Name: ______________________
Date: ______________________
Pd. _______

DRY T-SHIRT CONTEST!

Few things are as gross as a soaking wet t-shirt when you need to go out and actually get stuff done. It bunches up, makes you cold, and is just generally awful. However, we all know if you let it sit around long enough, it will dry. How does that work? Can your group speed up this process?

Procedures:

1. **Get a damp t-shirt from your teacher.**
2. **Together with your group members, decide what tactics you will use to dry this shirt as much as possible in the time allowed.**
3. **Develop a quantifiable (number driven) way to determine how dry your shirt is at the end of time.**

Discussion Questions: Part 1

1. How did your group decide to dry your t-shirt? Describe the reasoning behind your methods.

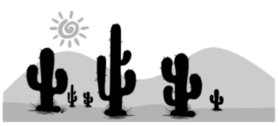
2. In science, QUANTIFIABLE data (data that can be expressed as a quantity—using numbers) is always preferred. How could we quantifiably determine the dryness of your t-shirt?

3. Provide the data of your shirt's dryness below:

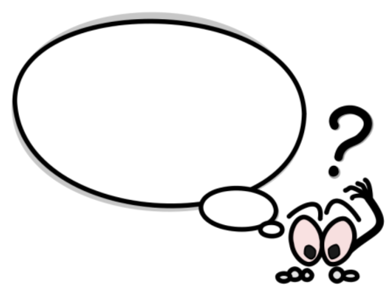
Name: ________________________
Date: ________________________
Pd. _______

DRY T-SHIRT CONTEST!

4. If I asked a student to provide evidence that they had the driest shirt, and their response was that their shirt "feels drier", would this data be considered a strong support for their hypothesis? Explain your answer.



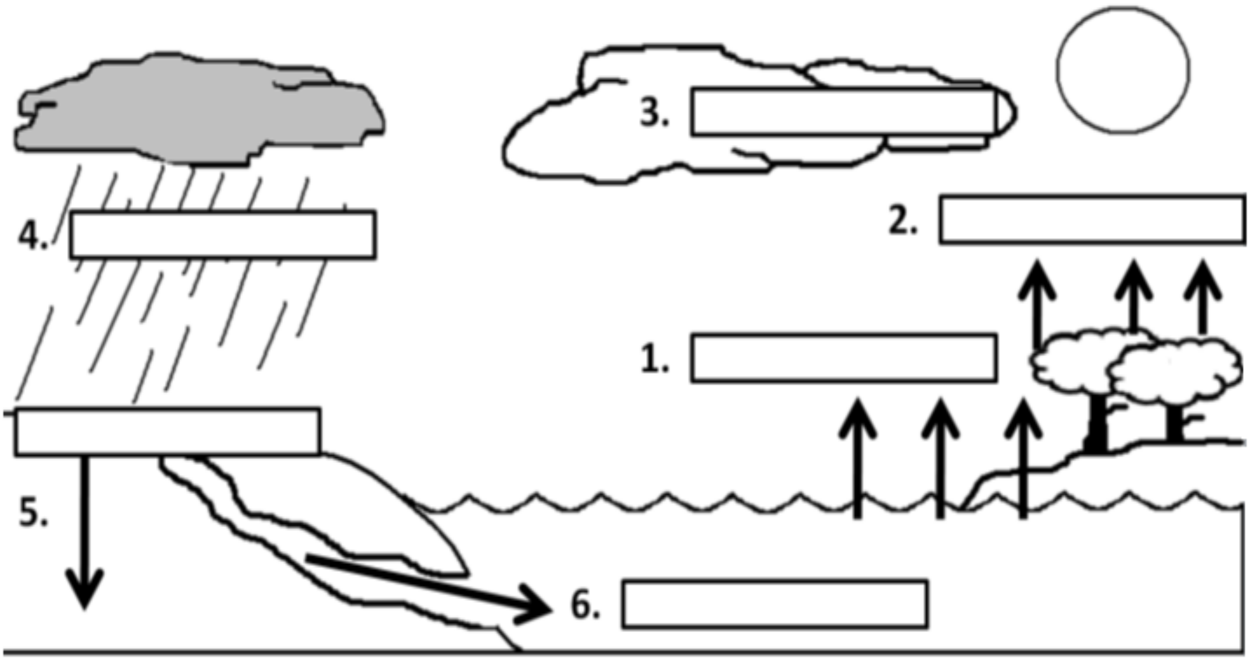
5. Where did the water from these wet shirts go? Has the water disappeared or is it possible to make it come back? Explain your answer.



Name: ______________________
Date: ______________________
Pd. _______

Water Cycle

Write the 6 water cycle terms ON the picture and IN the appropriate blanks below.



