Heading

Title

**Introduction**

**Purpose** To learn about various aspect of the Chemistry of Life.

**Discussion**

ATOMS are the simplest particle of an element that retains all the properties of that element, representing the smallest building blocks of Matter. Properties of atoms determine the structure and properties of the matter they compose. MOLECULES are groups of atoms connected together. Atoms of each element are composed of even smaller parts called Subatomic Particles: Neutrons, which have no electrical charge (in nucleus); Protons, which are positively charged (in nucleus); Electrons, which are negatively charged (around the nucleus in a “cloud”).

The number of protons of an atom of a particular element is called the Atomic Number. The number of protons + neutrons = Atomic Mass. Number of protons is normally balanced by an equal number of negatively charged electrons. Isotopes Have the same number of protons, but different number of neutrons.

Covalent bonds are Formed when two atoms **share** one or more pairs of electrons. **Ion:** Atom that has a negative or positive charge. Some atoms become stable by losing or gaining electrons. Atoms that lose electrons are called positive ions. Atoms that gain electrons are called negative ions. Because positive and negative electrical charges attract each other, **ionic bonds** form

Water (H2O) is a POLAR molecule. Polar Covalent Bonds WITHIN each molecule. Shared Electrons spend more time with Oxygen than with Hydrogens. Hydrogens become slightly positive; Oxygen slightly negative. This gives water special properties. Cohesion is the attraction between water molecules for each other. Adhesion is the attraction of water to other substances.

Heat is a form of energy in which there is a transfer from a warmer to a cooler substance. Specific heat is the ability of a substance to hold heat. Water has a high specific heat and therefore, takes a long time to heat up or cool down compared to metals.

A SOLUTION is a liquid consisting of a uniform mixture of two or more substances. Solute is the substance that is dissolved (lower quantity). Solvent is the dissolving agent (higher quantity). Acids and bases are solutions. Acids have high concentration of H+ ions with pH below 7, and bases have high concentration of OH- ions with pH above 7.

**Materials** Worksheet Computer, Windows, Microsoft Internet Explorer

**Procedures**

Follow the Directions for each section**.**

Isotopes and Atomic Mass

*Use the URL link provided to complete this section.*

<https://phet.colorado.edu/en/simulations/isotopes-and-atomic-mass>

1. Click on “Isotopes” and then, “Mass Number” on the scale.

2. Write the chemical equation for water (as shown): 2H2O 🡪 H3O+ + OH-

3. Complete the chart below.

a. Click on each element.

b. Look in the upper left for subatomic particles.

c. Click on the “Symbol” button. Replace the numbers in the “Symbol” row to match the correct nuclear symbol.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | H | He | Li | Be | B | C | N | O | F | Ne |
| Protons |  |  |  |  |  |  |  |  |  |  |
| Electrons |  |  |  |  |  |  |  |  |  |  |
| Neutrons |  |  |  |  |  |  |  |  |  |  |
| Mass |  |  |  |  |  |  |  |  |  |  |
| Symbol | ?X? | ?X? | ?X? | ?X? | ?X? | ?X? | ?X? | ?X? | ?X? | ?X? |

4. What do you notice about the number of protons and electrons for each element?

5. What determines the atomic mass for each element?

Bonding & Solutions

1. Watch the videos:

<http://somup.com/cF6eq5nVpn> Electrical Conductivity (Properties) ctr (1:13) ... solids & water

<http://somup.com/cF6eq8nVpq> Electrical Conductivity (Properties) ctr (1:31) ... solutions

 a. Identify the type of bonding (ionic or covalent) in salt, sugar, and hydrochloric.

b. Give evidence to prove your answer?

2. Watch the video: <https://screencast-o-matic.com/watch/cFXiD9YP5e> Dancing Water (1:09)

 a. Why did the water bend towards the charged straw?

b. What are some major properties of water based on using a straw to drink?

3. Watch the video: <http://somup.com/cFXTY7nQr4> (0:24) Salt Dissolves in Water

a. What are the components of a solution?

b. What substances in the video represent the components of the solution?

