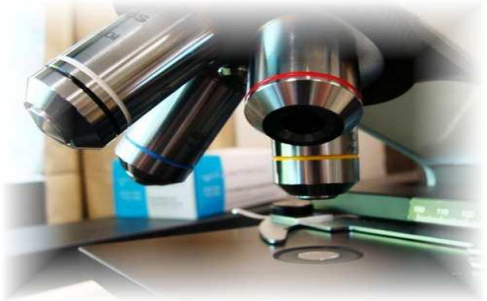

About Science Prof Online PowerPoint Resources

• Science Prof Online (SPO) is a free science education website that provides fully-developed Virtual Science Classrooms, science-related PowerPoints, articles and images. The site is designed to be a helpful resource for students, educators, and anyone interested in learning about science.

• The SPO Virtual Classrooms offer many educational resources, including practice test questions, review questions, lecture PowerPoints, video tutorials, sample assignments and course syllabi. New materials are continually being developed, so check back frequently, or follow us on Facebook (Science Prof Online) or Twitter (ScienceProfSPO) for updates.

• Many SPO PowerPoints are available in a variety of formats, such as fully editable PowerPoint files, as well as uneditable versions in smaller file sizes, such as PowerPoint Shows and Portable Document Format (.pdf), for ease of printing.

• Images used on this resource, and on the SPO website are, wherever possible, credited and linked to their source. Any words underlined and appearing in blue are links that can be clicked on for more information. PowerPoints must be viewed in *slide show mode* to use the hyperlinks directly.

• Several helpful links to fun and interactive learning tools are included throughout the PPT and on the Smart Links slide, near the end of each presentation. You must be in *slide show mode* to utilize hyperlinks and animations.

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Image: Compound microscope objectives, T. Port

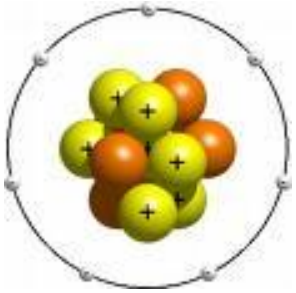
Inorganic Chemistry

For additional resources on this lecture topic, see the Inorganic Chemistry Main Page on SPO.

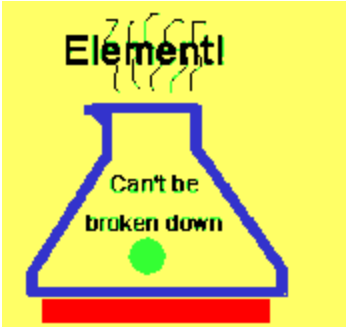
Image: Chemicals in Flasks, J. Sullivan, Wiki

Chemical Basis of Life:

Atoms, Molecules & Compounds



- _____ → Anything that occupies space and has mass.



- _____ → Substances that can't be broken down any further. *[Living things are composed of 24 elements. More than 100 in the periodic table.]*

- **Atom** → The smallest unit of an element.

  [atoms = protons (+) and neutrons in the nucleus orbited by electrons (-)]

- _____ → Atoms chemically bonded with other atoms.

- _____ → Molecules composed of two or more different kinds of elements.

Reminder... Molecule vs. Compound

- ***Q:** What do we call **two or more atoms joined together chemically?***
- ***Q:** What do we call a molecule containing **at least two different elements?***
- All compounds are molecules but not all molecules are compounds.
- ***Examples of molecules:*** Carbon dioxide (CO_2) and methane (CH_4) , molecular hydrogen (H_2), molecular oxygen (O_2) and molecular nitrogen (N_2).
- ***Examples of compounds***: Only molecules containing two or more elements, such as carbon dioxide (CO_2) and methane (CH_4).

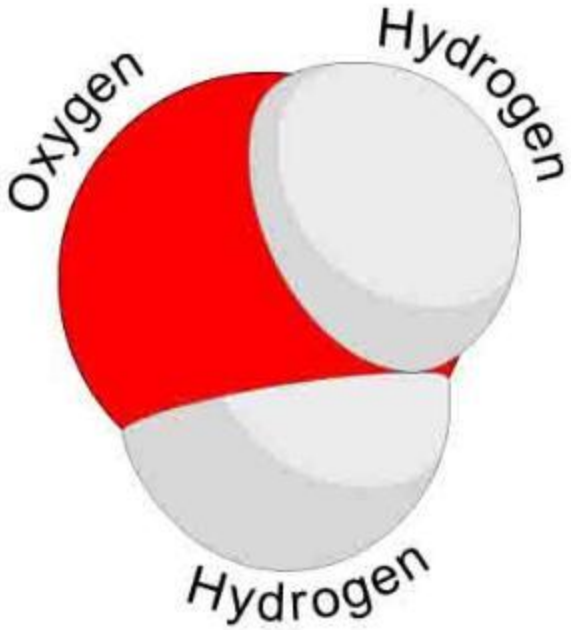
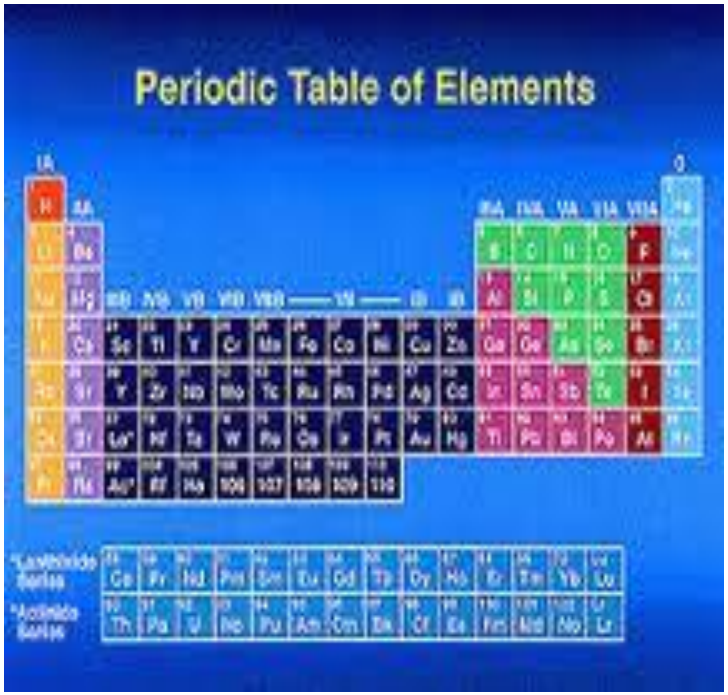


Image: Water Molecule, Wiki

Chemical Shorthand



Chemical _____

- Begins with **one or two letters** based on elements name.
- ***Q:*** *What if there is more than one element that starts with the same letter?*
- Example: Carbon (C), Calcium (Ca), Chlorine (Cl)

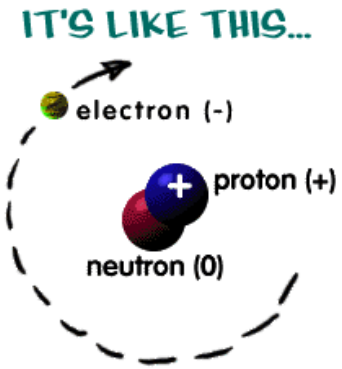
Follow this link to see Daniel Radcliff (Harry Potter) **sing "The Element Song".**

Chemical _____

- "Shorthand" for a compound.
- Contains chemical symbols of the elements that make up the molecule.
- Numerical subscripts represent number of atoms of each element in molecule.
  Example: H_2O *= water; has two hydrogen atoms and one oxygen.*
- More than one molecule of same type…the group of letters is preceded by number.
  Example $2H_2O$ *= two water molecules.*

Image: Periodic Table of Elements, NASA

The Structure of an Atom



Atoms are the basis for everything in the universe.