____________________ 1. When **liquid water** in oceans, lakes, puddles, etc**. changes into water vapo**r and goes into the air using heat from the sun.

____________________ 2. The process by which **water** from the leaves of plants, **changes into water vapor** and goes into the air.

____________________ 3. When **water vapor** in the air **changes into liquid water droplets** and produces dew, fog, or clouds.

_____________________4. Rain, snow, sleet, freezing rain, drizzle, and hail.

_____________________5. The process by which water soaks into the ground.

_____________________6. Water that travels over the surface of the Earth in rivers and streams.

Name: ______________________
Date: ______________________
Pd. _______

Water Cycle

Discussion Questions: Part 2

6. Which process above caused your shirt to become dry? Explain your choice.

7. You may have noticed if you grab a cold can of soda on a hot summer day, water droplets begin to form on the side of the can. What process above would explain this phenomena? Explain your choice.

8. If a small amount of salt water is allowed to evaporate from a cup, what will happen to the salt? How will the cup look after evaporation has taken place?

Name: ________________________
Date: ________________________
Pd. _______

Water You Worried About?

We all know you're supposed to drink lots of water. Your parents, your doctor, heck, even poet Samuel Taylor Coleridge, in his epic sailing poem "The Rime of the Ancient Mariner" said:

Water, water everywhere and all the boards did shrink.
Water, water everywhere, nor any drop to drink.

But WHY? What's so essential about this simple chemical?

Discussion Questions Part 3:

1. In Samuel Taylor Coleridge's poem, why does the narrator have no water to drink?

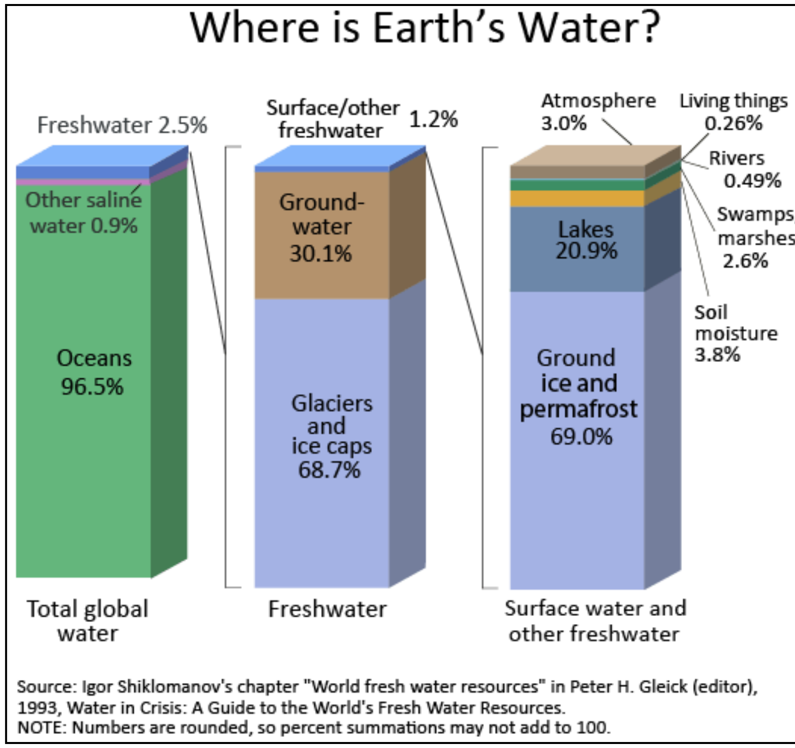
2. How could a sailor overcome the problem of having no water?

3. Why do we need water? What happens to our bodies without water?

Name: ________________________
Date: ________________________
Pd. _______

Water You Worried About?

Use the chart below to help you answer the following questions.



4. Look at the column of **'Total global water'**. What **percentage** of this water could humans use to drink? Why can't the rest of this water be used?

5. Look at the column of **'Freshwater'**. What **percentage** of this water could humans use to drink? Why can't the rest of this water be used?

6. Look at the column of **'Surface water and other freshwater'**. What **percentage** of this water could humans use to drink? Why can't the rest of this water be used?

7. Come up with at least **TWO** possible ways to access the majority of water that humans aren't able to drink from the table above. Be sure to fully explain your reasoning.

