

SeaMATE

PufferFish



This is a general guide for building a SeaMATE PufferFish ROV. It includes a list of items that need to be purchased for building a PufferFish ROV in a classroom as well as links to presentations and activities to facilitate teaching and building.

[The PufferFish ROV with thrusters and tether is available here for purchase.](#)

Many of the presentations have instructor-added audio files. Click the audio icon in the top left corner of each slide to hear a MATE instructor's audio presentation of the slide.

[Click here to download this guide as a PDF.](#)

[Click here for the standards alignments for all PufferFish ROV lessons.](#)

[Click here for assessments for the PufferFish ROV kit.](#)

Kits/Equipment Materials to Order:

The following materials should be ordered for every PufferFish build.

- 1 [PufferFish ROV Kit](#) per group of students*. A group is usually 2 to 4 students.
- 1 [PufferFish Grab Bag](#) spare parts kits for every 4 to 5 groups of students.
- 1 [MATE Wire Soldering Lab Kit](#) per student.
- 1 [MATE PufferFish practice board kit](#) per student.
- 1 [PVC Frame Kit](#) per group of students, easily obtainable from your local hardware store and 30 cm of foam from big box stores / dollar stores.
- 1 [Hydraulics Kit \(7.6m\)](#) per group of students (if doing Simple Hydraulics).
- 1 Hydraulic tool (PVC), 1 Non-moving manipulator (plastic hanger) per group of students.

*PufferFish ROV kits may be taken apart and re-used for future builds. Just the printed circuit board can be removed and replaced with a [PufferFish Circuit Board Kit](#), or the entire control box can be replaced with a [PufferFish Control Box Kit](#). See [Reusing the PufferFish ROV Kit](#) for instructions on taking apart and re-assembling a used PufferFish kit.

The following materials need to be ordered only once. They can be re-used for future ROV PufferFish builds.

- 1 [Power Supply](#) with GFCI plug-in for every 2 groups of students. Note that if you do not have a source of AC electricity (wall outlet) near your pool, alternative methods of powering the ROV may be needed.
- 1 [ROV-in-a-Bag Assembled Angelfish Kit](#) per group of students.
- 1 set of [PVC and fittings](#) from hardware store and 30 cm of foam from big box stores / dollar stores per group of students for the ROV-in-a-Bag activity.
- 1 [set of tools](#) to construct the PufferFish ROV kit per group of students. Some consumables may need to be purchased repeatedly.
- 1 [Simple Circuits Lab Kit](#) per group of students.
- 1 [Frame Pool](#). Used for practice and testing. Not needed if you have full time access to a larger pool. Note: Purchase in wintertime for large discount; price increased in springtime.
- 1 set of simple missions. [Pool rings](#) are a simple item to easily pick up from the bottom of the pool. Alternatively, the [Spanish Galleon Competition Kit](#) offers a more complex mission for ROVs to complete. Alternatively, you can use [MATE ROV Competition missions](#) from past years. See the Missions Presentation for additional information.

Introduction to Remotely Operated Vehicles	
Underwater Robotics textbook reading: Chapter 1, Sections 1.1 to 1.3, pages 1-38. Chapter 2, Section 2.1 – 2.2, pages 66-84.	
2 hours	Quick ROV Building <ul style="list-style-type: none"> • Presentation: ROV 101 and ROV Design • Activity: ROV-in-a-Bag • Activity: Engineering Design Cycle using ROV-in-a-Bag
20 minutes	The Mission <ul style="list-style-type: none"> • Presentation: ROV Mission
Instructor Resources: How to Implement ROV-in-a-Bag How to Get a Team Started	
Standards	NGSS , Common Core , ISTE , P21

Tools and System: Frame	
Underwater Robotics textbook reading: Chapter 4, Section 4.6.2.1, page 183. Section 4.9, pages 195 – 202.	
20 - 30 minutes	Tools <ul style="list-style-type: none"> • Presentation/Activity: Using Tools
2 hours	Computer Aided Design (optional) <ul style="list-style-type: none"> • Presentation: CAD (Computer Aided Design)
1 hour	ROV Frame <ul style="list-style-type: none"> • Presentation: General Frame Information • Presentation: Frame Design and Stability • Activity: Design and Build the Frame
30 minutes	Team Building <ul style="list-style-type: none"> • Presentation/Activity: Company Formation: Teams come up with a company name, ROV name and tagline • Presentation/Activity: Teams present their company name, ROV name and tagline
Instructor Resources: Tools and Tool Management in the Classroom	
Standards	NGSS , Common Core , ISTE , P21

