Name_____ **Date**_____

Sugar and Salt Solutions PhET – Introduction to Solutions

Goal: you will be able to

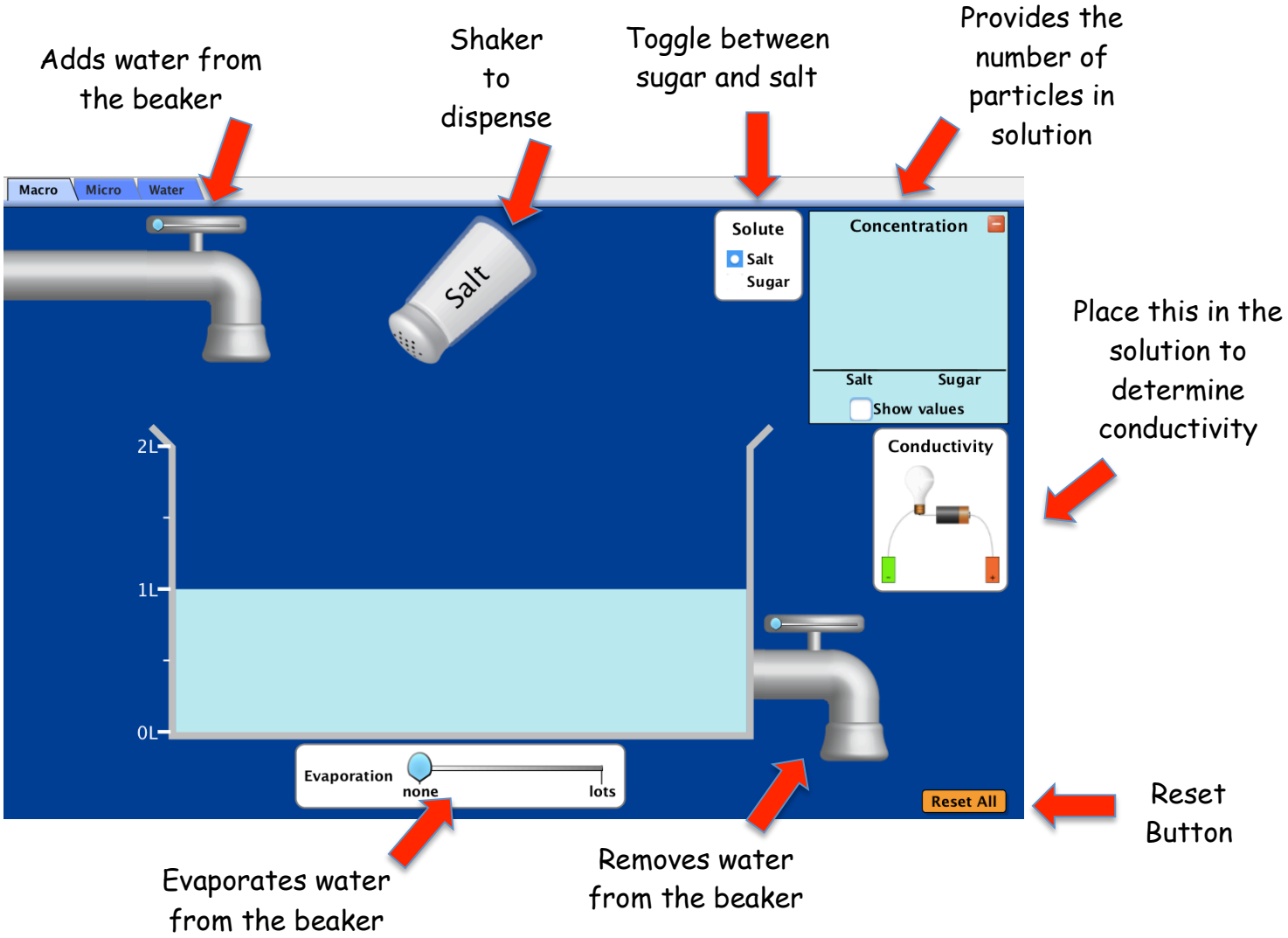
1). Compare the behavior of sugar and salt in water

2). Identify sugar and salt as either an electrolyte or non electrolyte

3). Draw particle diagrams representing aqueous solutions of salt in water and sugar in water

4). Propose an explanation of the behavior of the conductivity tester in the salt and sugar solutions.