***Q:** What are the three basic parts of an atom?:*

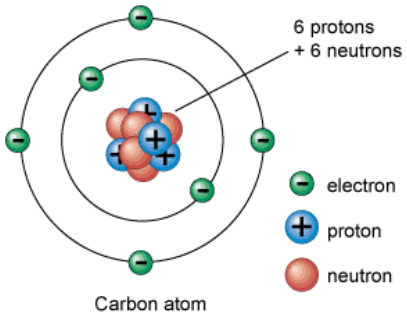
- _____ = "-" negative charge
- _____ = "+" positive charge
- _____ = neutral (a charge of zero)

The thing that makes each element unique is the number of protons, since the number of neutrons and electrons can vary.

Protons and **neutrons** always in the center of atom (the nucleus).

Electrons are found whizzing around nucleus in areas called orbitals.

***Q:** If there is an equal number of electrons and protons in an atom, what is it's charge?*



NERDY SCIENCE JOKE: A neutron walks into a bar and asks "How much for a drink?"

***Q:** What does the bartender tell him?*

Images: Structure of Atom, Chem4Kids Website; Carbon, Universe Today Website

Chemical Bonding and Electron Valences

The electrons in an atom are located at different **energy levels**.

Electrons in the highest energy level are called **valence electrons**.

Number of valence electrons governs an atom's bonding behavior.

***Q:** What is the **max number** of valence electrons for a full valence shell?*

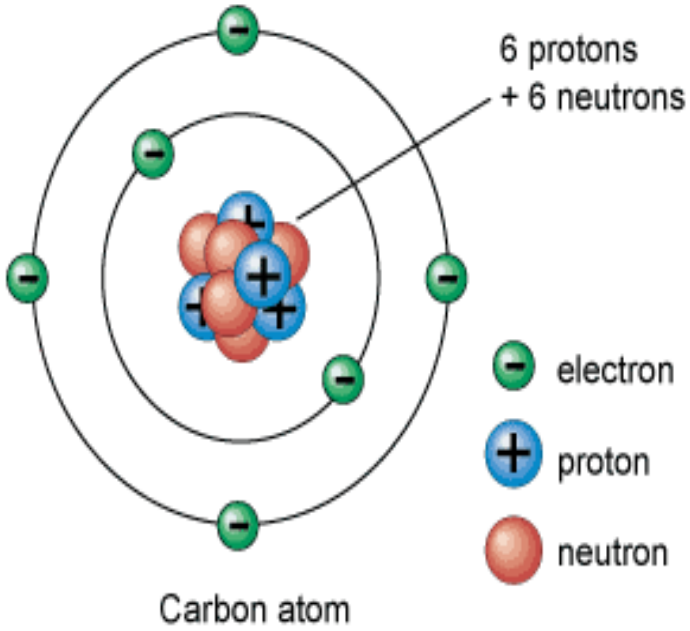
Atoms are much more stable, or less reactive, with a full valence shell.

This stability can be achieved one of two ways:

- _____ bond

- _____ bond

By moving electrons, the two atoms become linked. This is known as **chemical bonding**.



Images: Carbon, Universe Today Website

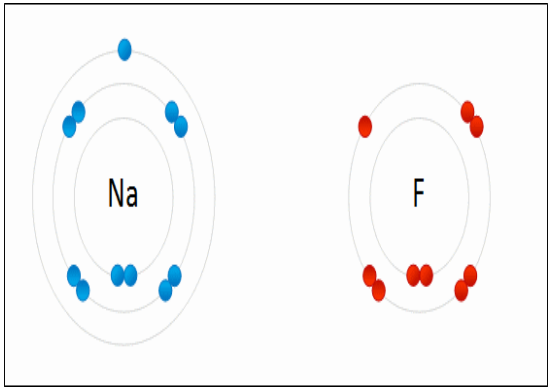
From the Virtual Cell Biology Classroom on ScienceProfOnline.com

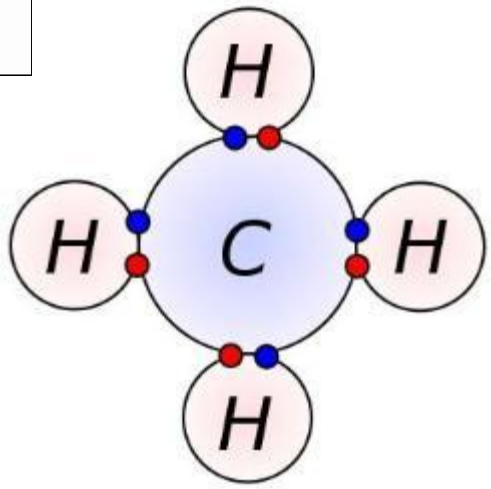
Three Main Types of **Chemical Bonds:**

1. _____

2. _____

3. _____





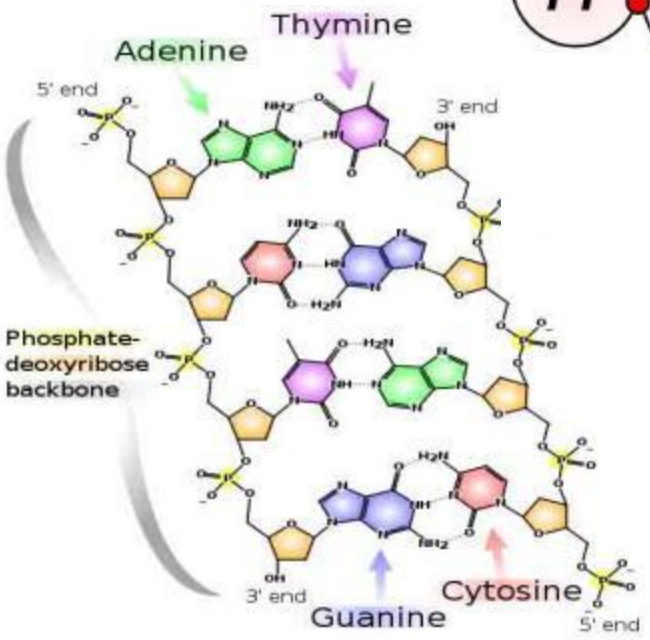
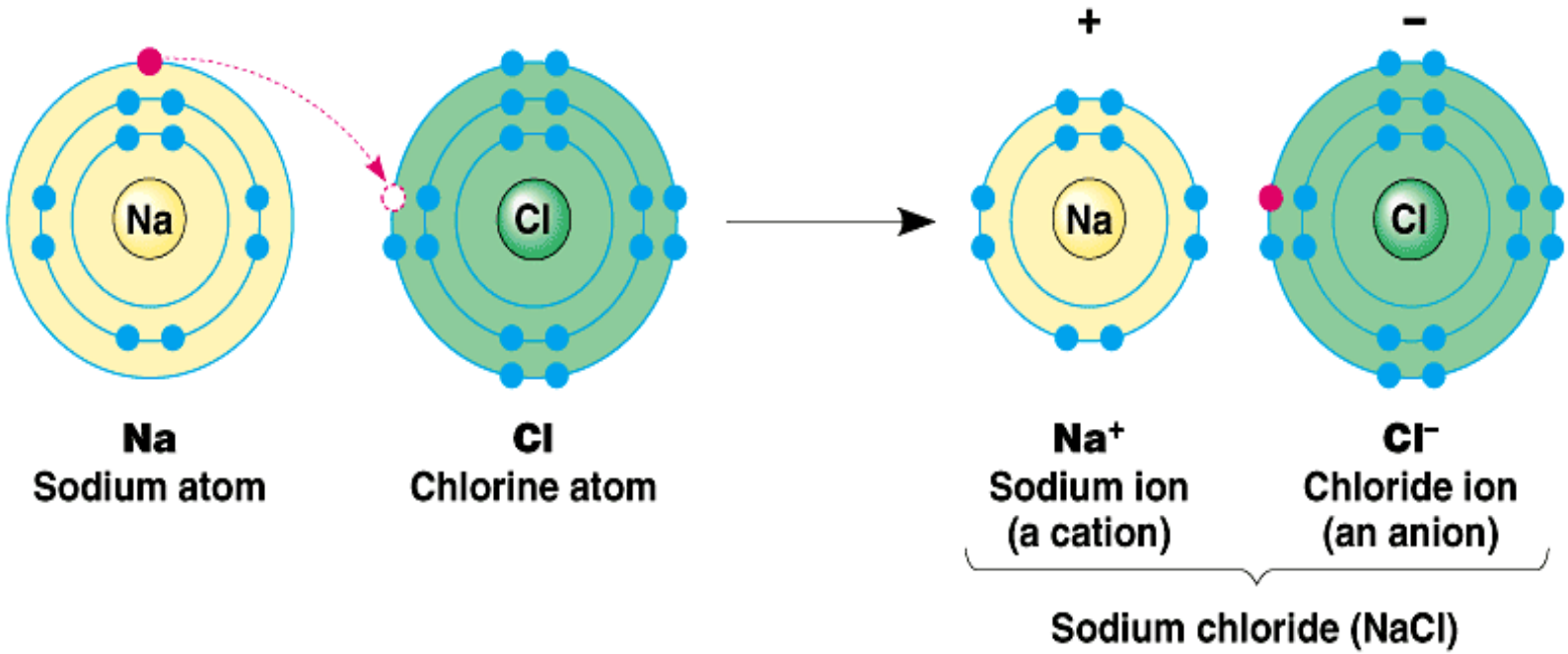


