Diving Submarine

Procedure:

1. Always wear safety goggles.

2. • Remove the periscope cap from the submarine.
   • Rinse the square inner chamber in the sink.

3. • Dry your hands.
   • Place the submarine over the small dish and loosely fill the inner chamber with baking powder.
   • Firmly replace the periscope cap and dust off any excess baking powder.

4. • Hold the submarine upside down under water in the tank and shake it gently for 10 seconds.
   • Let go of the sub and observe for a few minutes.
     □ What is coming out of the bottom of the submarine?
     □ What happens to the submarine just before it dives?

5. Make a small pile of baking powder from the powder spilled on the dish and add a drop of water.
   □ What happens?

6. Rinse the small dish and the inside of the submarine in the sink.

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How does the submarine dive and surface?

A Closer Look:

The material making up the submarine is more dense than water, so it dives at first. As the water reacts with the baking powder, gas bubbles lift up the submarine, much as an air mattress lifts you up in water. When the submarine surfaces, it tilts and the bubble of gas escapes, so the submarine dives again. The whole process repeats until all the baking powder has reacted.

Baking powder contains three ingredients: cream of tartar (KC$_4$H$_6$O$_6$) and calcium dihydrogen phosphate (Ca(H$_2$PO$_4$)$_2$), and baking soda (NaHCO$_3$). The first two ingredients react to make an acid. The acid reacts with the baking soda, producing carbon dioxide gas (CO$_2$).

A real submarine, such as OMSI's USS Blueback, operates under the same density principles. It surfaces by adding air to its tanks and dives by replacing that air with denser water.