## Activity #2: *Plimsoll Marks on Ships*

### Objective 20: Physical Science

In this activity, students learn about the effects of temperature and salt content on the density of water.

**Description:** By examining the Plimsoll marks on a ship, students decide if a ship can safely make a certain trip without having to off-load cargo.

### ▶ *Directions*

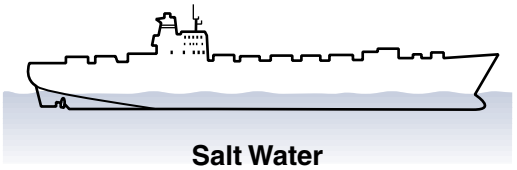
1. Duplicate the article and the pictures found on the following pages and give copies to students. Have students read the article.

2. Discuss the article with the class. Ask students the following questions:

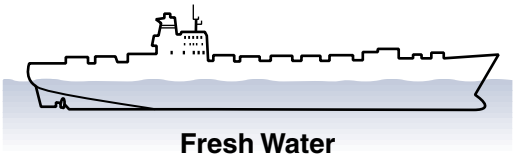
   - Why do you think the Plimsoll marks might be important to a ship's captain? *(They tell how much cargo can be loaded onto a ship when traveling in different water conditions.)*
   - If loaded to the exact same Plimsoll mark, can a boat hold more cargo in a freshwater lake or in a cold part of the ocean? *(Cold part of the ocean because the water is more dense.)*
   - Find Barbados and Iceland on a map. If a ship loaded cargo in Barbados and traveled to Iceland, would the ship float higher or lower in the water when it arrived in Iceland? *(The boat would be higher in the water at the end of the trip in Iceland.)*
   - Using what you know about water density, if cold water is allowed to run gently into a bathtub filled with hot water, what will happen to the water? *(The cold water will sink to the bottom of the bathtub because it is more dense than the warm water.)*

# Water Density and Plimsoll Lines

The water covering Earth's surface is not the same at every location. Some is fresh water, like that in a lake or stream, and some is salty. Near the poles, the water is very cold. Water near the equator is warmer. For ship captains, these differences are important to know, because ships will float differently in different kinds of water. Salt water, like that in the ocean, is denser than fresh water. A ship in salt water will float higher than it will in fresh water.

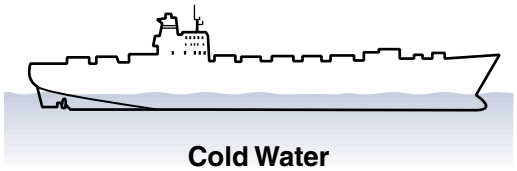


Salt Water

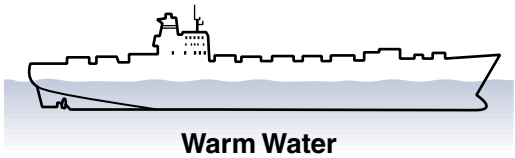


Fresh Water

Temperature also affects how a ship will float. Cold water is more dense than warm water, so a ship will float higher in cold water.



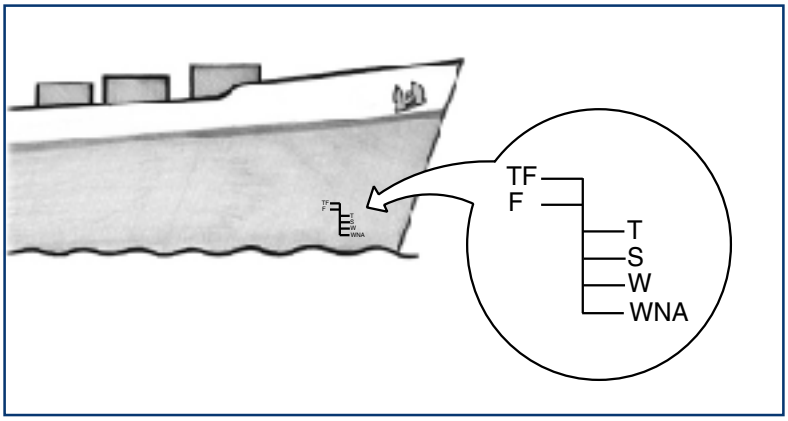
Cold Water



Warm Water

Ships have special marks on their sides called *Plimsoll marks,* or *Plimsoll lines.* These marks tell how much cargo can be loaded onto ships in different water conditions in order to ensure that the ship has enough "reserve buoyancy" when traveling from one type of water to another. For example, if a ship were loaded to full capacity while in cold salt water, it would sink dangerously low in the water if it traveled into warm fresh water.

# Water Density and Plimsoll Lines




Notice that some of the marks point to the left and some to the right. The marks to the left show how much cargo can be loaded when the ship is in fresh water. TF stands for tropical fresh water. A ship can be loaded to this line in warm, fresh water. F means fresh water that is colder than tropical water. The marks to the right show how much cargo can be loaded in saltwater conditions. The T stands for tropical, or warm water. The S line shows how much can be loaded in colder salt water. The W line shows how much can be loaded in winter. WNA stands for winter, North Atlantic.

A ship loaded to the TF line while in tropical fresh water would of course always be safe, because the ship can only ride higher when traveling in other kinds of water. But a ship loaded in a cold saltwater port will always sink lower in other kinds of water. So it must start out riding high in the water—at the WNA Plimsoll mark.