ROVe pack

Teacher's Guide

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ROVe PACK TEACHER'S GUIDE

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Material adapted from NOAA National Marine Sanctuaries and SeaPerch.

go.wisc.edu/ROVe

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TEACHER'S GUIDE

CONTENTS

SUMMARY

TEACHING AREAS

Middle School Science, NOAA, ROVs, Engineering, STEM, Wisconsin Sea Grant, Aquatic Science, Marine Science

GRADE(S)

5-8

BRIEF DESCRIPTION

Students will learn about ROVs and their use in scientific research. They will be introduced to the engineering design process before constructing their own ROV.

PERFORMANCE OBJECTIVES / I CAN STATEMENTS

- ☐ I can follow the engineering design process to research, design, build and test an ROV.
- ☐ I can understand how ROVs are used in marine environments.
- ☐ I can identify a variety of careers that use ROV technology.

MATERIALS

MATERIALS SUPPLIED

In this kit:

- ☐ Build-your-own ROV kit
- ☐ Inflatable pool
- ☐ Teacher's guide (this document)

Website with supporting material:

PRESENTATIONS:

- ☐ Remotely Operated Vehicles (ROVs)
- ☐ Slideshare
- ☐ The Engineering Design Process

DOCUMENTS:

- ☐ Research Resources
- ☐ Formative Assessment
- ☐ Brainstorming Guidelines
- ☐ Engineering an ROV – A Team Project

MATERIALS NEEDED

- ☐ Computers, tablets or smartphones

LESSON PLAN

DAYS 1 THROUGH 3

1. Presentation: "Remotely Operated Vehicles (ROVs) How can we see under water?"
   15 minutes
2. Student research and slide creation
   45 minutes
3. Student group presentations
   45 minutes
4. Formative assessment (optional)

DAY 4

1. Watch *The Engineering Process: Crash Course #12.2* (go.wisc.edu/b3lsdu)
   6 minutes
2. Presentation: "The Engineering Design Process"
   15 minutes
3. Share brainstorming guidelines
4. Practice brainstorming and adhering to guidelines: **Paper clip exercise**
   10 minutes

   - ☐ Hand out a paper clip to groups
   - ☐ Give them 3 minutes to write as many uses for it as they can
   - ☐ Have them circle their best idea, put a star near their weirdest idea and count how many ideas they came up with
   - ☐ Report to class
5. Students work on steps 1 through 3 of "Engineering an ROV Team Project" packet
6. Assign students to bring materials they will use to construct ROVs

DAY 5

Complete "Engineering an ROV Team Project steps 4 and 5"

DAYS 6-7

Complete "Engineering an ROV Team Project steps 6 and 7"

RUBRIC

RUBRIC FOR ROV SLIDE SHOW

	Text Font Choice and Formatting	**Cooperation**	**Effectiveness**	**Originality**
4	Font formats (e.g., color, bold, italic) have been carefully planned to enhance readability and content.	Group delegates tasks and shares responsibility effectively all of the time.	Project includes all materials needed to gain a comfortable understanding of the topic. It is a highly effective presentation.	Presentation shows considerable originality and inventiveness. The content and ideas are presented in a unique and interesting way.
3	Font formats have been carefully planned to enhance readability.	Group delegates tasks and shares responsibility most of the time.	Project includes most materials needed to gain a comfortable understanding of the material but is lacking one or two key elements. It is an adequate slide presentation.	Presentation shows some originality and inventiveness. The content and ideas are presented in an interesting way.
2	Font formatting has been carefully planned to complement the content. It may be a little hard to read.	Group delegates tasks and shares responsibility some of the time.	Project is missing more than two key elements. It would make an incomplete slide presentation.	Presentation shows an attempt at originality and inventiveness.
1	Font formatting makes it difficult to read the material.	Group often is not effective in delegating tasks and/or sharing responsibility.	Project is lacking several key elements and has inaccuracies that make it a poor slide presentation.	Presentation is a rehash of other people's ideas and/or graphics and shows very little attempt at original thought.