Image: Formation of ionic sodium fluoride, Wdcf; Methane Covalent Bonds, Dynablast, Wiki; DNA Chemical Structure, Madprime, Wiki

_____ Bonds

Involves transfer of electrons between two atoms.

Found mainly … inorganic compounds.



Ion = an atom or group of atoms which have lost or gained one or more electrons, making them negatively or positively charged.

Q: *What are positively charged ions (+) called?* _____

Q: *What are negatively charged ions (-) called?* _____

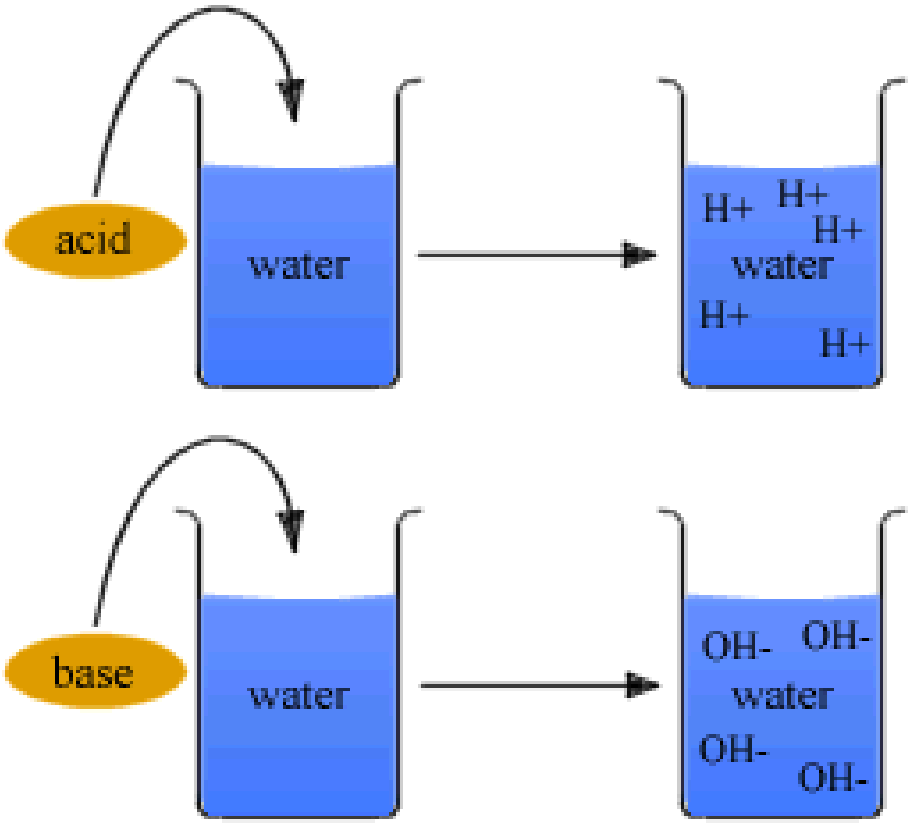
Images: Sodium Chloride, University of Winnepeg

From the Virtual Cell Biology Classroom on ScienceProfOnline.com

Ions: Acids & Bases

An _____ is any ionic compound that releases _____ _____ (H^+) in solution.

A _____ is any ionic compound that releases _____ _____ (^-OH) in solution.



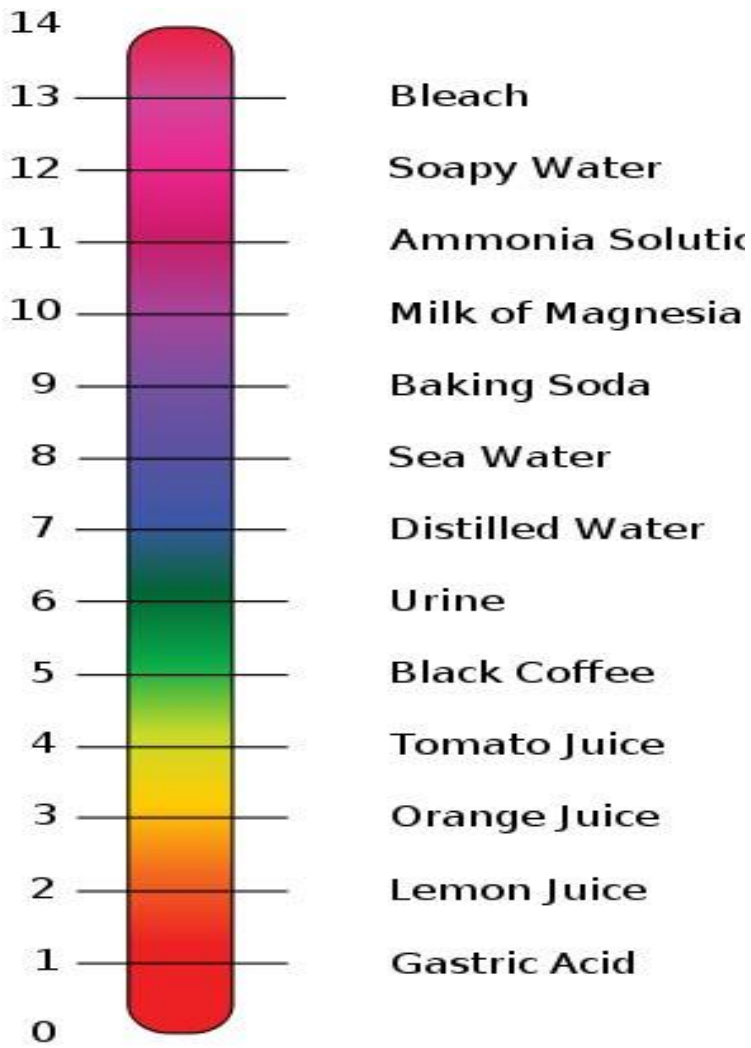
Measurements of Acidity & Alkalinity (pH)

Acidity of a solution > measured by concentration of hydrogen ions (H+).

pH ranges: 0 (very _____) to 14 (very _____).

