TECHNOLOGY DIVISION

The Challenge

Your team has been assigned a critical mission deep below the surface of the ocean where traditional navigation systems cannot be used. In these conditions, visibility is near zero and communication must remain covert. To complete this mission, your team must design and construct a remotely operated vehicle capable of navigating a simulated underwater area (on land) using remote sensing technology. In addition, your team must be able to both send and receive encoded digital messages and gather real-time environmental data including temperature and air pressure.

Real World Examples

Submarines, underwater drones, and autonomous maritime vehicles all operate in environments where light and GPS signals are unavailable. These vehicles rely on sonar to "see" in the dark, just as dolphins and bats use echolocation to navigate and hunt. Naval communication systems also use encrypted signals to transmit vital information securely. Environmental monitoring equipment onboard these vessels helps ensure crew safety and mission success by detecting changes in internal and external conditions.

Things to Consider

Navigation: Navigating without sight is no easy task. Your design must be able to determine the location of obstacles and a safe path forward. Just as submarines and certain marine animals use sonar or echolocation to "see" with sound, your vehicle must detect distance and obstacles to navigate the environment safely. Pay close attention to sensor placement, signal timing, and how your team will interpret and react to the information it receives. Test and adjust your vehicle repeatedly to improve accuracy and avoid collisions.

Reliable Encoded Communication: This is necessary when operating in isolation. Your team must be able to send and receive encoded digital messages at a specified distance. How will your team encode the message so it can be interpreted clearly on the receiving end? How will you ensure messages aren't lost or corrupted? Think carefully about both the structure of your code and the technology you use to transmit and receive it.

Environmental Awareness: Critical for safe and successful operation, you must be aware of your environment. The sensors must be integrated into the vehicle and report values accurately and clearly. Think about how your team will receive and communicate this information.

You won't be following a blueprint for this mission – your team is inventing a solution for conditions where visibility is zero, communication must be secure, and awareness of the environment is key. There are no limits to how your vehicle can be shaped, how it moves, or how it interprets the world around it. Whether inspired by nature, science fiction, or your own original ideas, your system should reflect bold thinking and smart problem-solving.

The Digital Ship Challenge organizers would like to stress that the majority of work on all phases of the project is to be designed and constructed by the students.

Judging Criteria

The challenge involves components which will be judged: a digital engineering notebook, presentation binder, prototype iterations, presentation on the day of the competition, design and construction, and the demonstrated performance.

Constraints

The vehicle will need to navigate in a simulated underwater operating area (on land) that measures 6 ft. x. 6 ft. Vehicles will only be required to move in 2 dimensions (no change in elevation). No cameras or video devices can be attached to the vehicle.

The vehicle you are designing cannot exceed 12" x 12" x 24".

The vehicle must operate on a self-contained power source. (Not tethered to a power supply)

Movement must be controlled remotely by a team member, who will not be able to see the vehicle. Wi-Fi will be available.

You will send a sequence 3 types of alpha-numeric encrypted messages to another teammate located at a distance not greater than 10 feet. That teammate will be required to receive the messages, decode and report the messages to a judge. All messages must be delivered without line-of-sight signals between teammates. The encrypted messages will consist of all letters of the alphabet and numbers from zero to nine. The teams will need to provide the encryption key to the judges at the pre-test check. All message transmissions will be encrypted.

The vehicle must be capable of measuring air temperature and pressure. This information must be sent directly to the vehicle operator in an encrypted message.

A maximum of 2 team members will be allowed to enter the testing space but will not be allowed to handle the vehicle during the test. These team members will send an encrypted message to the outside team members that provide the location of the obstacles, air temperature and pressure, and a randomly generated code word.

A maximum of 2 team members will be outside of the testing space.

*If the above constraints are not met, a penalty will be assessed. *

Team Registration

Team selection: Individual schools will determine how they will select their teams.
Maximum number of students per team is four.

Teams must submit their intent to participate by September 12, 2025. Teachers will need to submit this information online at https://forms.gle/zZ9QrVJomNrewJbc9.

