Student Sheet 1

MATH APPLICATION ACTIVITY: ICEBERGS!

The RMS Titanic, a great ocean liner believed to be unsinkable, made its voyage from England to New York in 1912. On 14 April, just before midnight, she collided with an iceberg estimated to be 70-150 m long and 20-40 m high above the water surface. N. In reality, such drifts are relatively rare. It is estimated that of the 15,000 to 30,000 icebergs produced annually by the glaciers of Greenland only one percent (150 to 300) ever make it to the Atlantic Ocean. Sadly for the passengers and crew of RMS Titanic, it sank with the loss of 1513 lives in the icy waters of the North Atlantic.

Climate change is melting ice at both ends of the planet as major expanses of polar ice are now undergoing a continuous and rapid retreat. An ***iceberg*** is a great chunk of ice that has broken off o **"calved"** from one of the ice sheets in Antarctica or the Arctic, from a glacier or from another iceberg. Icebergs in the North Atlantic are irregularly shaped and are sharply crested. They are thousands of feet wide, equally as long and hundreds of feet thick. Icebergs from Antarctica usually have a flat surface. A single iceberg from Antarctica can cover an area of several miles and may have a thickness of 2,000 feet or more. That's an amazing statistic to consider given the massive size of some icebergs, but the very fact that ice floats is incredible.

To understand why ice floats, it is important to understand the concept of density. ***Density*** is calculated by dividing an object's ***mass*** (amount of matter) by its ***volume*** (the space it occupies), or ***D=M/V***. Density basically describes how tightly packed a substance's atoms are. A high density means that a substance has tightly packed atoms, while the atoms in a low density substance are more spread out. Density is a physical property of all substances and it is always the same, no matter how much of the substance there is. Pure gold, for example, always has a density of 19.3 g/mL (grams per milliliter). Pure liquid water's density is 1.0 g/mL, and a norm by which to compare other substances.

When water freezes, the water molecules spread out to line up in a definite crystal-like structure. If you've ever noticed the bump on an ice cube or had a can of soda explode in the freezer you have observed this. While most other substances contract, water ***expands*** as it becomes a solid. Because water expands as it freezes, ice takes up more space (has a greater volume) than liquid water does. The amount of matter hasn't changed – but it is spread out over a larger space. This means that the density of ice (0.92 g/mL) is less than that of liquid water (1.0 g/mL). And because ice's density is lower than that of water, ice floats in water.

Seawater is slightly denser than fresh water because of the dissolved sediments and minerals. Its density is approximately 1.03 g/mL. That means that ice (like icebergs) also floats in seawater. In fact, fresh water from melting icebergs will form a layer on top of the denser seawater. Because the densities of ice and seawater are so close in value, the ice floats "low" in the water.

In the last 100 years the Earth's temperature has increased about half a degree Celsius. This higher temperature is causing some floating icebergs to melt. However, scientists do not think that it will make the oceans rise to a dangerous level. The rise will come from thermal expansion of the ocean and from melting glaciers and ice sheets. Twenty inches is no small amount -- it could have a big effect on coastal cities, especially during storms.

Student Sheet 3

PART I: OBSERVATION/COMPUTATION

	A	B	C	D	E	F	G	H
WEIGHT OF CONTAINER (g)								
AMT. of H_2O	25 ml	50 ml	75 ml	100 ml	125 ml	150ml	175ml	200ml
TOTAL (g)								
WEIGHT FROZEN (g)								
DIFFERENCE								

PART II: GRAPHING

Student Sheet 4

PART III: ICE CUBE/WATER DISPLACEMENT

	A	B	C	D	E	F	G	H
MASS (g)								
Water depth without ice cube								
Water depth with ice cube								
DIFFERENCE								
DENSITY (g/cm^3)								

NOTE: DENSITY= mass/volume (D=M/V)

PART IV: CALCULATING DENSITY OF ICEBERGS

ICEBERG	MASS (g)	VOLUME (cm^3)	DENSITY (g/cm^3)
A		25	
B		50	
C		75	
D		100	
E		125	
F		150	
G		175	
H		200	

Student Sheet 5

PART V: ANALYSIS

1. What type of water are icebergs made of?

2. What is the density of fresh water?

3. Compare Arctic and Antarctic icebergs.

4. Why did you have to weigh the 8 containers at the start of the activity?

5. Explain what density is. Use visuals if necessary.

6. Would the density of water be different on the moon? Why?

7. If an iceberg measured 50ft x 200ft x 1500ft, what would its volume be?

8. What part of the total volume of the iceberg in question 7 would be above water?

9. Does ice float? Explain why.

10. Does the amount of water when frozen weight the same as when liquid?

11. What do you think happens to the salt in seawater when it freezes?