Getting Familiar with the Program – Macro Screen



- Take a moment to play with the controls before moving on to the procedure!
- Select the **Reset All** button before proceeding

Procedure

- Make sure the solute is selected to **salt**

1). Pick up the conductivity tester and place it in the water in the beaker. Record your initial observations of the behavior of the light bulb in the water.

_____

2). Do **1 shake of salt** into the water. What do you observe about the light bulb?

_____

_____

3). **Add another shake** into the water. Record your observations.

_____

_____

4). **Add additional shakes** of salt into water. Continue to record your observations.

_____

_____

There are **three variables** for you to consider.

- Adding water
- Removing water
- Evaporating water

Select one variable and record it in the space provided

Variable: _____

Proceed with **adjusting this variable** and record the observation of the light bulb.

_____

_____

Select a different variable and record it in the space provided. Add more salt to the water if necessary.

Variable: _____

Proceed with **adjusting this variable** and record the observation of the light bulb.

_____

_____

_____

Select the last variable and record it in the space provided. Add more salt to the water if necessary.

Variable: _____

Proceed with ad**justing this variable** and record the observation of the light bulb.

_____

_____

_____

Select the **Reset All** Tab

- Change the solute from **salt** to **sugar**

1). Pick up the conductivity tester and place it in the water in the beaker. Record your initial observations.

_____

2). Do **1 shake of sugar** into the water. What do you observe about the light bulb?

_____

3). Add **another shake** into the water. Record your observations.

_____

4). Add **additional shakes of sugar** into water. Continue to record your observations.

_____

Consider the three variables previously listed.

- Adding water
- Removing water
- Evaporating water

Modify each variable with the sugar water mixture. **Record the observations** of the light bulb.

_____

_____

_____

Define the following terms:

Solute:

_____

_____

Solvent:

_____

_____

Solution:

_____

_____

Electrolyte (look up the definition in the class set of review books)

_____

_____

Non-Electrolyte (look up the definition in the class set of review books)

_____

_____

Based on the above definitions, consider **water**, **salt** and **sugar**

- Make a claim identifying the **solute(s)** in this simulation

_____

Provide evidence to support your claim:

_____

_____

- Make a claim identifying the **solvent(s)** in this simulation

_____

Provide evidence to support your claim:

_____

_____

Switch the top tab to **Micro**

- In the solute box, make sure that the selected solute is **sodium chloride**

1). Add **1 shake** of **sodium chloride** into the water.

How does the sodium chloride appear **prior** to entering the water?

_____

_____

_____

Draw a particle diagram of your observations in the space below. If necessary, reset this simulation to see the sodium chloride again.

How does the sodium chloride appear **once it has entered** the water?

_____

_____

_____

Draw a particle diagram of your observations in the space below.

Describe the **ratio** of sodium ions to chloride ions that appears in the concentration box

_____

Understanding the Dissolution of NaCl

What type of intramolecular force (chemical bonding) occurs within NaCl(s)?

_____

Do any intermolecular forces occur in NaCl(s)?

_____

Write the **dissolution equation** for sodium chloride dissolving in water. Make sure to use the labels (s) for solid and (aq) for particles in the aqueous solution

_____

Are the particles in the water atoms or ions? How can you tell?

_____

_____

When the solid is added to the water, individual sodium and chloride ions are formed. Is this a physical or chemical change?

_____

Evaporate all the water from the beaker. What happens to the particles in the water? Is this a physical or chemical change? Justify your answer by providing evidence from your observations.

_____

_____

_____

Refer back to your answers from the previous Macro Tab

Review your answers from the activity with the conductivity tester and the NaCl(aq). Provide a reason using evidence that you have gathered to explain why the light bulb lit up in the NaCl(aq) solution.

