MarineTech

STEM Careers in Marine Industry

Project Funded by NSF under ITEST

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Prof. Deborah Chen
Co Project Directors
Old Dominion University
Norfolk, Virginia

Located in historic Norfolk.
• Founded in 1930 as a division of the College of William and Mary.
• Old Dominion is now one of only 101 public universities with a Carnegie/Doctoral Research-Extensive distinction.
• Approx. 20,000 students
• Proximity to NASA Langley Research Center
• 200 miles south of Washington DC
Lean Institute at ODU is Your Host

Focus on Research, Education & Short Courses, Conferences and Implementation

* Implementation is done with the help of Virginia Applied Technology and Professional Development Center
MarineTech Project Goals

- Increase student awareness about careers in the STEM workforce, specifically in marine engineering and technology.
- To attract students towards marine engineering and technology careers to meet the critical shortage of workforce in this area.
- To train students in the use of information and communications technology tools to work collaboratively on group projects.
- To incorporate project-based pedagogy using Maine kits 1-4, Sea Perch robotics and ship building for students to connect physical science concepts to marine engineering and technology.
MarineTech covers 3 geographical areas:
Hampton Roads, Central Virginia, South Virginia

40 Teachers and 80 students from middle and high school will participate in this 3 year program.

Marine Tech also features carefully constructed evaluation component that will examine the impact of this project based learning approach on student knowledge, instructional practices and student career interests.
For Teachers

- Two day professional development summer workshops.
- Online training (10 hrs every semester), classroom visits and support from ITTIP.
- Each participating teacher will receive:
  - 1 Sea Perch Robot Kit
  - 4 Marine Kits and
  - Associated curriculum
  - $1800 stipend for 3 years
  - 2 Graduate Credits
For Students

- Saturday Academies  
  (64 hrs during school year, 4 Saturdays/Semester)
- Summer Academies (80hrs/summer)
- Counseling Services.
- Field Trips to Shipyards and Marine Museums
- $1200 stipend for 3 years.
Expectations from Students

- Saturday Academy (4 Saturdays / Semester for 3 years)
- Summer Academy (2 week long Workshop each Summer)
- Active Participation in Classroom Implementation of Marine Kits and Sea Perch
- Active Participation in Field Trips
- Active Participation in Sea Perch and Human Powered Container Ship Competition
<table>
<thead>
<tr>
<th>YEAR 1-Spring</th>
<th>YEAR 1- Fall</th>
<th>YEAR 2-Spring</th>
<th>YEAR 2-Fall</th>
<th>YEAR 3-Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Saturdays</td>
<td>4 Saturdays</td>
<td>4 Saturdays</td>
<td>4 Saturdays</td>
<td>4 Saturdays</td>
</tr>
<tr>
<td>Shipyards and marine industry terminology I</td>
<td>Shipyards and marine industry terminology II</td>
<td>Introduction to Sea Perch /ROV</td>
<td>Introduction to ROV/ROV operation and applications</td>
<td>Introduction to ship design/CAD/simulation</td>
</tr>
<tr>
<td>Shipbuilding production processes (hands-on)</td>
<td>Shipyards operations / shipyard IT/Advanced Concepts</td>
<td>Shipbuilding production process(hands-on)</td>
<td>Web page design II</td>
<td>Activity shipbuilding production process (hands-on)</td>
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<tr>
<td>Field trip to Marine Science Museum</td>
<td>Field trip to Marine Science Museum</td>
<td>Field trip to Marine Science Museum</td>
<td>Field trip to Marine Science Museum</td>
<td>Field trip to Marine Science Museum</td>
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<tr>
<td>Use of IT in shipping related and other careers I</td>
<td>Use of IT in shipping related and other careers II/Career exploration</td>
<td>Web page design I / Career exploration</td>
<td>Web page design III/Career Exploration</td>
<td>Web page design project / Career Exploration</td>
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<tr>
<td>March 14</td>
<td>March 21</td>
<td>April 18</td>
<td>April 25</td>
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<tr>
<td><strong>Shipyards &amp; Marine Industry Terminology I</strong></td>
<td><strong>Shipbuilding Production Processes (Hands-on)</strong></td>
<td><strong>Field Trips to Marine Museum</strong></td>
<td><strong>Career Counseling</strong></td>
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<tr>
<td>• Speakers from Marine Industry (NGNN, Colonna’s, BAE, Apprentice School) (4 hrs)</td>
<td>• Peninsula Higher Education Center</td>
<td><strong>Group-1:</strong> Hampton Roads - HR</td>
<td>By Dr. Nina Brown</td>
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<tr>
<td></td>
<td></td>
<td><strong>Group-2:</strong> Central Virginia - CV</td>
<td>9:00 AM - 12:PM (3 hrs)</td>
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<td><strong>Group-3:</strong> South Side Virginia –SS</td>
<td>• 3 graduate student in SS &amp; CV</td>
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<td></td>
<td>• Career Exploration</td>
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<td>• Games, Competition, raffles</td>
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<tr>
<td><strong>LUNCH</strong></td>
<td><strong>LUNCH</strong></td>
<td><strong>LUNCH</strong></td>
<td><strong>LUNCH</strong></td>
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</tr>
<tr>
<td><strong>Use of IT in Marine Industry by Prof Deborah Chen</strong> (3 hrs)</td>
<td><strong>Counseling Sessions by Dr. Nina Brown</strong></td>
<td><strong>Mariner’s Museum</strong></td>
<td><strong>Math &amp; Science Exploration By Dr. Sueanne Mckinney Dr. Daniel Dickerson</strong></td>
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<tr>
<td>• 21st century skills</td>
<td></td>
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<td>1:00PM - 4:00PM (3 hrs)</td>
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<tr>
<td>• CS basics-Activities using Computer Science Unplugged</td>
<td></td>
<td></td>
<td>• Discussion of Assignment before Fall</td>
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</tbody>
</table>
# Saturday Academies