Specific Heat

*Use the video link provided to complete this section.*

**Video Demonstration:** [**https://screencast-o-matic.com/watch/cFX609YWH6**](https://screencast-o-matic.com/watch/cFX609YWH6)

**CALORIMETRY TABLE for Cadmium**

|  |  |
| --- | --- |
| **MASS DATA** | **TEMPERATURE DATA** |
| **Material** | **Mass** | **Material** | **Temperature** |
| Metal cylinder | **g** | Boiling water | **º C** |
| Water in Calorimeter | **º C** |
| Name of Metal 🡺  | Water in cup after metal was added | **º C** |
| Calorimeter Styrofoam |  |
| Cup + water |  |  |  |
| Water alone | **g** | ∆T of water | **º C** |
|  |  | Heat gained by water | **1254 j** |
|  |  | ∆T of Cadmium | **º C** |

1. Which substance experienced the greatest change in temperature: the cadmium cylinder or the water? Give evidence.

2. Based on this activity, which substance, cadmium or water, has the highest specific heat?

3. Give two examples from daily life where specific heat is a major factor.

4. Which way does heat flow in terms of warm and cold objects?

Acid-Base Chemistry

*Use the URL link provided to complete this section.*

<https://phet.colorado.edu/en/simulations/acid-base-solutions>

1. Click on “Introduction”. Use the pH tool and pull it down into the solution (beaker).

2. Write the chemical equation for water (as shown):

3. Complete the chart below. Click between the “Molecules” and “Graph” button for information.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Substance | Strong Acid | Weak Acid | Strong Base | Weak Base |
|  |  |  |  |  |
| pH |  |  |  |  |
| [H3O+] mol/L |  |  |  |  |
| [OH-] mol/L |  |  |  |  |
| Relative number of molecules |  |  |  |  |

Define an acid:

Define a base:

**Errors**

Each section provided a simulation or video link with data output so the errors should be minimal besides inaccurate copying or manipulating of the data. The error section can also afford the learner opportunity to offer any ideas for relevant further study/research of this topic or scientific principle (this is optional).

**Resources/Bibliography**

Chemistry Overview Lab. *Lab Worksheet*. Biology Course Site, Week 3. Learning CTR Online, n.d. Web. 23 Sept. 2022. [www.learningctronline.com/biology-course-site-s1](http://www.learningctronline.com/biology-course-site-s1).

Electrical Conductivity. Specific Heat. *Video Links*. Chemistry Course Site, Weeks 4 & 25. Learning CTR Online, n.d. Web. 16 Sept. 2022. <[www.learningctronline.com](http://www.learningctronline.com)/biology-course-site-s1>.

PHET Interactive Simulations. Isotopes and Atomic Mass. Acid-Base Chemistry. @ 2022 University of Colorado Boulder. n.d. Web. 23 Sept. 2022. <https://phet.colorado.edu/en/simulations/>

ANSWER KEY

Isotopes and Atomic Mass

*Use the URL link provided to complete this section.*

<https://phet.colorado.edu/en/simulations/isotopes-and-atomic-mass>

1. Click on “Isotopes” and then, “Mass Number” on the scale.

2. Write the chemical equation for water (as shown): 2H2O 🡪 H3O+ + OH-

3. Complete the chart below.

a. Click on each element.

b. Look in the upper left for subatomic particles.

c. Click on the “Symbol” button. Replace the numbers in the “Symbol” row to match the correct nuclear symbol.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | H | He | Li | Be | B | C | N | O | F | Ne |
| Protons | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Electrons | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Neutrons | 0 | 2 | 4 | 5 | 6 | 6 | 7 | 8 | 10 | 10 |
| Mass | 1 | 4 | 7 | 9 | 11 | 12 | 14 | 16 | 19 | 20 |
| Symbol | 1H1 | 2He4 | 3Li7 | 4Be9 | 5B11 | 6C12 | 7N14 | 8O16 | 9F19 | 10Ne20 |

4. What do you notice about the number of protons and electrons for each element?

**The number of protons and electrons for each element of a neutral atom is the same.**

5. What determines the atomic mass for each element?

**The number of protons plus neutrons determines the mass for each element.**

Bonding & Solutions

1. Watch the videos:

<http://somup.com/cF6eq5nVpn> Electrical Conductivity (Properties) ctr (1:13) ... solids & water

<http://somup.com/cF6eq8nVpq> Electrical Conductivity (Properties) ctr (1:31) ... solutions

 a. Identify the type of bonding (ionic or covalent) in salt, sugar, and hydrochloric.

