Special Properties of Water
Lesson 3: Water has a High Heat Capacity

Heat Capacity is the amount of heat energy required to raise the temperature of a substance. Water is very good at soaking up heat; it has a high heat capacity. Water can absorb a lot of heat without raising its temperature.

Since water needs to absorb a lot of heat to raise its temperature... it can take a long time to lose this heat and lower the temperature of water.

It's difficult to change the temperature of water, this stabilizes the temperature in bodies of water which is less stressful on aquatic organisms.

With our bodies being 65% water we are able to expend less energy in order to maintain a constant body temperature of 37°C.

We experience this all around us.

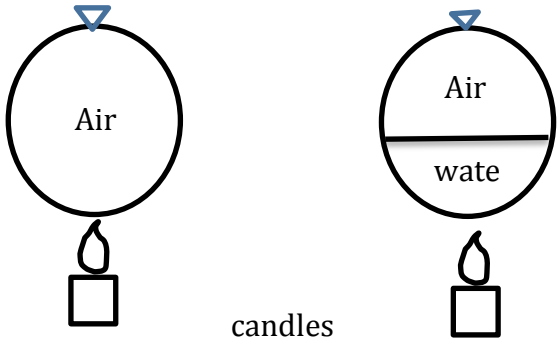
Water is great at cooling things down... water puts out fires, water cools automobile engines, and machinery... water cools us down. The ocean keeps the air near the coast cool during the summer. The world's oceans keep our planet Earth from overheating each day.

Once it's warm ...water stays warm. Air near the coast is warmer during the winter than it is further inland at the same latitude. The great ocean current known as the Gulf Stream absorbs its energy in the Gulf of Mexico and Tropic of Cancer then heads north along the Atlantic Coast and still has enough heat stored to warm up Iceland and the British Isles giving them milder winter climates, even though their latitudes are far to the north.

Heat Capacity of Water Demonstration: Balloon over a Flame

Hold two balloons over a candle… one balloon inflated with air and one filled partly with water.

Light the candles and describe what happens.



candles

The heat capacity of water is much better than that of air and absorbs the heat from the flame without becoming hot enough to melt the balloon preventing it from bursting.

Shoreline demo: Heat Capacity of Sand vs. Water

Perhaps you have experienced walking barefoot on hot sand at a beach on the way toward the water. Upon reaching the water it feels so much cooler on your feet. Why is the water so much cooler even though it received the same amount of energy from the Sun as the sand?

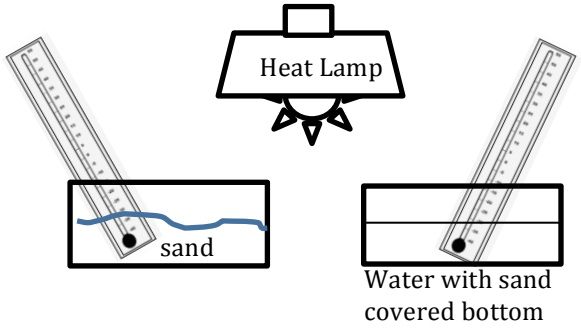
Materials : A heat lamp, two small metal or aluminum pans, two Celsius thermometers, sand and water at ambient temperature (enough to fill the metal pans).

Procedure:

1. Fill one pan halfway with sand. Cover the bottom of a second identical pan with a thin layer of sand and fill it halfway with water.

2. Record the starting temperature of the sand and water in the table below.

3. Place the containers of sand and water under a heat lamp for 2-3 minutes, then record the temperatures of the sand and water.



Starting Temperature	After Heating	After Cooling
Sand _____^{o}C	Sand _____^{o}C	Sand _____^{o}C
Water _____^{o}C	Water _____^{o}C	Water _____^{o}C

4. Next place the containers together in a cool location (like a refrigerator) for 5 minutes.

5. Record the temperature after the cooling period.

Follow up Discussion

• *In this set-up we attempt to have both sand and water receive the same amount of energy from the lamp.*

•*The material that experiences the greatest change in temperature when heated is sand.*

•*Water must be absorbing more energy from the lamp as its temperature doesn't change much.*

• *The sand doesn't have the same heat capacity as that of water. It can only absorb a small amount of the energy from the heat lamp and then the extra energy is given off and transferred to the air and to the thermometer.*

Application of Knowledge

Large bodies of water such as oceans keep the air near them from extreme temperature change.
The ocean can keep the air along the coast cooler in the summer as they absorb a lot of heat from the air.
The ocean can keep the air along the coast little warmer in the winter as from the heat stored over the summer.

With water's tremendous heat capacity, the relatively thin layer of water covering 70% of the Earth's surface, known as our ocean, helps to moderate the temperature of the whole planet.