Name: ___________________________
Date: ___________________________
Pd. ________

Salty Language

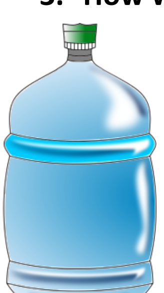
You smile as you glance down at your velvet vest and salt soaked shoes. Braced beneath the traditional sails of your ship, a sleek speed demon jutting through the waves, you truly embrace your character- You are a **pirate!** You grin as you look at your classmates, swaggering and strutting around the electrically lit deck with their eye patches and parrots. All your hard work at the science fair paid off- you won this spot on the pirate reenactment ship and are now off to explore the seven seas just like real pirates. Making your way starboard, the wind picks up, the sky turns ominous and threatening. In the blink of an eye, it is upon you: buffeting winds, loss of satellite signal, crashing waves. A huge tidal wave engulfs the deck of the ship , suddenly the ship is topsy –turvy and BOOM! You're shipwrecked on a desert island. The galley of the ship has washed ashore (kitchen for you landlubbers), cabinets still secured tightly. A quick search reveals the terrible truth – you have a kitchen, but you have no water. How can you get clean drinking water now?

List Possible Materials From the Kitchen and Island:

Identify our problem:

1. **How can I design ___________________ in order to ________________________________?**
2. **List the materials your group chose in the box below:**

3. **How will you know if your design was successful? What quantifiable data can you gather?**



Name: ________________________
Date: ________________________
Pd. _______

Salty Language

5. Why is it important that your design be as efficient and fast as possible? What would the real world consequences of an ineffective design be?

6. Where will the energy to do this process come from? How is this energy represented in this model?

Name: ___________________________
Date: ___________________________
Pd. ________

Possible Solutions and Ideas:

6. **In the box below, draw a proposed design of your device.** Be sure to label materials used in this design. You should also label how you expect the water to behave/travel/move through your design. In the space below your image, write out your rationale for your choices:

Rationale of this design:

SAFETY CHECK!!!

Read and initial the following boxes.

I will be heating liquid water into gaseous water (steam) in glass or metal containers. Boiling water is 100 °C (212 F) and can cause severe burns. Steam will be at temperature of 100 °C and above.

1. I need to where lab goggles at all times. ☐
2. I need to wear a lab apron at all times. ☐
3. I need to use caution when handling all materials. ☐
4. I should never touch glassware directly with my hands after heating– hot glass looks like cool glass. ☐

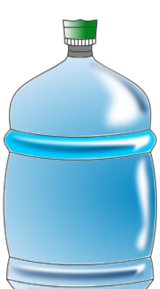
Name: ___________________________
Date: ___________________________
Pd. ________

Create one of your possible designs and test this prototype.

7. How successful was this design? Provide your data.

8. What elements of your design worked as you expected? Explain your results.

9. What elements will you change or improve in your final design? Explain your choices.



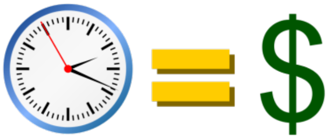
Name: ______________________
Date: ______________________
Pd. _______

Testing your refined idea:

10. **In the box below, draw the design of your final device**. Be sure to label materials used in this design. You should also label how you expect the water to behave/travel/move through your design. In the space below your image, write out your rationale for your choices:

Rationale of this design:

11. **How successful was this design? Provide your data.**



Time is money

Name: ___________________________

Date: ___________________________

Pd. _______

Let's consider how effective your design was. We want to figure out how much water your body requires, and the amount of time and energy it would take to purify that much salt water.

12. Metric Mass calculation. First, convert your mass from pounds (lb) into kilograms (kg).

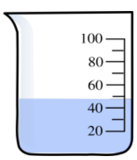
a. Your weight in pounds = __________ lbs

b. 1 lb = .45 kg. SO your weight * .45 kg/ 1 lb will equal your weight in kg.

c. Your weight ______lbs * .45 kg/1 lb = ___________kg

My mass is __________kg

13. How many liters (L) of water do you require a day?



a. The human body requires 32.6 milliliters (mL) of water per kg of body weight.

b. Multiply your mass in kg by 32.6 mL/kg to get the mL of water needed per day.

c. Your weight ___________kg *32.6 mL/kg = _________________mL of water per day.

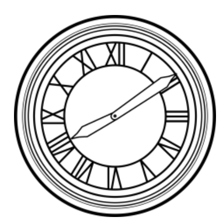
d. Convert mL to L . 1 L = 1000 mL.

e. ________ mL * 1 L/1000 mL = ________ L

I need _________ L of water per day

14. How long would it take you to collect that much water with your device?

a. I collected ______mL of water in ______ min



b. Convert mL to L: ______mL *1 L/ 1000 mL = _________L

c. That means I make fresh water at a rate of ______ L/min.

d. Multiply this number by 1440 to get _________ L/day.

I made water at a rate of _____L/day

15. Compare your answers to 13 and 14.

Can you make enough water to survive? If so, do you have enough time to still sleep, eat, and forage for food and fuel?

Name: ______________________
Date: ______________________
Pd. ______

Energy is money

We've explored the practicality of this method of desalination from the time perspective. Now let's look at it in terms of resources. How much energy is needed to heat up all that water???