RUBRIC

RUBRIC TEAM PROJECT: ENGINEERING AN ROV

Student name: ______________________________

	The Packet	ROV Design Drawing	Design Revisions	Function	Team Collaboration
4	Packet is 100% complete and shows student went beyond general expectations.	Technical drawing is neat with clear measurements and labeling for all components.	Three or more design revisions were made with reasons for the change.	Structure functions extraordinarily well, and meets all design requirements.	Almost always listens to, shares with, and supports the efforts of others. Tries to keep people working well together.
3	Packet is 100% complete and shows students met the expectations.	Technical drawing is neat with clear measurements and labeling for most components.	Two design revisions were made with reasons for the change.	Structure functions well, holding up under and meets most of the design requirements.	Usually listens to, shares, with, and supports the efforts of others. Does not cause "waves" in the group.
2	Packet is approximately 75% OR student did not meet expectations.	Technical drawing provides clear measurements and labeling for most components.	One design revision was made with reasons for the change. OR, design revisions were made without reasons.	Structure functions pretty well, but only meets few design requirements.	Often listens to, shares with, and supports the efforts of others, but sometimes is not a good team member.
1	Packet is incomplete and student did not meet expectations.	Technical drawing does not show measurements clearly or is otherwise inadequately labeled.	No revisions were made.	Fatal flaws in function and does not meet design requirements.	Rarely listens to, shares with, and supports the efforts of others. Often is not a good team player.

KEY TERMS AND GLOSSARY

Archimedes Principle The relationship between buoyancy and displaced fluid. A force equal to the weight of the fluid it displaces buoys up an immersed object.

AUV Autonomous underwater vehicle.

Bathyscaphe A manned submersible vessel.

Buoyancy The apparent loss of weight of an object submerged in a fluid.

Density A property of a substance, equal to the mass divided by the volume; commonly thought of as the lightness or heaviness of a substance.

Mass A measure of the quantity of matter in a body; the amount of stuff in an object.

Neutrally Buoyant A state in which the forces of gravity and buoyancy are in equilibrium or balance.

Orthographic An orthographic drawing is a method that allows someone to represent a three-dimensional object on a two-dimensional piece of paper. By drawing the object from various angles, the artist is able to show how the object looks in the real world.

Pressure The force per unit of surface area. It is exerted perpendicular to the surface and measured in pascals.

Propulsion The action of pushing forward, caused by devices (motors and propellers) that transform electrical energy into motion.

REMUS Remote environmental monitoring unit.

ROV Remotely operated vehicle. An underwater robot.

Tether Wiring that connects the ROV to the person on land and allows for electronic control.

Weight The force on a body due to the gravitational attraction of another body (usually Earth).

ADDITIONAL RESOURCES

My Submarine Ocean Explorer coexploration.org/oe/kws/
From NOAA's Office of Ocean Exploration and Research and the College of Exploration

NOAA's National Marine Sanctuaries sanctuaries.noaa.gov

NOAA's Office of the Coast Survey nauticalcharts.noaa.gov/csdl/RD.html

SeaPerch seaperch.org

Wisconsin Great Lakes Shipwrecks wisconsinshipwrecks.org
From the University of Wisconsin Sea Grant Institute

PERFORMANCE ASSESSMENT

This will be completed as students share ROV designs with the class. They must demonstrate that the design requirements outlined in step 2 of the design process have been met.

1:1 device add on: Students film and show video of their functioning ROV.

STANDARDS

Ocean Literacy Principles

Principle 6: The ocean and humans are inextricably interconnected.

Principle 7: The ocean is largely unexplored.

Great Lakes Literacy Principles

Principle 1: The Great Lakes, bodies of fresh water with many features, are connected to each other and to the world's oceans.

Principle 4: Water makes Earth habitable; fresh water sustains life on land.

Principle 5: The Great Lakes support a broad diversity of life and ecosystems.

Principle 6: The Great Lakes and humans in their watersheds are inextricably interconnected.

Principle 7: Much remains to be learned about the Great Lakes.

NGSS: 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.

Common Core State Standards (CCSS): Literacy

ELA-Literacy.W.8.1.
Write arguments to support claims with clear reasons and relevant evidence.

ELA-Literacy.W.8.7
Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

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About the
ENGINEERING DESIGN PROCESS

The ENGINEERING DESIGN PROCESS

This is the engineering design process as defined in the **video** (go.wisc.edu/b3lsdu) you showed on day four of the lesson plan, with its associated NGSS Standard. Like the scientific method, the engineering design process is a flexible tool. In real world applications, engineers and designers do not always perform each step. Sometimes a design is handed off to another team member to complete a step or the rest of the project.

1. DEFINE THE PROBLEM.

What do you want to find out?

What is your challenge?
For example: How can I design an ROV that does...?

NGSS Standard met: 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.

2. IDENTIFY DESIGN REQUIREMENTS.

What does it need to do?

What can you use to do it?

What information do you need?

Are there other things that exist to solve this problem?
This step in the engineering design process was partially covered earlier in the week during the work on ROVs.

NGSS Standard met: MS-ETS1-1 Engineering Design

3. DEVELOP A SOLUTION.

What are your design requirements? (This includes size and availability of resources.)

Brainstorm and sketch possible design solutions.

Analyze the pros and cons of each design idea developed.

Select a design approach.

NGSS Standard met: 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.

NGSS Standard met: 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.

