## ROVs, HOVs and Buoyancy

Lesson plan, Student materials, Teacher notes, Supplemental materials

*Topics*

* History of undersea exploration
* Different types of craft used by scientists to explore the deep sea
* Engineering concepts used in the design of submersibles
* Exploring buoyancy in submersible design

*Resources used*

Introductory Power point: History of undersea exploration By Jessica Thompson

*Teaching Physical Concepts in Oceanography: An Inquiry Based Approach* By: Boss, Weller, Lofton and Albright

*National Geographic* Magazine Articles: James Cameron’s Deep Sea Challenge parts 1 and 2

<http://ngm.nationalgeographic.com/2013/06/125-deepsea-challenge/barcott-text>

<http://ngm.nationalgeographic.com/2013/06/125-deepsea-challenge/cameron-text>

Bill Nye the Science Guy Episode on Buoyancy http://www.dailymotion.com/video/xlafg6\_bill-nye-buoyancy\_tech

Lab: Marine Technology Society Journal, Winter 2009: *Modeling the Trieste to Explore Density and Buoyant Force*.

By: Marilyn Sniffen of Hillsdale Middle School, El Cajon, CA

<http://www.whoi.edu/alvin/>: Woods Hole Oceanographic Institute

<http://www.oceaneering.com/rovs/>: Video of ROV in action

<http://www.virginoceanic.com/team/operations-team/>: Richard Branson project

*Essential Questions*

* How has undersea exploration technology changed throughout history?
* How is each type of craft used and for what purpose?
* What must engineers consider in terms of materials and physical conditions, when designing and building the underwater craft?

*Learning Objectives*

* Students will become familiar with types of undersea craft
* Students will understand how scientists use undersea craft
* Students will imagine their own experience designing undersea craft
* Students will determine what materials and structures make the best floatation devices
* Students will model undersea craft
* Explore how mass and volume effect density and buoyant force
* Students will calculate the weight necessary to sink a model sub using Archimedes’ Principle

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| **Grades 9-12** | **Day 1 (45-50 minutes)** | **Day 2**  | **Day 3(90 min. period or 2-3 45 min.)** | Day 4 |
| **Notes/ discussion** | Present power point The History of Undersea Exploration. Be sure to show the videos provided. Discuss the differences in materials used and overall design of the craft. Compare and contrast Piccard’s *Trieste* with Cameron’s *Deepsea Challenger*. | Show Bill Nye episode on buoyancy. <http://www.dailymotion.com/video/xlafg6_bill-nye-buoyancy_tech>   | Refresh the students on the previous lesson and activities on pressure and buoyancy.See the write up in Modeling the *Trieste* this is a longer exploration. If you choose to have students do the construction, add a 45min. day  | *Trieste* modeling lab may cross into this day |
| **Activity** | Make a Venn diagram or T chart comparing the Trieste to the Deepsea Challenger  | “Designing Floats” Activity 3.3 in *Teaching Physical Concepts in Oceanography* | Exploration: Modeling the Trieste to Explore Density and Buoyant Force. |  |
| **Materials** | Power point “History of Undersea Exploration. | Web access or taped Bill Nye show. For activity: Containers w/ salt and fresh water, two beakers, small vials, weights, balloons, rubber bands, straws, scale, ruler, grad cylinder | See the write up in Modeling the *Trieste*  |  |
| **Assessment/ HW** | Read the National Geographic article *Deepsea Challenge Part 1* and answer the post reading questions for HW. | Have students read the supplemental handout “Buoyancy and Density” and answer the included reading questions. This will prepare them for the next activity, Modeling the Trieste | Post lab conclusion and analysis from student worksheet | Read Part 2 of the National Geographic Article and do the narrative writing prompt. (Assign over the weekend for best results) |

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| **Above timeline adapted for 6-8**  | **Day 1** | **Day 2** | **Day 3/4** |
| **Notes/ Discussion** | Show footage from <http://explorationnow.org/video>to insight some discussion and excitement about the potential discoveries of ROVsUse guide: *Introduction to Underwater Vehicles* Have students fill in the guide while using the internet to research types of undersea craft | Guide students through the supplemental handout “Buoyancy and Density” to make sure they understand these concepts  | Show pictures of the Trieste and discuss how both positive and negative buoyancy were maintained |
| **Activity/ Demos** | Researching onlinePrint out pictures of each type of craft (AUV, HOV, ROV) | Designing Floats activity | Modeling the *Trieste* |
| **Materials** | Computer lab access or laptops | See write up: Designing Floats | See the write up: Modeling the *Trieste*  |
| **Assessment/ HW** | Have students do research at home and make a Venn Diagram or T-chart comparing the *Trieste* to the *Deep Sea Challenger* | Student success at Designing Floats activity | Final test: Can the models they designed establish neutral buoyancy? |