16. Energy needed to boil 1 L of water.

a. It takes 2264.2 kJ to evaporate 1 L of water. (that's 5400 food calories of energy – or 12 King size Snickers candy bars!!!! If you charge your iPhone every day for a whole year it will only use 7200kJ **PER YEAR. Water is an energy hog**).

b. I need ________L of water/day

c. Multiply _______L H2O/day * 2264.2 kJ/1 L H2O = __________ kJ Energy/day

17. You are on a desert island! Where can you get that kind of Energy?

a. Burning wood produces 21,000 kJ/ kg of wood. Great –right? 1 kg = 2.2 lbs.

b. Nope. If the wood is wet or cut from living trees that water must be boiled off before the fire can really burn well. This reduces energy potential by 35%.

c. 21,000 kJ/kg *.65 = ___________kJ/kg of wet wood

d. AND you have an open fire! Another **70%** of the energy is **lost** to the air!

e. __________kJ/kg of wet wood * .30 = ________ kJ/kg wet wood in an open fire.

I can get ________kJ/kg wet wood in open fire

18. How much wood do you need to gather each day?

a. ________ kJ Energy/day * 1 kg/ _______kJ wet wood in an open fire = _______ kg

b. Multiply by 2.2 to get back to pounds. ___kg * 2.2 = ____ lbs of wood to gather/day

But that's only if your device can harness that energy in the 1 hour before that wood has completely burned away!

19. What about in a more efficient energy setting? Let's explore using coal to generate electricity. (think of an electric tea kettle for example). To generate the same 2264.2 kJ of energy would require burning .31096 kg coal/L of water.

a. The average American uses 303-379 liters (80-100 gallons) of clean H2O each DAY

b. I use 303 L H2O * .31096 kg coal/L of H2O = ___________ kg coal/ day

c. That means 314 million people in US * ______kg coal/day = __________kg coal /day to generate clean drinking /household water from salt water.

d. In pounds, _________kg coal/day * 2.2 lbs/ 1 kg = __________________lbs coal/day

Name: ___________________________
Date: ___________________________
Pd. ________

DRY T-SHIRT CONTEST!

Few things are as gross as a soaking wet t-shirt when you need to go out and actually get stuff done. It bunches up, makes you cold, and is just generally awful. However, we all know if you let it sit around long enough, it will dry. How does that work? Can your group speed up this process?

Procedures:
1.Get a damp t-shirt from your teacher.
2.Together with your group members, decide what tactics you will use to dry this shirt as much as possible in the time allowed.
3.Develop a quantifiable (number driven) way to determine how dry your shirt is at the end of time.

Discussion Questions: Part 1

1.How did your group decide to dry your t-shirt? Describe the reasoning behind your methods.

Prompt students with reminders of how they dry off after swimming, being at the beach, drying dishes etc.

1.In science, QUANTIFIABLE data (data that can be expressed as a quantity—using numbers) is always preferred. How could we quantifiably determine the dryness of your t-shirt?

If stumped, prompt students with examples: Does your doctor write in your medical file- Johnny grew a lot this year? Jackie increased her height?

1.Provide the data of your shirt's dryness below:

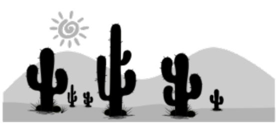
Students may organize their data many ways- that is okay.
Some may try to wring water out of the shirt and mass that. Others may want to mass their whole shirt. Others may compare mass of their shirt to others. Don't reveal initial masses yet.

Name: ________________________
Date: ________________________
Pd. _______

DRY T-SHIRT CONTEST!

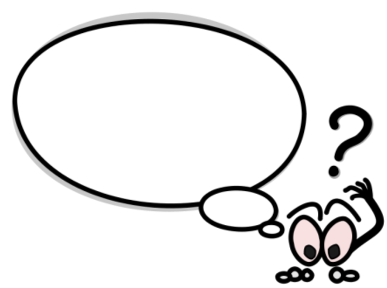
4. If I asked a student to provide evidence that they had the driest shirt, and their response was that their shirt "feels drier", would this data be considered a strong support for their hypothesis? Explain your answer.

No. Saying a shirt feels drier is a subjective qualitative response. In their words – this is a personal description that is relative for each person. It has no standard that applies to the whole class, and no numbers to conduct scientific analysis.



4. Where did the water from these wet shirts go? Has the water disappeared or is it possible to make it come back? Explain your answer.

The water from the shirt has evaporated (accept vaporized/boiled) off the shirt into the air. The water is no longer in the shirt, but it still exists In the environment as vapor in the air. Matter can neither be created nor destroyed.