Project Completion Process

Teachers and mentors will create a schedule for the mentors to meet with the students to provide feedback and complete check-ins. This can be done in person or virtually. A project guide including mandatory milestones will be provided.
A mid-year workshop will be scheduled in December. During this session students will have the chance to ask questions regarding the challenge, participate in Maritime Connect, and receive feedback on their progress. All teams and team members should plan to attend with documentation and prototype iterations. Lunch will be provided.

The Digital Ship Challenge will take place April 25, 2026, at OERI (formerly VMASC). Doors will open for registration at 8:00 am and the opening ceremony will begin at 8:45am. Teams should bring their completed design to the competition ready to be tested and be prepared to present. Full details about the day of the event will be emailed to teachers after the registration deadline.

Project Submission: Digital Engineering Notebooks and Prototypes are due April 17, 2026, by 4pm. Prototypes are to be dropped off at OERI for judging prior to the challenge. Teachers, please make arrangements with Jennifer Renne to drop off the prototypes. Digital Engineering Notebooks will be submitted online. All other criteria will be judged at the event, which will culminate in the demonstrated performance on April 25, 2026.

Schedule of events

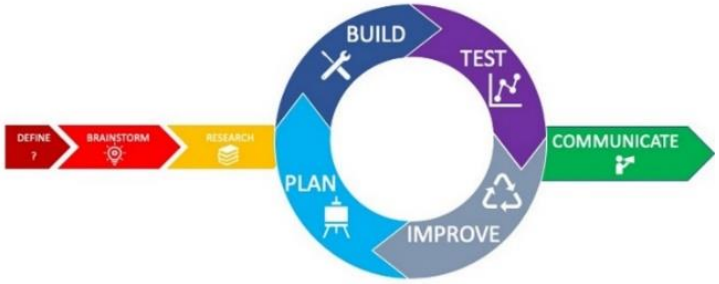
Intent to Participate	September 12, 2025
Teacher and Mentor Meeting	October 10, 2025
Mentor sessions at schools	As scheduled
Mid-Year Workshop at OERI	December 18, 2025
Digital Engineering Notebook online submission	April 17, 2026
Prototype drop off	April 17, 2026
Digital Ship Competition at OERI	April 25, 2026

If you have any questions, please contact Jennifer Renne at jrenne@odu.edu or 757-817-9975.

Scoring Criteria

The scoring for each component of the challenge will vary. A breakdown of scoring will be provided before the challenge. The information below gives an indication of what the judges will be looking for in all aspects of the competition. For maximum points, all criteria for each component must be fulfilled.

Digital Engineering Notebook:
Each team will create a digital engineering notebook that formally documents, in chronological order, all of the team's work throughout the challenge. This digital notebook serves as a comprehensive record of your planning, designing, prototyping, and testing and should follow the VDOE Engineering Design Process.



Your digital notebook should include **everything** you do or think related to the challenge – no detail is too small. Be thorough and intentional as you capture your progress and decisions.

This includes, but is not limited to:

- Brainstorming pages
- Sketches and technical drawings (CAD)
- Models/Prototypes pictures and videos
- Research notes and references
- Project calendar/schedule
- Roles and responsibilities of team members
- Calculations
- Budget & Materials
- Daily log
- Safety procedures (if applicable).

The technical drawings should be complete with appropriate annotations, material list and parts identified. The technical drawings should be printed on A size template and be scaled appropriately. Teams should be submitting orthographic and isometric drawings. Teams may should include other plans that relate to their challenge as appropriate.

Your digital notebook must be:
-Clear – Explain your thinking and design decisions
-Detailed – Include supporting data and thorough descriptions
-Organized – Use consistent formatting, section labels, and visual clarity

Be sure to include a title page, table of contents, and any references (citations in APA format).

The digital notebook will be used as a key tool during project checkpoints throughout the year. These checkpoints will serve as formal review moments where teams will earn points for submission. Staying current and organized in your digital notebook is essential to success throughout the year.

Presentation Binder:
In addition to the digital engineering notebook, each team is required to submit a physical binder that includes key artifacts from their design process (from the digital engineering notebook). This binder will support your presentation.

Your binder must include the following:

- Sketches
- CAD Drawings
- Code
- Calculations
- Any other documentation you believe strengthens your final presentation

Note: Not all items listed may apply to every challenge. Teams should include only the documentation that is relevant to their specific project.

All materials should be clearly labeled and organized to reflect progression of your project. This binder will be judged during the final presentation.

