

# NAVAL HISTORY STEM-H LESSON PLAN

**LESSON PLAN:** On the Brink of Nuclear War

**DEVELOPED BY:** John Clark, physics teacher and military historian, Deltona High School, Deltona, FL  
2012 Naval Historical Foundation STEM-H Teacher Fellowship

**ACTIVITY ONE:** Missiles Away (Physics)

**OBJECTIVE:** Students will solve projectile motion problems by determining how far away a U.S. nuclear submarine could launch its missiles and still hit the target. Students will see how advances in technology allowed Navy submarines to patrol closer and closer to home as newer missiles extended the maximum effective range.

**MATERIALS:**

Student Handout for activity and calculators

**INSTRUCTIONS:**

Students will be provided operational characteristics for six different submarine launched ballistic missiles and asked to calculate the maximum range of the missile by examining the missile's movement along the x and y axis.

This activity is for a basic physics class with simplified math. All launches take place at the optimum launch angle of 45 degrees. The acceleration phase of the solid rocket boosters is complete, and the "initial" velocity of the missile is provided to the student.

**NOTE:** Activity Two integrates Common Core English Language Art and Social Studies Standards into a discussion and literacy activity to introduce students to the ramifications of historical events associated with the Cuban Missile Crisis during the Cold War.

# NAVAL HISTORY STEM-H LESSON PLAN

## Activity 1: Missiles Away

Technology advances in missile design provided six different nuclear-tipped ballistic missiles for use in Navy ballistic missile submarines during the Cold War. Each one was more powerful and went further than its predecessor. This increased range changed the areas where American submarines patrolled. Given their calculations of maximum range for each missile, students are to determine where on the Atlantic Ocean a submarine could be and still land a missile on target on Moscow. Students will need a compass to draw a semi-circle to estimate the maximum range of locations the submarine could launch from. **(Hint: To compensate for the curve of the earth the circles will be draw around London. Subtract the distance of London to Moscow from your total missile range and use the remaining distance to plot your location from London).**

Distance:      New York to London = 5,600 Km      London to Moscow = 2,500 Km

US Navy Submarine Nuclear Ballistic Missiles					
Type of missile	Entered service	Launch angle	Initial Velocity in Km/sec	Initial Velocity in Km/hour	Range in Km
Polaris A1	1960	45°	2.30		
Polaris A2	1962	45°	2.60		
Polaris A3	1964	45°	3.36		
Poseidon	1972	45°	3.36		
Trident C4	1979	45°	4.25		
Trident D5	1990	45°	5.25		

Plot your range calculations on the map. Remember to subtract the distance between Moscow and London and the draw you distance semi-circle with London as the starting point. 

Questions:

What was a major disadvantage of the Polaris A1 missile?

What advantage did the submarine fleet gain when the Polaris A2 replaced the Polaris A1?

If three missiles have the same range what would be a strategic reason to upgrade?

Given three missiles had the same range, what changed in the mathematical relationship between acceleration and time? Why would the weapons designers want to do that?

What strategic advantage did the new Trident D5 provide for U.S. Navy submarines? (Hint: the distance from Moscow to Anchorage is 7,025 Km.)