The water can come back on the shirt through condensation (cooling the water vapor in the room until it condenses on the shirt, by either lowering the temperature of the room or just the shirt). Since the room is an open system- the odds are almost impossibly low that it will be the EXACT same water molecules in the shirt. (Yes, someone will ask this).

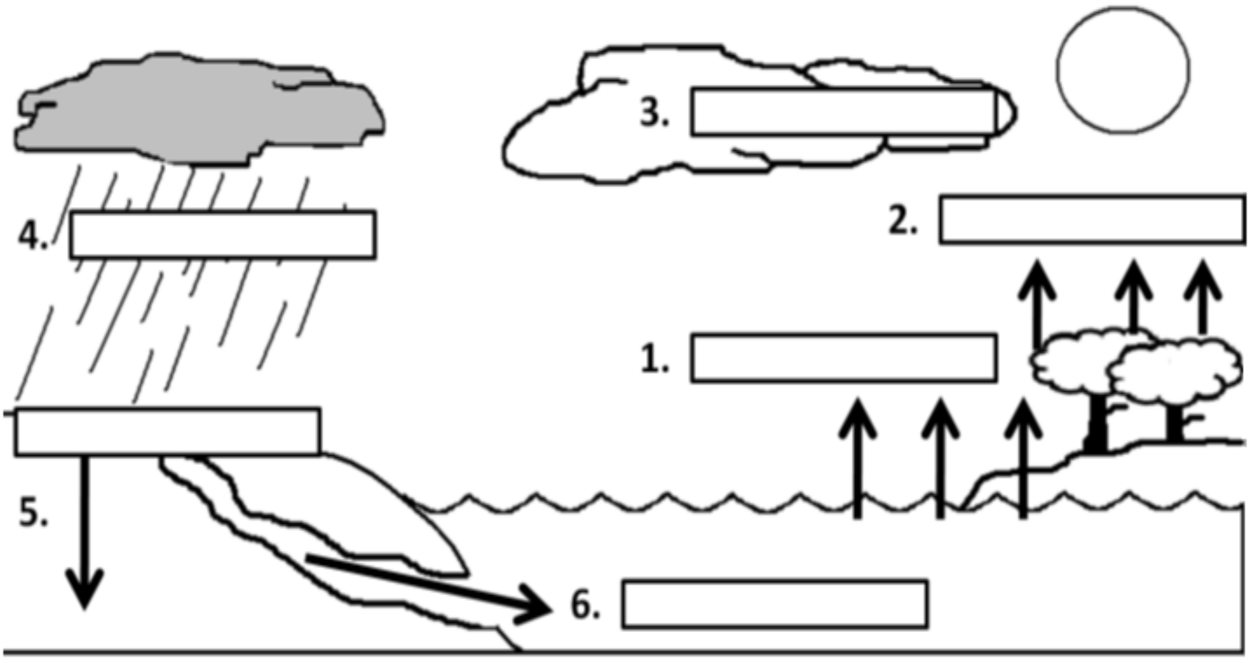
The water cycle is a cycle of water as it goes through solid, liquid, and gaseous phases, but the water molecules do not always end up in the same place they started in.

On the cool side – it is possible that the water molecule you drink today – has been inside a dinosaur at one point or another but not as an H2O, but the H or the O.

Name: ________________________
Date: ________________________
Pd. _______

Water Cycle

Write the 6 water cycle terms ON the picture and IN the appropriate blanks below.



___Evaporation______ 1. When **liquid water** in oceans, lakes, puddles, etc**. changes into water vapo**r and goes into the air using heat from the sun.

__Transpiration_____ 2. The process by which **water** from the leaves of plants, **changes into water vapor** and goes into the air.

___Condensation_____ 3. When **water vapor** in the air **changes into liquid water droplets** and produces dew, fog, or clouds.

___Precipitation_____4. Rain, snow, sleet, freezing rain, drizzle, and hail.

_____Infiltration_____5. The process by which water soaks into the ground.

_____Surface flow/ Runoff 6. Water that travels over the surface of the Earth in rivers and streams.

Name: ______________________

Date: ______________________

Pd. _______

Water Cycle

Discussion Questions: Part 2

6.Which process above caused your shirt to become dry? Explain your choice.

Evaporation dried the shirt because the liquid water molecules were converted into gaseous water vapor molecules by applying energy to the system. In the water cycle it is heat from the sun. In the classroom it was heat from the room, heat from body temperature, and movement of air through the shirt.

7. You may have noticed if you grab a cold can of soda on a hot summer day, water droplets begin to form on the side of the can. What process above would explain this phenomena? Explain your choice.

Condensation, because this is the reverse of evaporation. The gaseous water vapor molecules are converted into liquid water molecules. This happens when the gas molecules are cooled and lose energy to become a liquid. The cold pop can cools the water vapor in the air in the room. These water droplets condense on the side of the can as water droplets.