Change in just one unit of scale = tenfold change in H+ concentration.

If concentration of H+ = OH - … neutral.



Images: pH scale, Edward Stevens, Wiki

From the Virtual Cell Biology Classroom on ScienceProfOnline.com

Ions & Acids

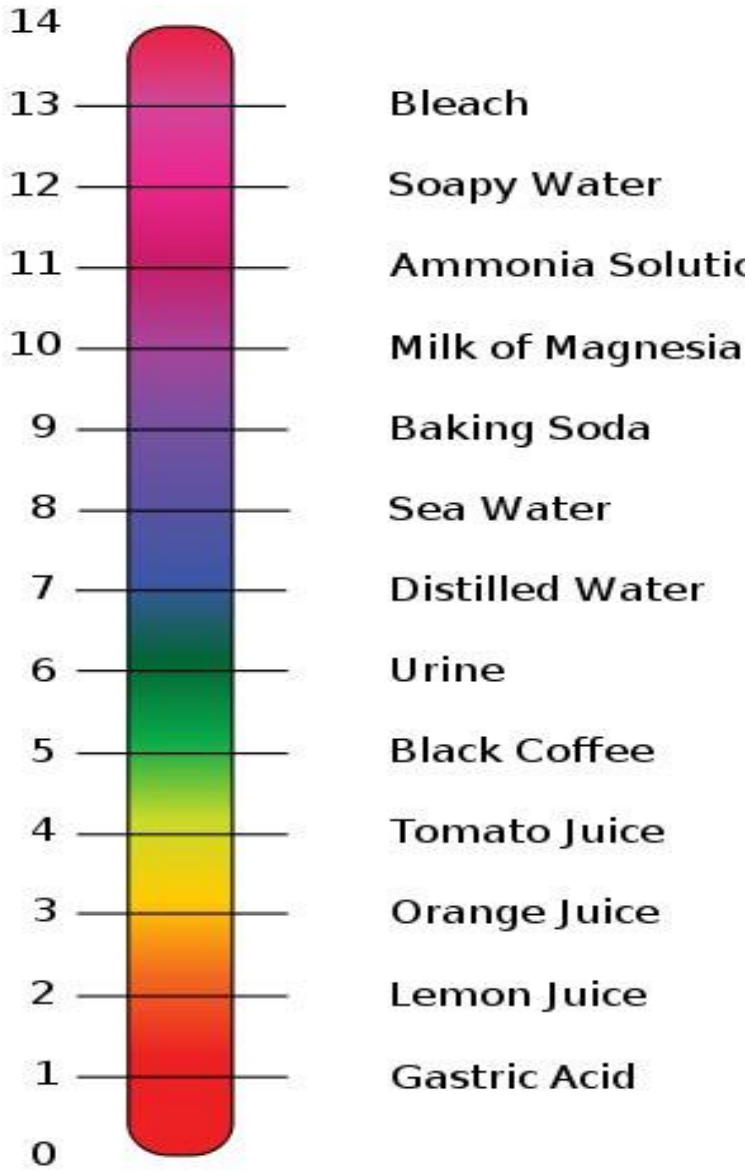
An **acid** is any ionic compound that releases hydrogen ions (H+) in solution.

Weak acids have a sour taste.

Strong acids are highly corrosive (So don't go around taste-testing acids.)

Examples:

- **Ascorbic acid** ($C_6H_8O_6$, Vitamin C)
- **Citric acid** ($C_6H_8O_7$, a weak organic acid in citrus fruits)
- **Phosphoric acid** (H_3PO_4, in pop…this stuff is also used to remove rust…hmmm)