_____

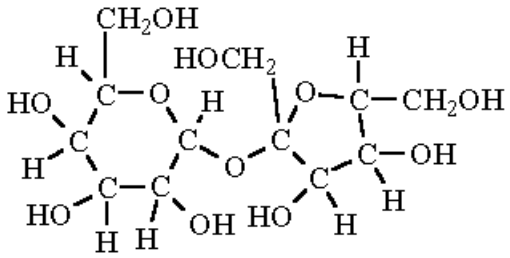
_____

_____

_____

Return back to the **Micro Tab** and Select **Reset All**

- In the solute box, make sure that the selected solute is **sucrose ($C_{12}H_{22}O_{11}$)**



Structural Formula of Sucrose

1). Add **1 shake** of **sucrose** into the water.

How does the **sucrose** appear **prior to entering the water?** (A general description is acceptable)

_____

_____

Draw a (general) particle diagram of your observations in the space below. If necessary, reset this simulation to see the sucrose molecule again. It does **NOT** need to have a correct molecular structure.

How does the sucrose appear **once it has entered** the water?

_____

_____

Draw a particle diagram of your observations in the space below. Again, it does **NOT** need to have a correct molecular structure.

Understanding the Dissolution of Sucrose ($C_{12}H_{22}O_{11}$)

What type of intramolecular forces (chemical bonding) occurs **within** the sucrose molecule?

_____

Write the **dissolution equation** for sucrose ($C_{12}H_{22}O_{11}$) dissolving in water. Make sure to use the labels (s) for solid and (aq) for particles in the aqueous solution

_____

Are the particles in the water atoms or ions or molecules? How can you tell?

_____

_____

When the solid is added to the water, individual molecules of sucrose are formed. Is this a physical or chemical change?

_____

Evaporate all the water from the beaker. What happens to the particles of sucrose? Is this a physical or chemical change? Justify your answer by providing evidence from your observations.

_____

_____

As the sucrose is added to the beaker, the substance changes from larger substances to smaller substances. In general, what is breaking when this process occurs?

_____

_____

Refer back to your answers from the previous Macro Tab

Review your answers from the activity with the conductivity tester and the aqueous sucrose solution. Provide a reason using evidence that you have gathered to explain why the light bulb did not light up in the $C_{12}H_{22}O_{11}(aq)$ solution.

_____

_____

_____

Return to the simulation. Select the Micro tab. In the solute box, select the yellow circle with the black arrow to advance to the next set of solutes. Select **calcium chloride** ($CaCl_2$).

- Shake the calcium chloride into the water

Describe the ratio of calcium ions to chloride ions

_____

If the conductivity tester was placed in this solution, do you think the light bulb would light up? Make a connection to the previous NaCl(aq) solution and the sucrose solution situations.

_____

_____

_____

In the solute box, select the yellow circle with the black arrow and advance to the next set of solutes. Select **sodium nitrate** ($NaNO_3$).

- Shake the sodium nitrate into the water

Describe the ratio of sodium ions to nitrate ions in solution

_____

What makes this solution different from the previous solutions in terms of ions present?

_____

Switch the top tab to **Water**

In the **Show box** in the bottom right hand corner, make sure both the **water partial charges** and the **sugar highlight** boxes are checked.

- Pick up the **salt crystal** and drop it in the middle of the screen.

Describe what occurs. If the ions immediately move off the screen, select the reset all button and add the sodium chloride again.

_____

_____

_____

Pause the simulation and observe the orientation of the water molecules around the sodium ion and the chloride ion.

- Using structural models of water, draw what you observe using **one sodium ion** and **one chloride ion**. This type of interaction is call **ion-molecule forces of attraction**.

Select **Reset All** on this screen

In the **Show box** in the bottom right hand corner, make sure both the **water partial charges** and the **sugar highlight** boxes are checked.

- Pick up the **sugar crystal** and drop it in the middle of the screen.

Describe what occurs. If the molecules immediately move off the screen, select the reset all button and add the sugar again.

_____

_____

_____