Explain that although the pop can or drinking glass appears to "sweat" – the water is NOT coming from inside the can or drinking glass! The water is coming from the air!

7. If a small amount of salt water is allowed to evaporate from a cup, what will happen to the salt? How will the cup look after evaporation has taken place?

The salt will remain in the cup as a solid when the water evaporates off. There will be no water in the cup, and crystals of solid white salt will remain.

Although the salt easily dissolves in the water, it is normally a solid at room temperature. When the water evaporates, it does not have enough energy to become a gas like the water – so it goes back into its crystalline state as a solid when the water evaporates.

Name: ________________________
Date: ________________________
Pd. _______

Water You Worried About?

We all know you're supposed to drink lots of water. Your parents, your doctor, heck, even poet Samuel Taylor Coleridge, in his epic sailing poem "The Rime of the Ancient Mariner" said:

Water, water everywhere and all the boards did shrink.
Water, water everywhere, nor any drop to drink.

But WHY? What's so essential about this simple chemical? *We depend upon water for survival*

Discussion Questions Part 3:

1.In Samuel Taylor Coleridge's poem, why does the narrator have no water to drink?
The narrator is on a ship at sea, surrounded by ocean water. Ocean water is full of salt, and the energy that the body needs to get rid of the excess salt from the body makes drinking salt water lethal to humans.
Salt water can make wooden boards shrink into different shapes after the water evaporates and leaves the salt behind.

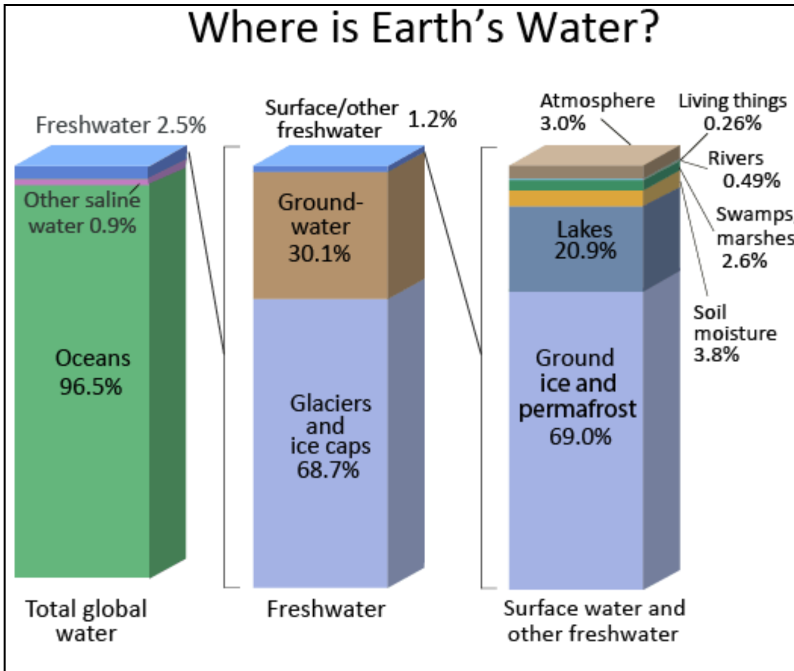
2.How could a sailor overcome the problem of having no water?
The sailors would need to bring drinking water with them and have ways of collecting rain water.

3.Why do we need water? What happens to our bodies without water?
Our bodies need water to carry out all the processes necessary for life-eating, breathing, circulation of blood, excretion of waste, thinking, moving. We are almost 70% water. All these systems shut down without water. Humans can only go 3-4 days without water before they will die.

Name: ______________________
Date: ______________________
Pd. _______

Water You Worried About?

Use the chart below to help you answer the following questions.



Source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, Water in Crisis: A Guide to the World's Fresh Water Resources.
NOTE: Numbers are rounded, so percent summations may not add to 100.

4. Look at the column of **'Total global water'**. What **percentage** of this water could humans use to drink? Why can't the rest of this water be used?

   2.5% is drinkable
   The rest is salty!

5. Look at the column of **'Freshwater'**. What **percentage** of this water could humans use to drink? Why can't the rest of this water be used?

   1.2% is readily available
   If you tap into groundwater with wells, then it will be 31.3% total- but this is not easily done in some place – it is too far underground under really hard rocks.
   The rest is frozen and inaccessible.

6. Look at the column of **'Surface water and other freshwater'**. What **percentage** of this water could humans use to drink? Why can't the rest of this water be used?

   The Rivers, swamps and marshes, and lakes will be the best sources = 23.99%
   The water vapor, soil moisture, and ground ice will be too hard to capture for use.

7. Come up with at least **TWO** possible ways to access the majority of water that humans aren't able to drink from the table above. Be sure to fully explain your reasoning.