Images: pH scale, Edward Stevens, Wiki

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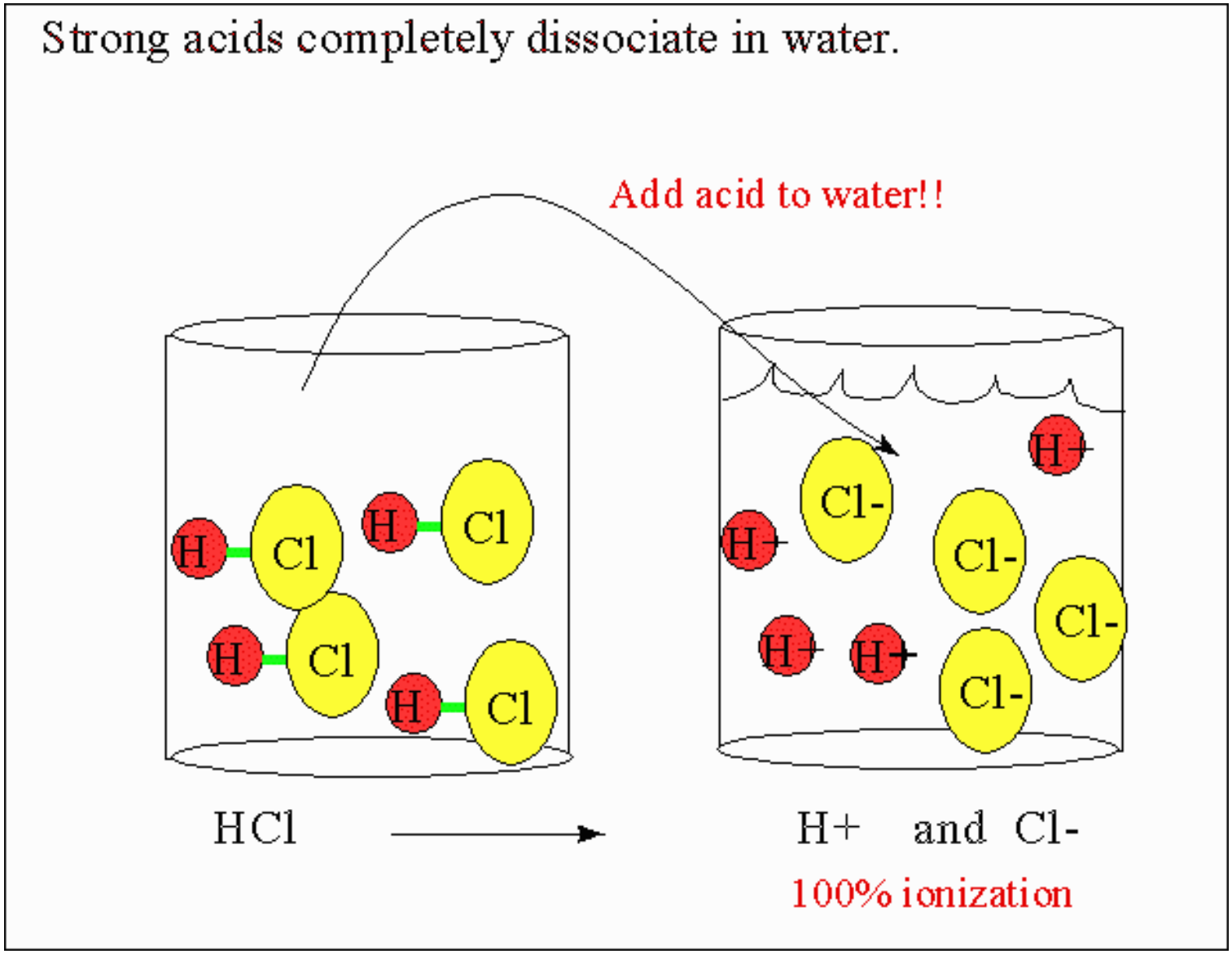
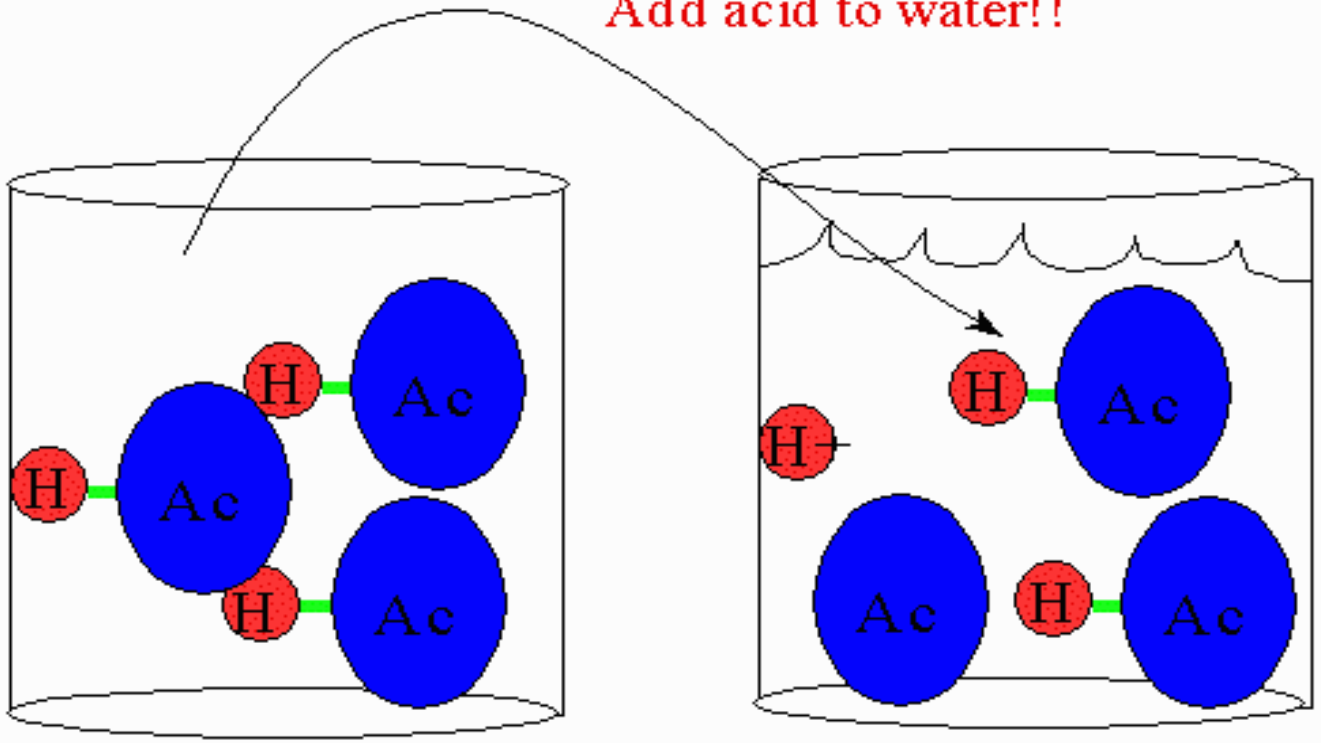


Images: Strong Acids, Department of Chemistry, CSU

From the Virtual Cell Biology Classroom on ScienceProfOnline.com

Weak acids DO NOT completely dissociate in water.



HAc → H+ and Ac and HAc

partial ionization

HAc = acetic acid = H-O-C(=O)-CH_3

Ions & Bases

A base is an ionic compound that releases hydroxyl ions (OH^-) in solution.

Bases are also called _____ substances.

Some general properties of bases include:

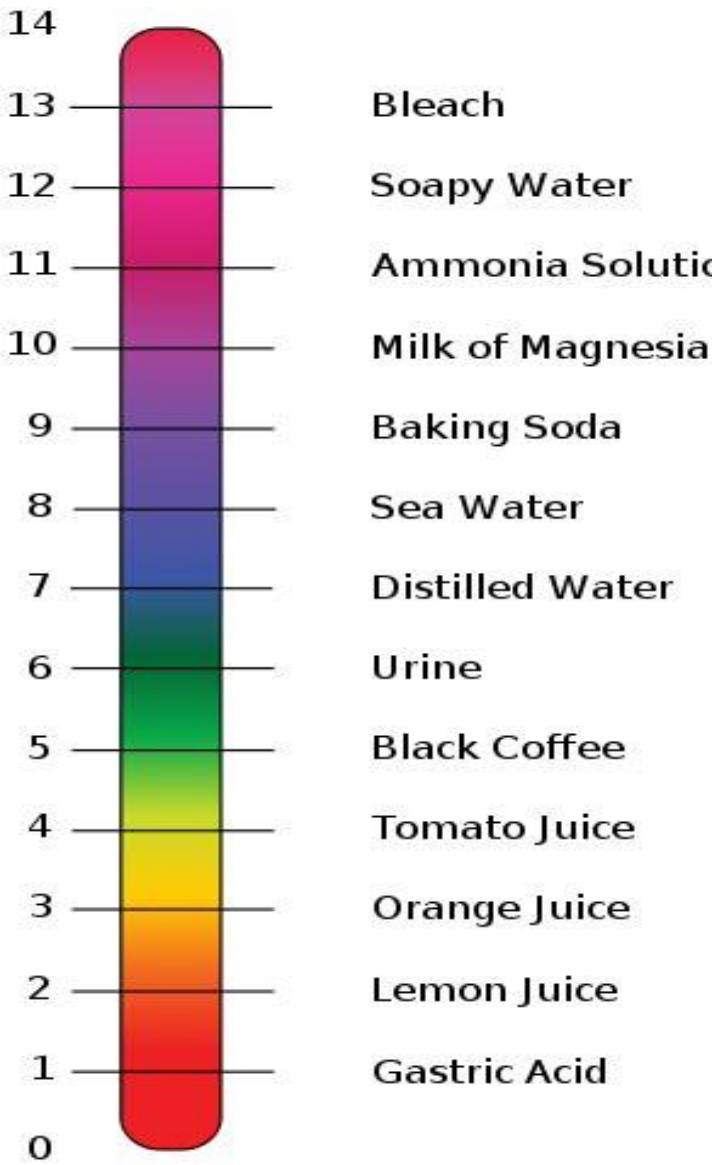
Taste: Bitter taste (opposed to sour taste of acids and sweetness of aldehydes and ketones).

Touch: Slimy or soapy feel on fingers.