<table>
<thead>
<tr>
<th>Oct 17</th>
<th>Oct 24</th>
<th>Oct 31</th>
<th>Nov 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Technology (Video Conferencing)</td>
<td>Nauticus, Norfolk (Field Trip)</td>
<td>Science (Video Conferencing)</td>
<td>Marine Career Industry Speakers – Instructional Module on Environmental Issues in Ship Building (Video Conferencing)</td>
</tr>
</tbody>
</table>

## Lunch Break

<table>
<thead>
<tr>
<th>Information Technology (Video Conferencing)</th>
<th>Nauticus, Norfolk (Field Trip)</th>
<th>Math (Video Conferencing)</th>
<th>Counseling (Live)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey</td>
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Fall 2009 Saturday Academies
Two-week Summer Academies for Students

In 2008 We covered,

- **Marine Kits** –
  MK1 - Shipyard Operations  MK2 - ship Construction
  MK3 - Ship Stability  MK4 - Ship Disaster Investigation

- **Instructional Modules** -
  IM1 – Shipbuilding History  IM2 – Ship and Offshore Structures
  IM3 – Hull Design  IM4 – Ship Operations

- **Other Activities**: Fieldtrips to shipyards and Museums.
Student Work posted on Website

Bird Kicker Game, by Paul Aelhart
Alien Game, by Kristine Currie
Two-week Summer Academies for Students

In 2010 We will be covering

- **Instructional Modules** -
  - IM1 – Force and Motion
  - IM3 – Submarines

- IM2 – Oceanography
  - IM4 – Deep Sea Salvage

- **Sea Perch Robot** – Design and build underwater robot and participate in a competition. Learn about engineering and science behind underwater robots.
Summer 2009
Sea Perch Competition
Summer 2009

Hampton Roads Schools
June 27th
Sea Perch Competition - Summer 2009

PORTSMOUTH
July 11th

Prize Distribution
Tentative Dates for 2010 Activities

Spring 2010 Saturday Academies
- March 13, and March 27, 2010
- April 17, and April 24, 2010

Summer Academies 2 weeks
- June 21 – June 26
- June 28– July 2

Fall 2010 Saturday Academies
- Oct. 9 and Oct 16, 2010
- Nov. 6 and Nov 13, 2010
Program for Spring 2010 Saturday Academies