   1. *Desalinating the ocean water is the most easily accessible water to humans and the most water available on the planet.*
   2. *Drilling to access deeper ground water reservoirs is another good option because of the amount of water there.*
   3. *Other answers accepted with good reasoning.*

Name: ___________________________
Date: ___________________________
Pd. ________

Salty Language

You smile as you glance down at your velvet vest and salt soaked shoes. Braced beneath the traditional sails of your ship, a sleek speed demon jutting through the waves, you truly embrace your character- You are a **pirate!** You grin as you look at your classmates, swaggering and strutting around the electrically lit deck with their eye patches and parrots. All your hard work at the science fair paid off- you won this spot on the pirate reenactment ship and are now off to explore the seven seas just like real pirates. Making your way starboard, the wind picks up, the sky turns ominous and threatening. In the blink of an eye, it is upon you: buffeting winds, loss of satellite signal, crashing waves. A huge tidal wave engulfs the deck of the ship , suddenly the ship is topsy –turvy and BOOM! You're shipwrecked on a desert island. The galley of the ship has washed ashore (kitchen for you landlubbers), cabinets still secured tightly. A quick search reveals the terrible truth – you have a kitchen, but you have no water. How can you get clean drinking water now?

List Possible Materials From the Kitchen and Island:

- Pots *aka Larger beakers*
- Cups *aka Small beakers*
- Tin foil
- Saran wrap
- Rubber tubing
- Wash clothes
- Fire (*aka Hot plate)*
- Sun (aka heat lamp)
- Funnel
- Plastic bottles
- Soda cans
- Heat resistant gloves
- Scissors
- Rope
- Rubber bands
- Clothes pins
- Masking tape

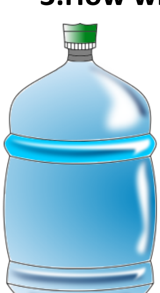
Identify our problem:

1.How can I design ***______a device_______*** **in order to** ***___remove salt from ocean water__?***

2.List the materials your group chose in the box below:

Will vary by group.

3.How will you know if your design was successful? What quantifiable data can you gather?



Students should be able to explain that they will be able to see and collect fresh water which can then mass to have quantifiable data. Also time is a quantifiable variable (most wont' list that here).

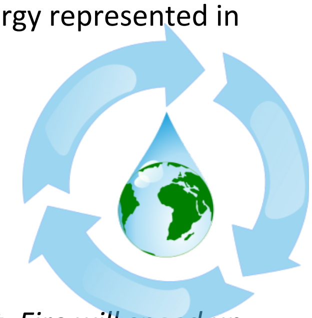
Name: ________________________
Date: ________________________
Pd. _______

Salty Language

5. Why is it important that your design be as efficient and fast as possible? What would the real world consequences of an ineffective design be?

It won't be used if it is not fast and efficient because time is money. Also- in the case of human survival beyond economics, the humans would die.

6. Where will the energy to do this process come from? How is this energy represented in this model?



Energy will come from an external source – the sun or fire on the Island. In the classroom, the sun will be a heat lamp, the fire will be a hot plate or bunsen burner.

In the model water cycle- we see the sun, a natural part of the environment. Fire will speed up the process, adding more energy to the process.

Name: ___________________________

Date: ___________________________

Pd. ________

Possible Solutions and Ideas:

6.In the box below, draw a proposed design of your device. Be sure to label materials used in this design. You should also label how you expect the water to behave/travel/move through your design. In the space below your image, write out your rationale for your choices:

Rationale of this design:

•*Students should explain the function of each piece of material used.*

SAFETY CHECK!!!

Read and initial the following boxes.

I will be heating liquid water into gaseous water (steam) in glass or metal containers. Boiling water is 100 °C (212 F) and can cause severe burns. Steam will be at temperature of 100 °C and above.

1. I need to where lab goggles at all times. ☐
2. I need to wear a lab apron at all times. ☐
3. I need to use caution when handling all materials. ☐
4. I should never touch glassware directly with my hands after heating– hot glass looks like cool glass. ☐

Name: ______________________
Date: ______________________
Pd. _______

Create one of your possible designs and test this prototype.

7.How successful was this design? Provide your data.

Students should say whether they collected any water. If so, it should be A quantifiable number in mass or volume. Brief commentary on what worked And did not.

8.What elements of your design worked as you expected? Explain your results.

Students should go over what parts of their device and what processes worked and why.

9.What elements will you change or improve in your final design? Explain your choices.

Students should discuss what did not work well and how they would fix it.

