
- ☐ ALL ABOARD
  Rescue 10 or more ping-pong balls in one trip
- ☐ HEAVY LIFT
  Rescue 1 "elephant" (a heavy wiffle ball)
- ☐ PACHYDERM PACKING
  Rescue 2 "elephants"

ENGINEER YOUR CAREER

Mechanical Engineer
Works on the development of many kinds of machines—engines, tools, power systems, robots and more.

Naval Architect
Designs and builds marine vessels, such as boats, submarines, yachts, ferries and cruise ships.

Biomedical Engineer
Creates technologies and tools that help to improve medical diagnosis, monitoring and treatment.