Reactivity: Strong bases are caustic on organic matter, react violently with acidic substances.

Examples:

- **Sodium hydroxide**, NaOH, of lye or caustic soda used in oven cleaners.
- **Magnesium hydroxide**, $Mg(OH)^2$, also known as milk of magnesia, a weak base used in antacids and laxatives.

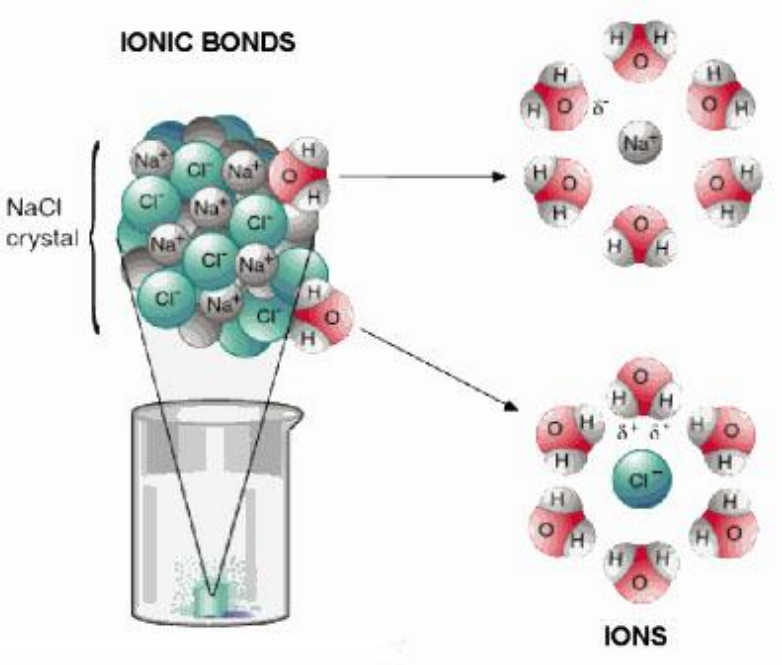


Images: pH scale, Edward Stevens, Wiki

Ions & _____

Compounds that dissociate in water and produce cations other than H+ and anions other than OH- are called **salts**.

The most familiar salt is **sodium chloride**, the principal component of **common table salt**.



Other examples of salts:

Baking soda ($NaHCO_3$)

Epsom Salts ($MgSO_4$)

Salts: The Role of _____

- Certain salts, called buffers, can combine with excess hydrogen (H+) or hydroxyl (OH-) ions.

- Produce substances less acidic or alkaline.

- ***Example:*** *Antacids like Tums are buffers made of the salt calcium carbonate (CaCo3).*

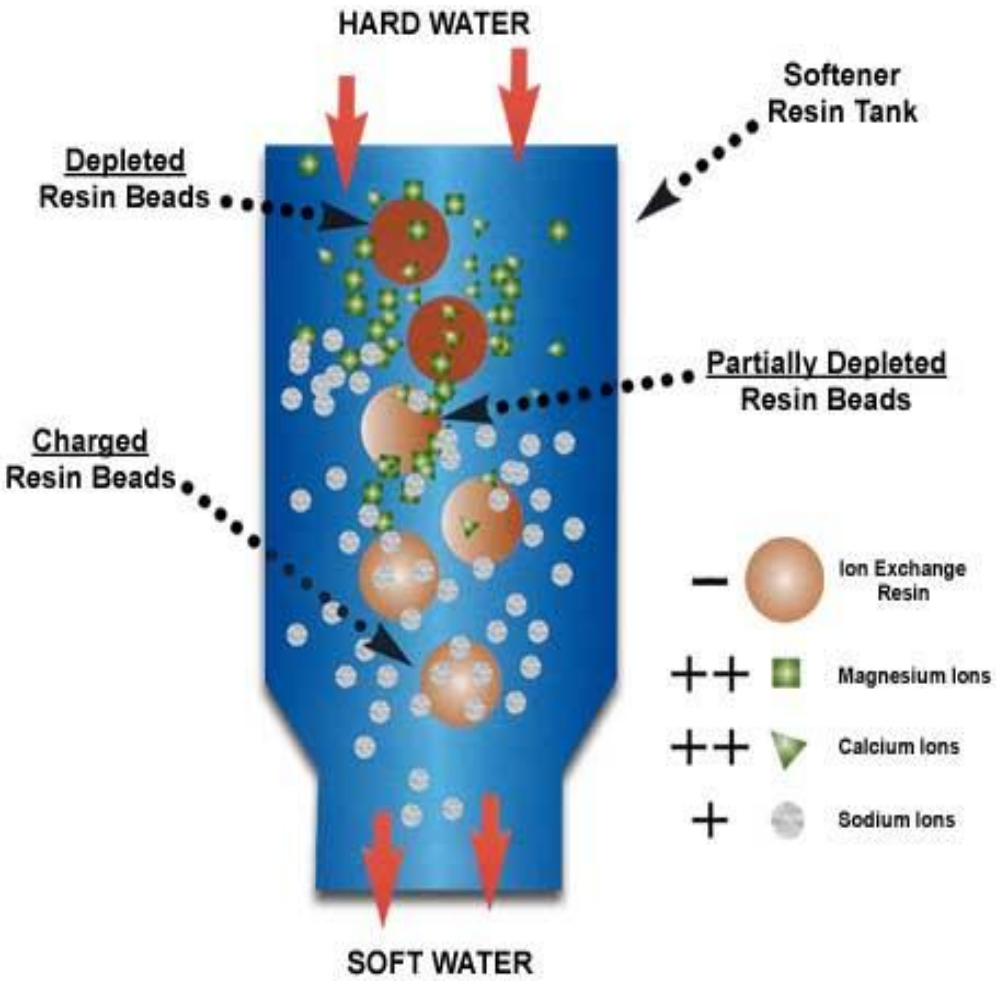
Reactions Involving Ions

*Remember…***Ion** = an atom which has lost or gained one or more electrons, so it's negatively or positively charged.

The Principle of

_____ _____

is a common water softening method.



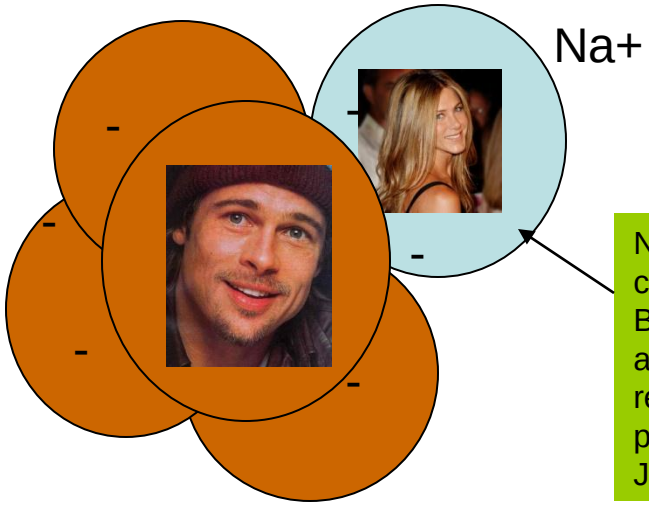
Lets use a **Branganalogy** to help us Understand the Concept of Ion Exchange…