**Salt and hydrochloric acids are ionic compounds; sugar is a covalent molecule.**

b. Give evidence to prove your answer?

**Salt and hydrochloric acid conducted electricity, but sugar did not.**

2. Watch the video: <https://screencast-o-matic.com/watch/cFXiD9YP5e> Dancing Water (1:09)

 a. Why did the water bend towards the charged straw?

**Water is a polar molecule, meaning its “ends” are relatively charged (+ and -). The charged straw attracted the end of water that was oppositely charged of the straw.**

b. What are some major properties of water based on using a straw to drink?

**Cohesion (water sticks to itself), adhesion (water sticks to the straw), capillary action (pulls the water up the straw)**

3. Watch the video: <http://somup.com/cFXTY7nQr4> (0:24) Salt Dissolves in Water

a. What are the components of a solution?

**Solute (gets dissolved) and solvent (does the dissolving)**

b. What substances in the video represent the components of the solution?

**Solute (salt) and solvent (water)**

Specific Heat

*Use the video link provided to complete this section.*

**Video Demonstration:** [**https://screencast-o-matic.com/watch/cFX609YWH6**](https://screencast-o-matic.com/watch/cFX609YWH6)

**CALORIMETRY TABLE for Cadmium**

|  |  |
| --- | --- |
| **MASS DATA** | **TEMPERATURE DATA** |
| **Material** | **Mass** | **Material** | **Temperature** |
| Metal cylinder | **58.95 g** | Boiling water | **~100º C** |
| Water in Calorimeter | **22.0º C** |
| Name of Metal 🡺 **cadmium** | Water in cup after metal was added | **25º C** |
| Calorimeter Styrofoam |  |
| Cup + water |  |  |  |
| Water alone | **100. g** | ∆T of water | **3.0º C** |
|  |  | Heat gained by water | **1254 j** |
|  |  | ∆T of Cadmium | **75.0º C** |

1. Which substance experienced the greatest change in temperature: the cadmium cylinder or the water? Give evidence.

*The metal had the greatest change in temperature (75***º** *C versus 3***º** *C for the water)*.

2. Based on this activity, which substance, cadmium or water, has the highest specific heat?

*The water has the higher specific heat*.

3. Give two examples from daily life where specific heat is a major factor.

* *Michigan stays cooler in the summer due to the high specific heat of water in lakes. The water absorbs the heat of the land. Michigan stays warmer in the winter due to the high specific heat of water in lakes. The water releases heat to the land. This is what we call a “temperate climate.”*
* *When we cook foods containing water, it takes longer to heat up than solid foods and it takes longer to cool down. For example, tomatoes stay hot a long time due to their high water content (when they are heated).*

4. Which way does heat flow in terms of warm and cold objects?

*Heat flows from a warmer object to a cooler object*.

Acid-Base Chemistry

*Use the URL link provided to complete this section.*

<https://phet.colorado.edu/en/simulations/acid-base-solutions>

1. Click on “Introduction”. Use the pH tool and pull it down into the solution (beaker).

2. Write the chemical equation for water (as shown): 2H2O 🡪 H3O+ + OH-

3. Complete the chart below. Click between the “Molecules” and “Graph” button for information.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Substance | Strong Acid | Weak Acid | Strong Base | Weak Base |
|  |  |  |  |  |
| pH | 2 | 4.5 | 12 | 9.5 |
| [H3O+] mol/L | 10-2 | 10-5 |  |  |
| [OH-] mol/L |  |  | 10-2 | 10-5 |
| Relative number of molecules | Many | Fewer | Many | Fewer |

Define an acid: ***a compound that dissolves in water to form Hydrogen ions, H+***

Define a base: ***a compound that dissolves in water to form hydroxide ions, OH-***