Basic Electronics	
Underwater Robotics textbook reading: Chapter 8, Section 8.4, pages 377-388.	
1 hour	Electronics <ul style="list-style-type: none"> • Presentation: Multi-meter Basics • Presentation: How Switches Work • Presentation: Simple Circuits • Video: Simple Circuits Helpful Hints • Activity: Simple Circuits Lab • Handout: Electrical Symbols
Instructor Resources: Simple Circuits Lab Key	
Standards	NGSS , Common Core , ISTE , P21

Systems: Power, Control, Tether & Propulsion Troubleshooting (fixing problems)	
Underwater Robotics textbook reading: Chapter 7, Section 7.5, pages 319-323. Chapter 8, Section 8.7.4, pages 425-428. Chapter 9, Section 9.4 to 9.4.4, pages 466-473.	
1 hour	Soldering <ul style="list-style-type: none"> • Presentation: Soldering & Waterproofing Wires • Activity: Soldering Wires • Presentation: Solder & Seal Connectors • Presentation: How to Solder Components to a PCB
20 minutes	ROV Power System <ul style="list-style-type: none"> • Activity: Creating your ROV's power wire • Presentation: Power Options for your ROV
3 hours	ROV Control System <ul style="list-style-type: none"> • Activity: Creating the Practice Board • Activity: Building the PufferFish Control Box REV 7
30 minutes	ROV Tether System <ul style="list-style-type: none"> • Presentation: General Tether Information • Activity: Connecting the Tether to the Control Box
45 minutes	ROV Propulsion System <ul style="list-style-type: none"> • Activity: Attaching Propellers to the Motors • Activity: Creating the Tether Management Cross • Activity: Connecting the Motors to the Tether
45 minutes	Troubleshooting <ul style="list-style-type: none"> • Presentation: PufferFish SID • Presentation: Basic Electrical Troubleshooting - PufferFish

	<ul style="list-style-type: none"> • Activity: Tracing Voltage through the PufferFish ROV
Standards	NGSS , Common Core , ISTE

System: Payload	
Underwater Robotics textbook reading: Chapter 9, Section 9.3.2.1, page 463; Section 9.4.5, pages 473-477. Chapter 10, Section 10.2.4, pages 543-544.	
2 hours	Camera <ul style="list-style-type: none"> • Presentation: Waterproofing a Camera • Presentation: Connecting a camera to a PufferFish ROV
1 hour	Hydraulics <ul style="list-style-type: none"> • Presentation: Hydraulic Manipulators • Presentation: Non-moving Manipulators • Activity: Create a payload(s) to complete the mission tasks
Standards	NGSS , Common Core , ISTE

System: Buoyancy / Ballast	
Underwater Robotics textbook reading: Chapter 6, Section 6.1 to 6.2, and Tech Notes from Section 6.3, pages 252-267.	
1 hour	Buoyancy and Ballast <ul style="list-style-type: none"> • Presentation: ROV Buoyancy • Activity: Measuring flotation • Activity: Weighing your ROV and Calculating Buoyancy
Instructor Resources: Buoyancy Exercise Worksheet Key Simple Buoyancy Exercise Worksheet Key	
Standards	NGSS , Common Core , ISTE

ROVs Outside the Classroom	
1 Hour	The MATE ROV Competition <ul style="list-style-type: none"> • Presentation: The MATE ROV Competition • Videos: MATE ROV Competition Videos
30 minutes	Virtual Field Trips <ul style="list-style-type: none"> • Presentation: Virtual Field Trips
15 minutes	The Ocean Workforce <ul style="list-style-type: none"> • Link: Creating Tomorrow's Ocean Workforce

2 hours	Exploring the Oceans <ul style="list-style-type: none"> • Activity: Directed Learning Questions
Instructor Resources: Directed Learning Questions Searches Standards: Ocean Literacy , NGSS , Common Core	

Safety and Operations	
Underwater Robotics textbook reading: Safety notes and safety considerations (41 references), see Index, page 765, safety considerations.	
20 minutes	Safety <ul style="list-style-type: none"> • Presentation: General ROV Safety • Activity: Safety Check
1 – 3 hours	Operations <ul style="list-style-type: none"> • Activity: Operating in a pool to achieve the mission tasks

[Click here to access a previous version of the building instructions for the SeaMATE PufferFish ROV kit.](#)