Robotics and Engineer Class Objectives
For
Mr. Hagen's Robotics classes

Knowledge and Skills acquired while attendance ROV class, building an ROV, and possibly competing in a MATE ROV Competition

Yellow is for SCOUT, Green is for NAVIGATOR
Scout is primarily Junior High ROV and Navigator will be focused on High School.
Even if a student enters as a Navigator for the first time, the Knowledge and skills of the lower level should be acquired.

General Engineering/Project Management
A student finishing the SCOUT NAVIGATOR class should be able to:
[all levels but responses/activities will be increasingly complex for each progressive level]

1. Describe and implement the engineering design process (spiral).
2. Describe specific strategies to address common design and building challenges (keeping on schedule, on budget, team dynamics, safety, etc.)
3. Define project constraints (time, money, expertise, vehicle depth, etc.)
4. Build a shallow diving ROV using hardware-store technology.
5. Develop a diverse team with various skills and disciplines. Learn how to effectively communicate both as a group and individually.
6. Be able to describe the steps to conflict resolution.

Technology and Society
A student finishing the SCOUT NAVIGATOR class should be able to:

1. Describe what a robot is.
2. Describe the common types and uses of modern underwater vehicles.
3. Conduct an underwater mission and relate this mission to what commercial ROVs are doing in science and industry.
4. Describe the type of occupations support the marine technical industry.
5. What is mechatronics and how do these knowledge and skill set relate to building ROVs. How do these knowledge and skill sets apply to other sectors of our economy?

6. Identify motivating factors and key historic events in the evolution of underwater vehicles.
7. Name and describe the major subsystems of a modern work class ROV.

Electrical Knowledge:
A student finishing the SCOUT NAVIGATOR class should be able to:

1. Define current, voltage, resistance and explain their relationship to Ohm's Law.
2. Describe what a complete circuit contains.
3. Describe the operation of a switch.
4. List three different types of DC power sources and select an appropriate battery for your vehicle.
5. Describe the importance of good electrical connections.
6. Describe the method for changing the direction of rotation of a DC motor.
7. Describe the purpose of a fuse.
8. Describe elementary electrical safety practices.

9. Calculate series, parallel and combination circuit values using Ohm's Law.
10. Calculate the resistance value and power rating of series resistors.
11. Describe the purpose of Pulse Width Modulation for motor control.
12. Describe the use of a MOSFET switch in a motor control.
13. Demonstrate best practices for soldering electronic components.
14. Demonstrate proper safety procedures when working with electrical power.
15. Describe the need for filter capacitors.
16. Design a simple filter circuit to protect cameras from motor spikes.
17. Describe methods of video transmission.

Mechanical Knowledge:

A student finishing the SCOUT NAVIGATOR class should be able to:

1. Use plumbing fittings to build a simple ROV frame.
2. Show proper methods for attaching cables to the frame.
3. Demonstrate the ability to make accurate measurements.
4. Demonstrate proper wire routing and sealing methods.
5. Design a gripper using hydraulic or pneumatic controls (fluid power).
6. *Use a Computer Aided Design program to build a simple ROV frame.
7. Describe at least one sealing technique for motors.
8. *Use the Bollard test to explain how to match a propeller with its motor to maximize the output thrust and efficiency.
9. Describe the difference between energy and power.
10. Describe safety procedures for working with fluid power.

Ocean Engineering/Physical Science Knowledge:

A student finishing the SCOUT NAVIGATOR class should be able to:

1. Apply Newton' Laws of Motion and Law of Gravity to building ROVs.
2. Describe ways that the physical properties of water differ from those of air. Explain how each of those differences presents challenges and/or opportunities for those designing or using underwater vehicles.
3. Explain why things in water sink, float or tip over and how ballast systems can be used to control these processes.
4. Describe the difference between positive, negative and neutral buoyance and explain why the designers of most underwater vehicles strive for near-neutral buoyancy.
5. Build a simple marine collection device.
6. List and describe the physical forces affecting underwater vehicle motion.
7. Calculate the buoyancy necessary to make any device neutrally buoyant.
8. Describe what a payload is and why it's important for an underwater robotic vehicle. Why are multiple and/or interchangeable payloads particularly useful?
9. Build a marine collection device with moving pieces.

Computer Science

A student finishing the SCOUT NAVIGATOR class should be able to:

1. Use a spreadsheet program to graph sensor data.
2. Use a spreadsheet program to perform simultaneous solutions for buoyancy problems.

Additional Skills

A student finished the SCOUT NAVIGATOR class should be able to:

- Be able to recognize a clients needs and develop a product to meet those needs.
- Be able to affectively market and present a product.
- Be able to speak and communicate affectively to a audience of both technical and non-technical people.
- Be able to write a grant and fundraise in a variety of ways.

Math is involved in many of the steps in building and controlling an ROV. Ohm's law, for instance, is central to designing the electrical systems for ROVs, even at the most basic of levels. Measuring and cutting, calculating buoyancy requirements, Bollard testing, and calibrating senses all involve a bit of applied mathematics.

Through this class and competition, the students gain a variety of additional knowledge and skill sets that are critical to making people readily employable:

- 21st Century Skills (e.g. communication, teamwork, leadership, entrepreneurship, creativity, critical thinking, problem solving, motivation, time and resource management) and these skills are assessed by their parents and teachers, along with competition judges.
- Technical Writing and Oral Communication are practiced and assessed during the competition.