<table>
<thead>
<tr>
<th>Saturday Academies</th>
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<tbody>
<tr>
<td>March 13</td>
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<tr>
<td>Field Trip</td>
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<tr>
<td>Mid Atlantic Maritime Academy</td>
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<tr>
<td>(MAMA)</td>
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<tr>
<td>March 27</td>
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<tr>
<td>Marine Career</td>
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<tr>
<td>Industry Speakers</td>
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<tr>
<td>(Video conferencing)</td>
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<tr>
<td>April 17</td>
</tr>
<tr>
<td>Math</td>
</tr>
<tr>
<td>(Video Conferencing)</td>
</tr>
<tr>
<td>Doctoral Students to Assist</td>
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<tr>
<td>April 24</td>
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<tr>
<td>Information Technology</td>
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<tr>
<td>(Video Conferencing)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Lunch Break</th>
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</thead>
<tbody>
<tr>
<td>Field Trip</td>
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<tr>
<td>VA Aquarium</td>
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<tr>
<td>Career Counseling</td>
</tr>
<tr>
<td>(Live) Videoconferencing for</td>
</tr>
<tr>
<td>last 1 hour</td>
</tr>
<tr>
<td>Science</td>
</tr>
<tr>
<td>(Video Conferencing)</td>
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<tr>
<td>Doctoral Students to Assist</td>
</tr>
<tr>
<td>Information Technology</td>
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<tr>
<td>(Video Conferencing)</td>
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</table>

Survey | Survey | Survey
# Program for Spring 2010 Summer Academies

## SUMMER WORKSHOPS

<table>
<thead>
<tr>
<th>June 21</th>
<th>June 22</th>
<th>June 23</th>
<th>June 24</th>
<th>June 25</th>
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</thead>
<tbody>
<tr>
<td>Student Summer Workshop</td>
<td>Student Summer Workshop</td>
<td>Student Workshop Sea Perch</td>
<td>Student Workshop Sea Perch</td>
<td>Field Trip</td>
</tr>
<tr>
<td>IM 1</td>
<td>IM 2</td>
<td>IM 3 (Teacher Workshop Sea Perch)</td>
<td>IM 4 (Student Workshop Sea Perch + ITTIP)</td>
<td>APM Terminal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>June 28</th>
<th>June 29</th>
<th>June 30</th>
<th>July 1</th>
<th>July 2</th>
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</thead>
<tbody>
<tr>
<td>Student Summer Workshop</td>
<td>Student Summer Workshop</td>
<td>Teacher Counseling</td>
<td>IM 3</td>
<td>Field Trip</td>
</tr>
<tr>
<td>IT</td>
<td>Science / Math</td>
<td>Student Counseling</td>
<td>IM 4</td>
<td></td>
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MarineTech Website

Program Summary:

1. 60 Math, Science and Technology Education teachers and 60 students

2. One week long professional development workshop during the Summer.

3. Classroom Implementation of instructional resources, building marine kits and Sea Perch underwater robot and human powered container ship for competition
Instructional Modules for 2010
Force and Motion

Force

Motion
Contents

1. Force and motion
2. Balanced and Unbalanced forces
3. Types of forces
4. Types of Friction.
5. Tension force
6. Hooke’s law
7. Gravity
8. Mass and weight
9. Newton's first law
10. Newton's Second law
11. Newton's third law
12. Momentum
Summary

Force and motion module that studies forces and how they affect motion.

Secondly the most common forces that affect motion are identified and analyzed in some detail how these forces combine to produce an overall effect on the motion of an object.
Hands on Activities

1. Coefficient of Friction: To find the coefficient of static, kinetic friction for different Surfaces.

2. Hooke's law: To verify Hooke's law (Relationship between force and deflection)

3. Projectile Motion: To study projectile motion

4. Acceleration: what does it mean to accelerate (using Pasco material)
class exercises

1. Newton's second law: (Quantitative problems on force, acceleration, mass)

2. Gravity: To find gravity of different Planets and effect of gravity on weight.

3. Newton's third law: (Complete the table by writing the reaction for each action)

4. Force and Motion: Crossword puzzles on forces and motion
   Match the following on force and motion
Oceanography
Summary

• The module gives a detailed description of oceanic currents and factors which causes it such as Tides, Coriolis Effect, Winds, Differences in water density,

• Study about different types of currents in ocean and about wave characteristics, Sofar channel, and Seafloor topography in detail.
Hands-on Activities

• CORIOLIS EFFECT: To simulate the Coriolis Effect by drawing a "straight" line on a rotating disc.

• WIND-DRIVEN OCEAN CIRCULATION (Gyre Circulation Patterns): To describe the typical gyre circulation pattern found in each of major ocean due to the movement of wind.

• HOW DENSITY EFFECTS WATER CURRENTS IN OCEAN: How the water movement due to density causes currents.

