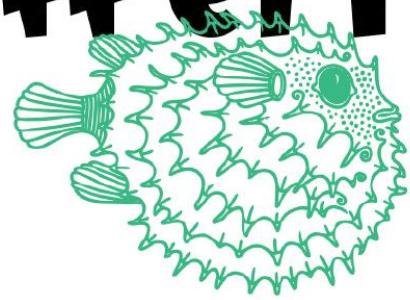
SeaMATE PufferFish



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 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 or Recommended PVC for Your Own Design 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 Frame Kit or PVC and Fittings for Your Own Design 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 MATE Tool Kit or Pufferfish 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 • **Presentation**: ROV 101 and ROV Design • **Activity**: ROV-in-a-Bag • **Activity**: Engineering Design Cycle using ROV-in-a-Bag
20 minutes	The Mission • **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 • **Presentation/Activity**: Using Tools
2 hours	Computer Aided Design (optional) • **Presentation:** CAD (Computer Aided Design)
1 hour	ROV Frame • **Presentation**: General Frame Information • **Presentation**: Frame Design and Stability • **Activity**: Design and Build the Frame • **Activity**: ROVAR: Physics of ROV Motion App
30 minutes	Team Building • **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 • **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 • **Presentation:** Soldering & Waterproofing Wires • **Activity:** Soldering Wires • **Presentation**: Solder & Seal Connectors • **Presentation**: How to Solder Components to a PCB
20 minutes	ROV Power System • **Activity**: Creating your ROV's power wire • **Presentation:** Power Options for your ROV
3 hours	ROV Control System • **Activity**: Creating the Practice Board • **Activity**: Building the PufferFish Control Box REV 7
30 minutes	ROV Tether System • **Presentation**: General Tether Information • **Activity**: Connecting the Tether to the Control Box
45 minutes	ROV Propulsion System • **Activity**: Attaching Propellers to the Motors • **Activity**: Creating the Tether Management Cross • **Activity**: Connecting the Motors to the Tether
45 minutes	Troubleshooting • **Presentation**: PufferFish SID • **Presentation**: Basic Electrical Troubleshooting - PufferFish

	• **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 • **Presentation**: Waterproofing a Camera • **Presentation**: Connecting a camera to a PufferFish ROV
1 hour	Hydraulics • **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 • **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 • **Presentation**: The MATE ROV Competition • **Videos**: MATE ROV Competition Videos
30 minutes	Virtual Field Trips • **Presentation**: Virtual Field Trips
15 minutes	The Ocean Workforce • **Link:** Creating Tomorrow's Ocean Workforce

2 hours	Exploring the Oceans • **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 • **Presentation**: General ROV Safety • **Activity**: Safety Check
1 – 3 hours	Operations • **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.