1. Brad Pitt is a negatively charged resin bead

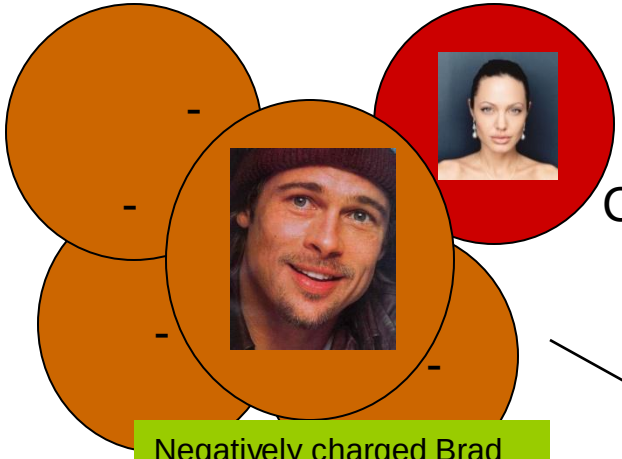
2. Jennifer Anniston is a positively charged Sodium ion

Now lets say that 'positiveness' equates with 'drop-dead gorgeousness'

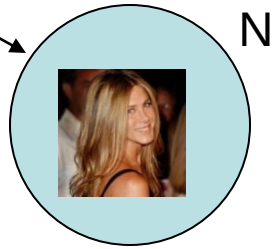
3. Angelina Jolie is a positively charged Calcium Ion



Negatively charged Brad is attracted to reasonably positive Jennifer.



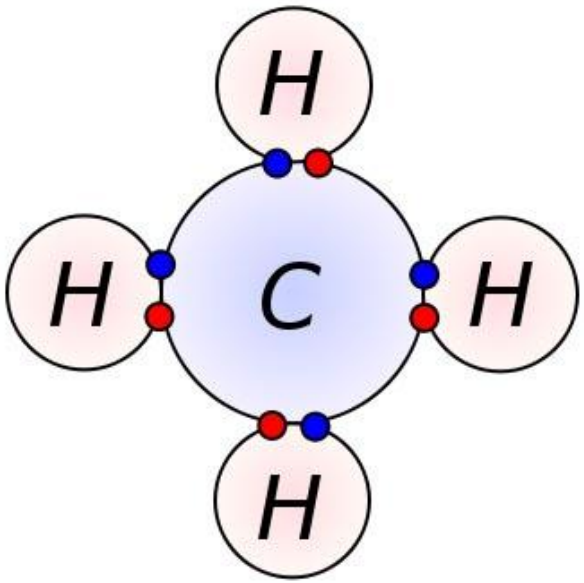
Negatively charged Brad lets go of reasonably positive Jennifer in the presence of insanely positive Angelina.

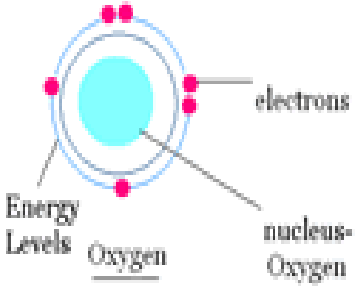


_____ Bonds

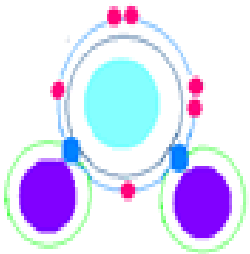
***Covalent Bonds*:** Involve the sharing of a pair of electrons between two atoms.

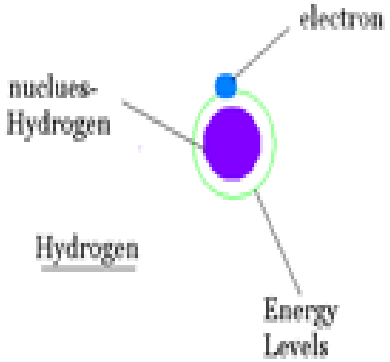
Found mainly … organic compounds





If combined you get...





... H_2O

Because the Oxygen and Hydrogen are sharing two electrons. It has two have two Hydrogen Atoms , because Hydrogen only has one electron.

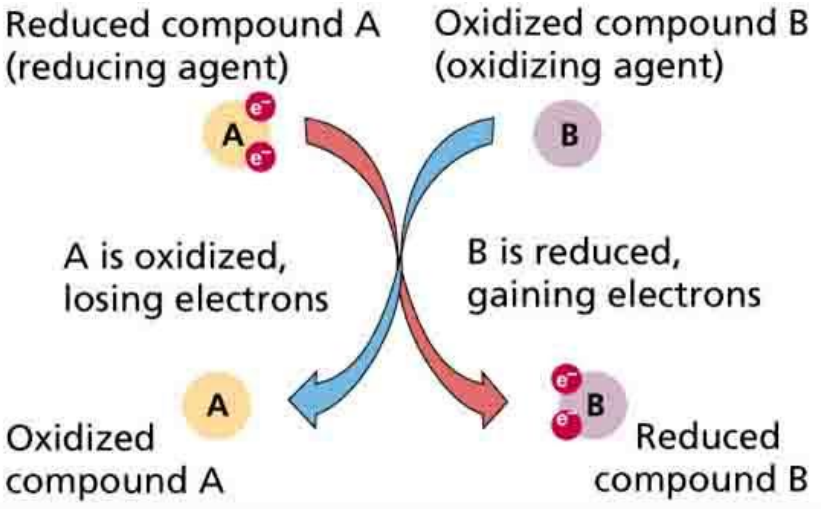
Image: Methane Covalent Bonds, Dynablast, Wiki

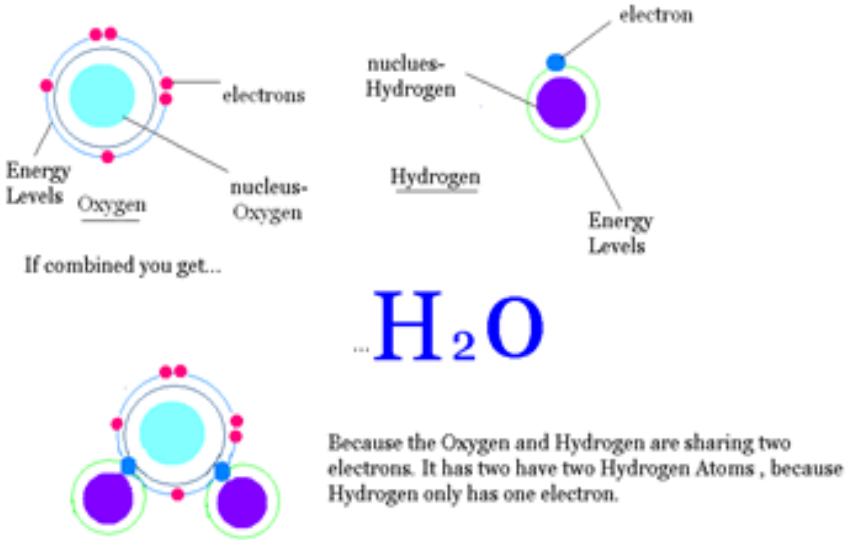
Oxidation - Reduction Reaction

- Or **Redox** reaction = chemical reactions in which electrons are **gained**, **lost** (*Q: What kind of bond?*) or **shared** (*Q: What kind of bond?*) in a chemical reaction.

- _____ describes the loss of electrons by a molecule, atom or ion.

- _____ describes the gain of electrons by a molecule, atom or ion.





