

## Lesson Plan: WHO IS JOHN PHILLIP HOLLAND AND WHAT BOATS SINK AND FLOAT?

Class: 5<sup>th</sup> and 6<sup>th</sup> Class

Subject: History

Strand: Story

Strand Unit: Stories from the lives of people in the past



Illustration © John Joyce, 2006

### Aim / Learning Objective:

The aim of the lesson is to introduce students to an Irish marine historical personality called John Phillip Holland, who was responsible for influencing the design of submarines. By designing their own DIY submarine, students will also learn about boats that can sink and float.

### Skills:

Students will have developed questioning and predicting skills as well as the following:

- Work as historians developing their research skills
- Understand time, chronology, change, continuity, cause and effect.

### Materials:

- Access to computers, internet and a library
- Who is John Phillip Holland and What boats sink and float worksheet.

Experiment materials:

- A deep basin of water
- Plasticine
- A small plastic drink bottle
- A bendy straw or bendy plastic tube
- Scissors

### Preparation / Background Information:

#### John Phillip Holland (1841 – 1914)

#### In the Beginning:

John Phillip Holland was born on February 29th 1841 in Liscannor Co. Clare, Ireland. His father John Holland Senior, patrolled the west coast of Ireland as a Coast Guard on horseback. It was his father's duty to watch out for attempts of invasion by the French.

#### The First Plans:

In 1853, Mr Holland senior and his family moved to Limerick and John was influenced by the teachings of

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Brother Dominic Burke who was his science teacher. Brother Dominic Burke greatly encouraged John Holland in his ideas. John had drawn out plans for his first submarine by the end of the 1850s.

### **HOLLAND I:**

In 1873, John immigrated to America with his family. After working as a schoolteacher in Paterson, New Jersey, he began designing submarines. He built the Holland I, a tiny two-ton, petrol-driven sub in 1877. The designs of Holland's submarines later reformed warfare for the Americans and Germans – particularly in the 2<sup>nd</sup> World War.

### **What was Holland's Secret?**

Before Holland, submarines dived by flooding water tanks that were contained inside the same space that the crewmembers lived and worked. These tanks took up a lot of space inside the hull and sometimes leaked, with disastrous results. Holland's design was to have a single watertight "pressure hull" in which the men lived and the delicate machinery of the submarine was contained, with the floodable "ballast tanks" OUTSIDE the pressure hull.

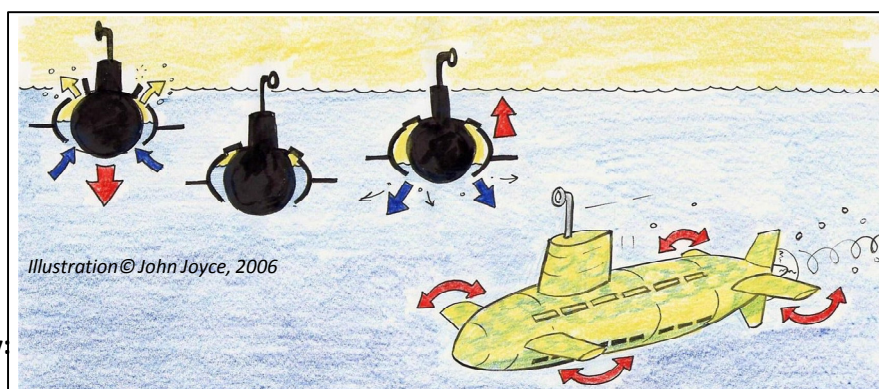
This made Holland's designs much more efficient and far safer. The principle of the ballast tank is still used in the design of modern nuclear submarines.

### **How does a submarine sink and float?**

Ballast tanks are used to make a submarine sink and float. The tanks sit on either side of the pressure hull like saddlebags on a horse. They have openings at the top, which can be closed by valves. They also have openings at the bottom, which stay open all the time. On the surface, the tanks are pumped full of air from high-pressure air tanks (making the whole submarine lighter than the water in which it sits) and the submarine floats.

To dive, the valves on top of the ballast tank are opened, the air flows out and the submarine sinks. Once the required depth is reached, a specially trained crew member (called the "Diving Master") changes the amount of water and air in the ballast tanks until the submarine is the same weight as the water and neither floats or sinks.

At this point, special fins called hydroplanes can be used to "fly" the submarine underwater, just as the wings of an aircraft are used to fly the plane in air as it moves forward. When the Captain wishes to surface, high-pressured air from tanks is blown back into the ballast tanks, the submarine becomes lighter than the water and it rises to the surface.



Activity:

The illustration shows how ballast tanks are used to make a submarine sink and floats.