Prototype Iterations:
All stages of your design, from initial concepts to the final product, should be thoroughly documented in your digital engineering notebook. This includes:

- Photographs of all physical models and prototypes (e.g., paper, cardboard, 3D printed, etc.)
- Images should show multiple angles and include captions or explanations describing what each view represents
- Descriptions of design changes and the reasons for those changes
- Testing documentation such as written observations, data, and video clips of prototypes in action

All prototypes will be submitted ahead of the challenge and used in the final presentation. Be prepared to explain how your design evolved throughout the project.

Presentation:
Each team will deliver a 7–10-minute presentation at their assigned time. All team members should be dressed professionally and be prepared to speak about any aspect of their project including their individual roles during the project. Following the presentation, judges will have an opportunity to ask questions.

As part of the presentation, teams are required to use their presentation binder and prototypes. They will be available for pick up the morning of the event. Judges will expect students to reference these materials when discussing:

- Key stages of the design process
- Final design decisions and how the design evolved
- How the prototypes and final design performed during testing and the demonstrated performance at the challenge
- Lessons learned and improvements

To encourage creativity, public speaking skills, and real-time communication skills, PowerPoint, Google Slides, or other digital presentation software are not permitted during the presentation. Teams are encouraged to think outside the box and find engaging ways to share their journey.

Demonstrated Performance:
This is the most exciting part of the Digital Ship Challenge! Each team will have the opportunity to demonstrate that their hard work has resulted in a design that can successfully meet the challenge. First, second, and third place will be awarded based on total points achieved.

Design and Construction of the final project: Judges will be looking for the following:

-Achievement of design specifications and constraints.
-Creativity and innovation of design.
-Quality of construction.
-Finish and appearance.

Schedule of Checkpoints

Each checkpoint is worth points towards the team's overall score. Teams are required to submit the following documentation by the date and time listed. All documentation must be submitted to receive points. No partial points will be awarded.

Checkpoint Date and Time	What needs to be submitted	Points
Review Challenge and Overview of Digital Engineering Notebook **October 22, 2025 11:59pm**	All Divisions: Initial section of the digital engineering notebook including: • Title Page with team name and school division • Table of contents page • Challenge Interpretation and problem summary • Preliminary team roles and schedule Team mentor/teacher should confirm student understanding of challenge and constraints	10
Research and Brainstorming **November 24, 2025 11:59pm**	All Divisions: Notebook Updates • Research Notes (depending on division) • Brainstorming sketches or concept drawings • Notes on materials or systems being considered	10
Mid-Year Workshop **December 18, 2025 Time TBD**	All Divisions: In-person attendance at the mid-year workshop. Bring to the event: • First iteration prototype(s) • Talking points/questions	25
Refined Design and Prototypes **January 14, 2026 11:59pm**	All Divisions: Notebook Updates • Revised Sketches • CAD Drawings • Updated material list • System layout/plan • Refined prototype photos • Notes from testing/troubleshooting Prototype should demonstrate key function(s): • Design Division: Dive/surface mechanism • Systems Division: Piping layout/connections • Tech Division: Messaging and sensing partially working	20
Refined Prototypes and Testing **February 11, 2026 11:59pm**	All Divisions: Notebook Updates • Update of testing trials • Problems identified and design iterations • Adjustments to drawings, layouts, code, etc. Include photos or video clips of prototype testing	20

Final Design Build and Test **March 25, 2026 11:59pm**	All Divisions: Notebook Updates • Final test results • Design validation • Documentation of final construction • Clean CAD drawings, material list, wiring/flow diagrams, etc. Ensure all constraints are met	10

Presentation Preparation
 	
April 3, 2026 11:59pm
	All Divisions:
	Presentation outline submitted
	• Prepare for your oral presentation (7-10 minutes)
	  • Must include information from notebook, design construction, testing, and the day of the challenge results
	  • Practice answering judging questions
		10

Digital Engineering Notebook and Prototype Submission **April 17, 2026 4pm**	All Divisions: In person drop off at OERI • Submit all physical models and prototypes All Divisions: Online submission of Digital Engineering Notebook	10
Digital Ship Challenge **April 25, 2026 Time TBD**	All Divisions: In person event at OERI	N/A

Each team will be provided with a folder on Google Drive where they will be uploading documents for each checkpoint. The mentor, teacher, and students on the team will have access to the folder. This can also be used as a way for mentors to give feedback to students. The VDMC team will be accessing the folder after the submission date for a checkpoint and scoring what has been submitted.