4. DRAW YOUR SOLUTION.

NGSS Standard met: MS-ETS1-3 Engineering Design

5. BUILD A PROTOTYPE.

Develop a full-size model to test design.

NGSS Standard met: MS-ETS1-4 Engineering Design

6. TEST IT.

Does it work the way you want it to?

NGSS Standard met: MS-ETS1-3 Engineering Design

7. EVALUATE YOUR SOLUTION.

Question everything!

What worked well?

How can it be made better?

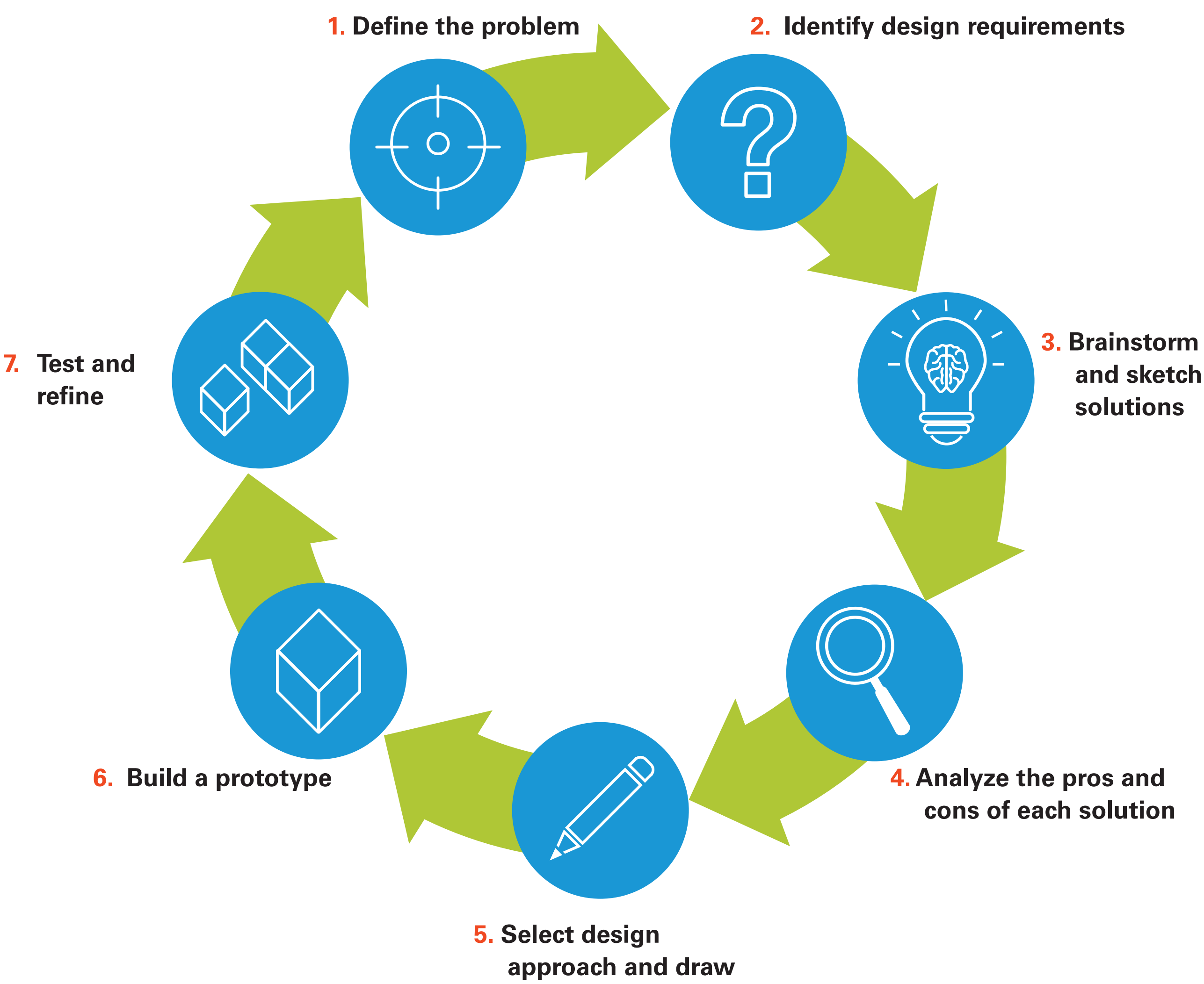
Maybe return to step 4 and refine design (more than once). Then perform steps 5, 6, and 7.

Remember: Sometimes the best design incorporates features from several designs.

NGSS Standard met: MS-ETS1-4 Engineering Design

Engineering an
ROV TEAM PROJECT

For the purposes of our Team ROV exercise, we have highlighted the steps the students will complete in designing and building their ROV.



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