Name: ________________________
Date: ________________________
Pd. _______

Testing your refined idea:

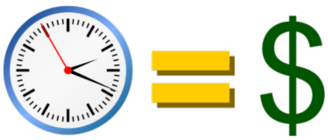
10.In the box below, draw the design of your final device. Be sure to label materials used in this design. You should also label how you expect the water to behave/travel/move through your design. In the space below your image, write out your rationale for your choices:

Rationale of this design:
Students should explain the function of each part of the device, and the scientific properties involved (heating water to allow evaporation, then cooling it to cause condensation of the clean drinking water).

11.How successful was this design? Provide your data.

Again, data in mL or g if they collected water, along with explanation of how the evaporation and condensation worked in this design.

Name: ____________________
Date: ____________________
Pd. ________



Time is money

Let's consider how effective your design was. We want to figure out how much water your body requires, and the amount of time and energy it would take to purify that much salt water.

For ease of calculations, use 100 lbs as example

12. Metric Mass calculation. First, convert your mass from pounds (lb) into kilograms (kg).

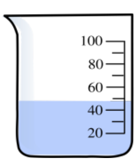
a. Your weight in pounds = *100* lbs

b. 1 lb = .45 kg. SO your weight * .45 kg/ 1 lb will equal your weight in kg.

c. Your weight *100* lbs * .45 kg/1 lb = *45* kg

My mass is *45* kg

13. How many liters (L) of water do you require a day?



a. The human body requires 32.6 milliliters (mL) of water per kg of body weight.

b. Multiply your mass in kg by 32.6 mL/kg to get the mL of water needed per day.

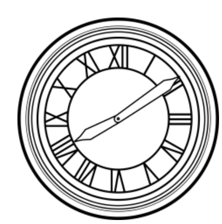
c. Your weight *45* kg *32.6 mL/kg = *1467* mL of water per day.

d. Convert mL to L . 1 L = 1000 mL.

e. *1467* mL * 1 L/1000 mL = *1.467* L

I need *1.467* L of water per day

14. How long would it take you to collect that much water with your device?



a. I collected *15* mL of water in *45* min

b. Convert mL to L: *15* mL *1 L/ 1000 mL = *0.015* L

c. That means I make fresh water at a rate of ***0.00033*** L/min.

d. Multiply this number by 1440 to get *0.48* L/day.

I made water at a rate of *0.48* L/ day

15. Compare your answers to 13 and 14.

Can you make enough water to survive? If so, do you have enough time to still sleep, eat, and forage for food and fuel?

No! I could only make 0.48 L/day. That's only a third of what I need to survive! And that would be doing this around the clock.

Name: ______________________
Date: ______________________
Pd. _______

Energy is money

We've explored the practicality of this method of desalination from the time perspective. Now let's look at it in terms of resources. How much energy is needed to heat up all that water???

16. Energy needed to boil 1 L of water.

a. It takes 2264.2 kJ to evaporate 1 L of water. (that's 5400 food calories of energy – or 12 King size Snickers candy bars!!!! If you charge your iPhone every day for a whole year it will only use 7200kJ **PER YEAR. Water is an energy hog**).

b. I need 1.467 L of water/day

c. Multiply 1.467 L H_2O/day * 2264.2 kJ/1 L H_2O = 3321.58 kJ Energy/day

17. You are on a desert island! Where can you get that kind of Energy?

a. Burning wood produces 21,000 kJ/ kg of wood. Great –right? 1 kg = 2.2 lbs.

b. Nope. If the wood is wet or cut from living trees that water must be boiled off before the fire can really burn well. This reduces energy potential by 35%.

c. 21,000 kJ/kg *.65 = 13650 kJ/kg of wet wood

d. AND you have an open fire! Another **70%** of the energy is **lost t**o the air!

e. 13650 kJ/kg of wet wood * .30 = 9555 kJ/kg wet wood in an open fire.

I can get 9555 kJ/kg wet wood in open fire

18. How much wood do you need to gather each day?

a. 3321.58 kJ Energy/day * 1 kg/ 9555 kJ wet wood in an open fire = 0.35 kg

b. Multiply by 2.2 to get back to pounds. 0.35 kg * 2.2 = 0.77 lbs of wood to gather/day

But that's only if your device can harness that energy in the 1 hour before that wood has completely burned away!

19. What about in a more efficient energy setting? Let's explore using coal to generate electricity. (think of an electric tea kettle for example). To generate the same 2264.2 kJ of energy would require burning .31096 kg coal/L of water.

a. The average American uses 303-379 liters (80-100 gallons) of clean H_2O each DAY

b. I use 303 L H_2O * .31096 kg coal/L of H_2O = 94.22 kg coal/ day

c. That means 314 million people in US * 94.22 kg coal/day = 29585356320 kg coal /day to generate clean drinking /household water from salt water.

d. In pounds, 29585356320 kg coal/day * 2.2 lbs/ 1 kg = 65087783904 lbs coal/day