Scoring

Digital Engineering Notebook

Max. Points	Criteria
5	Title Page: Clearly states the name of the challenge, team name, team member names, name of school.
5	Table of Contents.
10	Chronological documentation: Provides record of all team activities related to planning, designing, production, and preparation for the challenge. It should clearly demonstrate the progression of work overtime.
50	Content: Should include (but not limited to) brainstorming pages, pictures of hand drawn sketches, technical drawings (CAD – including orthographic, isometric, and any additional plans that relate to the challenge as appropriate), code (as applicable to the challenge), prototypes, testing documentation, calendar/schedule, roles, calculations, budget, daily log, safety procedures (if applicable). It should cover all aspects of the engineering design process. Drawings should reflect that the design meets the criteria provided.
20	Clarity: All components of notebook should be clear and understandable. Pictures, diagrams, charts, videos, etc. should be labeled and explained effectively.
15	Detail and organization: The notebook should be well-organized and exhibit a high level of detail. It should provide insights into the thought processes and decisions of the team while following the flow of the engineering design process.
5	References: If external sources are used, they should be appropriately cited in APA format.

Prototypes

Max. Points	Criteria
20	Designs from inception to final product are displayed (this includes all models or prototypes).

Presentation

Max. Points	Criteria
10	Appropriate attire: All team members should be dressed professionally and on time for presentation.
15	Knowledge and preparedness: All team members should demonstrate a comprehensive understanding of all aspects of the challenge. They are well-prepared to speak on any part of the challenge.
10	Presentation duration: Team presents in the 7–10-minute time frame.
15	Content: The presentation features content from the presentation binder, prototype iterations, and results of demonstrated performance (if possible).
10	Engagement and confidence: All team members should display confidence and be engaged while presenting. This includes maintaining eye contact, using a clear and audible voice, and conveying enthusiasm.
10	Question and answer session: All team members should be prepared to answer questions from the judges after their presentation. Responses should be knowledgeable and reflect a deep understanding of the project.

Presentation Binder

Max. Points	Criteria
5	Title Page: Clearly states the name of the challenge, team name, team member names, name of school.
15	Content: Sketches, CAD Drawings (orthographic, isometric, and any other applicable to challenge – printed on A size completed templates), Code, Calculations, any other documentation you believe strengthens your final presentation *Note: not all items listed above apply to every challenge. Teams should include only the documentation that is relevant to their specific project.
10	Clarity: All components of notebook should be clear and understandable. Pictures, diagrams, charts, etc. should be labeled and explained effectively.
15	Detail and organization: The notebook should be well-organized and exhibit a high level of detail. It should provide insights into the thought processes and decisions of the team while following the flow of the engineering design process.

Design

Max. Points	Criteria
40*	Overall width: 12”
	Overall length: 12”
	Overall height: 24” max.
	Navigation Sensors are present and operational
	Environmental sensors are present and operational
	Remote operations are functional
	Encryption communication is demonstrated, and key is provided
20	Creativity and innovation: Ship design exhibits creative and innovation solution and demonstrates a unique and thoughtful approach to solving the challenge.
20	Quality of construction: High quality construction with attention to detail and precision, it is durable and reliable.
20	Finish and appearance: The finished ship has an aesthetically pleasing appearance and the overall finish and surface quality meets or exceeds expectations.

*If any of the above criteria are not met, all points (40) will be deducted. *

Demonstrated Performance

Max. Points	Criteria
10	Communication Encrypted – All communications between team members is encrypted
30	Communications Mapping – Obstacles are correctly mapped
10	Communications Messaging – Message unencrypted accurately
10	Temperature Sensor – Temperature measurement (+/- 3 degrees)
10	Pressure Sensor – Pressure measurement (+/- 1 inHg/33.86mb)
60	Navigation Coverage – Sectors Covered (30 @ 2 points each)
-60	Safety Navigation – Obstacles hit (6 @ -10 points each)