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1. Discuss with the students the history of submarines and who John Phillip Holland was.
2. Get the students to complete the worksheet and research historical events at the time John Phillip Holland was alive. Research what changes were happening with technology and transport in John Phillip Holland's lifetime. Think about the ships that were used in the late 1800's to the changes during the 1<sup>st</sup> World War. Identify what was the cause and effect of the invention of the submarine e.g. during the 20<sup>th</sup> and 21<sup>st</sup> centuries? For example, what were submarines used for during the 2<sup>nd</sup> World War? How are submarines used today? Get the students to provide evidence of this with pictures of how submarine designs have evolved and what discoveries have been made. For example, look at how James Cameron was the first person in 50 years to reach the deepest point in the ocean, the Mariana Trench and what was discovered.
3. Complete the experiment to show how submarines work.

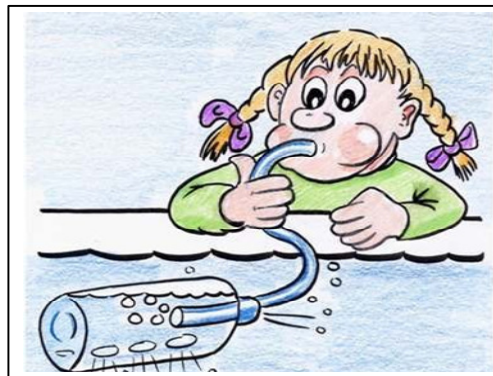


Illustration © John Joyce, 2006

- CAREFULLY – make a straight line of holes along the edge of a plastic bottle from the top to the bottom. (Take the lid off the bottle before cutting to release the air pressure inside it - otherwise it will be difficult to cut into the bottle). Safety note: it is recommended that teachers cut the holes in the bottle before the class.
- Mould a piece of plasticine around the bendy part of the straw to use to seal out the water.
- Place the shorter end of the plastic drinking straw through the top of the bottle, bending it so that it sticks up like a periscope. Press the seal in place.
- Submerge the bottle in the water with the holes upwards so that the bottle fills with water and sinks (this is like a submarine diving). A little bit of force may be required to force the air out of the bottle so it sinks. Now turn the bottle the other way around so that the holes are facing downwards (this is like the Captain shutting the top vents on the ballast tanks).
- Gently blow into the straw. Students are now “blowing ballast” – i.e. blowing in air and forcing water out of the bottle. The bottle “submarine” will then rise to the surface.

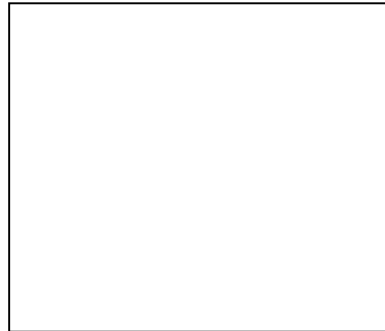
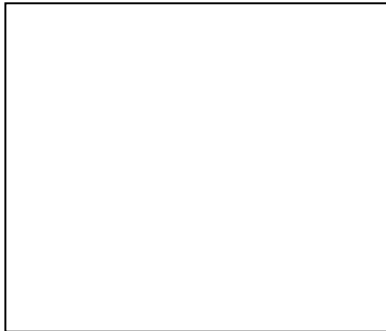
Worksheet: **WHO IS JOHN PHILLIP HOLLAND AND WHAT BOATS SINK AND FLOAT?**

Subject: **History**



**Working as a historian, use the internet and the library to research the following questions:**

1. Find a photograph on the internet of John Phillip Holland.
2. Find a picture of the submarine designs by John Phillip Holland.



3. Create a time line of John Phillip Holland and identify what other key historical events were taking place in Ireland and the rest of the world during his lifetime (e.g. Emigration, the 1<sup>st</sup> World War). For example, what was happening in Ireland when John Phillip Holland was born in 1840? What was happening in the world when he died 1914? Add pictures and drawings to represent the events on the time line.

Irish and World Events:

1840 1914

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John Phillip Holland Lifetime Events:

4. What changes happened with technology and transport in John Phillip Holland's lifetime. Think about the ships that were used in the late 1800's to the changes during the 1<sup>st</sup> World War.

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5. What was the cause and effect of the invention of the submarine e.g. during the 20<sup>th</sup> and 21<sup>st</sup> centuries? e.g. What were submarines used for during the 2<sup>nd</sup> World War? How are submarines used today?

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6. Write a letter to John Phillip Holland and tell him how submarines and submersibles are used today by marine scientists. Show evidence of this with pictures of how submarine designs have evolved and what discoveries have been made. (For example you could tell him how James Cameron was the first person in 50 years to reach the deepest point in the ocean - the Mariana Trench. You could also tell him about what he discovered deep in the ocean).

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