• AIR CURRENTS: To learn and understand convection air currents.
Class Exercises

- Composition of Ocean Water: To learn about the different percentage of salts present in ocean water
- Coriolis Effect: To learn and understand Coriolis Effect
- Tidal Ranges Compared To Moon Phases: To Understand how tides occur compared to Moon Phases
- Wave Characteristics: To learn how to calculate Wave speed using length and period
- Sofar Channel: To learn and understand how fast sound travels in ocean and the factors that effect the sound speed.
Submarines
Summary

• This module gives a detailed description on history of submarines, types, parts, working of submarine and dangers on submarine

• Study about different principles applied to make the submarine work like buoyancy, Boyle’s Law, effect of water pressure on the submarine with the help of hands on activities, class exercises and check on learning
Hands-on Activities

- Ketchup Submarine – small activity to discuss how the submarine submerges and rises because of the pressure.
- Archimedes Principle Activity – Observe how the object’s weight changes when submerged in water.
- SONAR Hands On- To trace the submarine located at the bottom of the sea floor.
- Build a Submarine Model – Build the model with the help of the items
Deep Sea Salvage
Shipwrecks are salvaged world wide for accident investigation, antique exploration and some other purposes. It is a million dollar industry that uses sophisticated navigation procedures, deep sea diving procedures and equipment and most cutting edge technology.

Deep Sea Salvation modules introduces students to the general procedure of salvation. It also teaches students basic concepts in navigation e.g. latitude, longitude, bearings etc. Hydrostatic pressure, underwater navigation using SONAR are also discussed in this module.
Hands-on Activities

Various interactive hands-on activities are used to teach practical applications of basic concepts

1. **Treasure Hunt** – Learn about Latitudes and Longitudes and locate various shipwrecks around the world using Google maps to find out sunken treasures

2. **SOS** – Learn about compass and bearing angles to locate the ship calling for help

3. **Around the World in 30 minutes** – Locate various ports around the globe using coordinates and bearings and calculate distance between them
4. **Deep Dive**—Use your scratch programming skills to simulate an underwater glider diving to the wreck, docking and coming back to the surface again

5. **Underwater Glider**—Build an underwater glider working on the density variation principle (WIP)
Class Exercises

1. **Hydrostatic Pressure** – Learn to calculate increase in hydrostatic pressure with increase in depth. Plot a pressure profile for your simulated dive in scratch.

2. **Underwater Navigation (SONAR)** – Learn the principles behind SONAR and solve a case study.
Year 1 Results

Student Backgrounds

Area-wise Student Distribution

Hampton Roads 27.9 %
Central Virginia 35.3 %
Southside Virginia 36.8%
Student dispositions (pre), sorted

- Good at Sci
- Sci Interest
- Career Goals
- Good at Math
- Math Inter
- Value of Acad
- Why Join MT
- Marine Sci Interest
- Science gen
- STEM career
Results of Survey - Examples

I would like to listen to scientists talk about their jobs

58% agree or strongly agree.
*comment:* more than half seem interested in the workplace roles for scientists

Engineering and Science magazines and stories are interesting

88% agree or strongly agree.
*comment:* interest in learning about the science fields; magazines and stories are typically read during voluntary or non-committed time, indicating a genuine interest. This is a very high response to this item compared to other projects the evaluation team is conducting.
I want to know how to build boats and submarines

85% agree or strongly agree.

*comment*: shows a strong correlation between student interest and program offering. Will be interesting to learn if this high agreement rating sustains throughout the program. In surveys since 2007 conducted by Education Design, INC on five other STEM science learning projects, the average “agreement” response rate is 58%.
Please rate how relevant you think the following STEM careers are to your region:
Student Responses in Central Virginia Summer Academy

1. Learning from Presentation  
2. Learning from Hands on activities  
3. Explanations in Hand outs
Student Responses in Central Virginia Summer Academy

1. Learning from Presentation

   - Instructional Module I - Ship Terminology
   - Instructional Module II - Ship and Offshore Structures

2. Learning from Hands on activities

   - Instructional Module III - Hull Design
   - Instructional Module IV - Ship Operations
Student Responses in Central Virginia Summer Academy

1. Learning from Presentation

2. Learning from Hands on activities
Teacher Responses in Hampton Roads

Day 1: Marine Kits (ODU)

Day 2: Math and Science Integration (ODU)

Day 2: Curriculum Integration (ITTIP)

1. Quality of Presentation
2. Presenters’ Knowledge of the Material
3. Organization of Information
4. Quality of Hand-outs
5. Content and Quality of hands-on activities
Thank You

http://www.themarinetech.org

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