Oil Rig

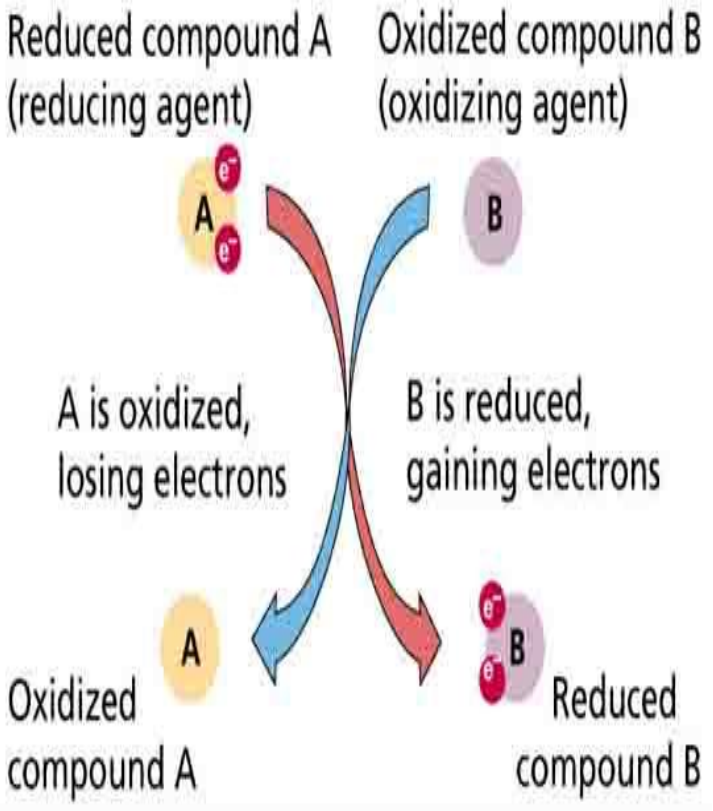


Image: Oil Rig Platform, Nasa

From the Virtual Cell Biology Classroom on ScienceProfOnline.com

_____ Bonds

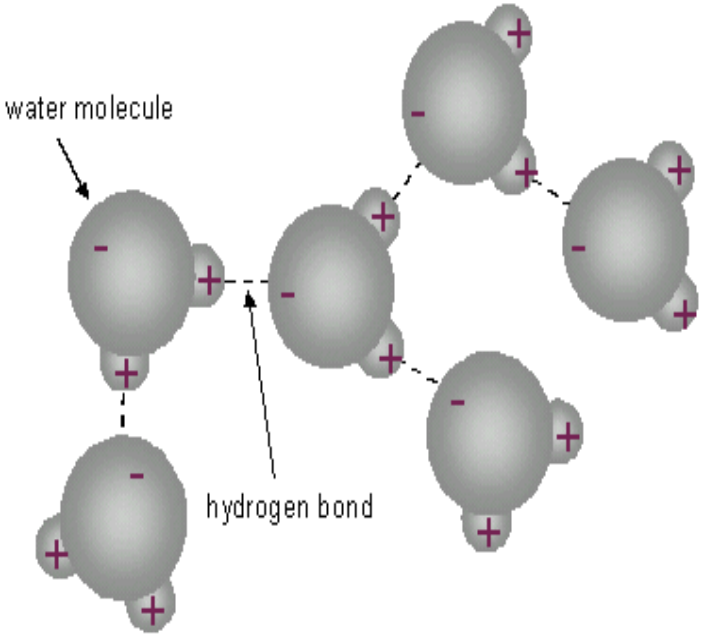
Hydrogen Bonds: When an atom of hydrogen is attracted to two atoms instead of only one.

Hydrogen bonds attract molecules to each other, but do not technically bond atoms together.

Bonding electrons are shared unequally by the hydrogen and oxygen atoms:

- negative charge (-) forms at _____ end
- positive charge (+) forms at _____end

When the electrons in a covalent bond are not equally shared, the molecule is _____.



Found in water, proteins & DNA

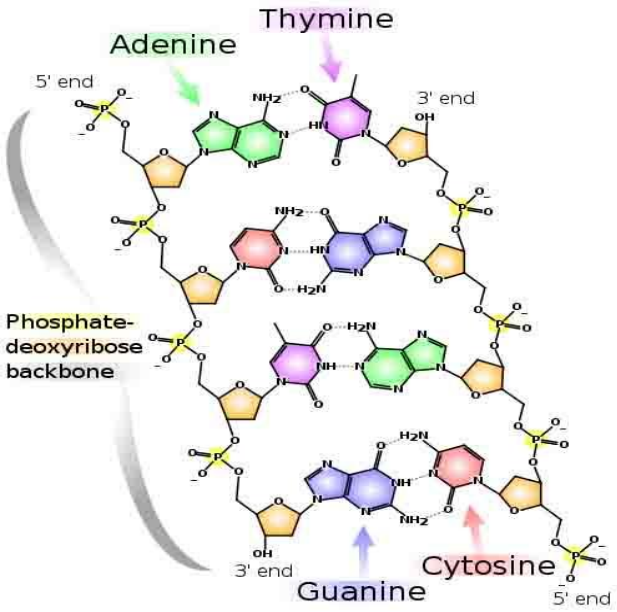


Image: DNA Chemical Structure, Madprime, Wiki; Water Striders, Markus Gayda, Wiki

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Neutrons

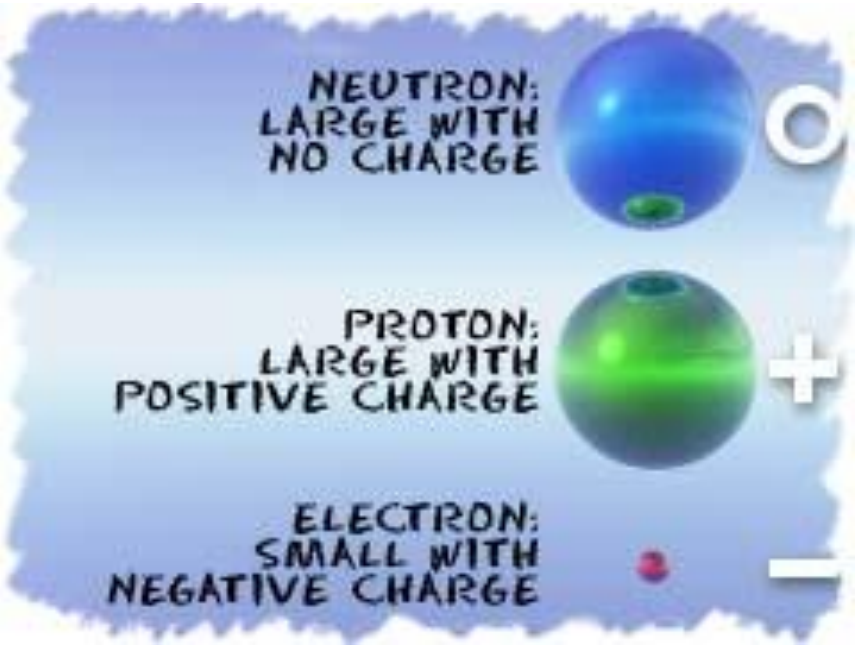
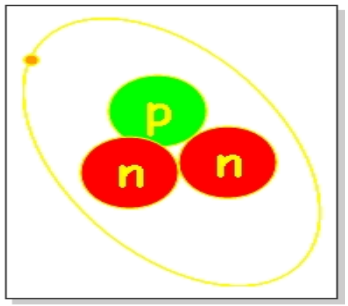


Image: Parts of Atom, Chem4Kids Website



What is an _____?

Normal Atoms

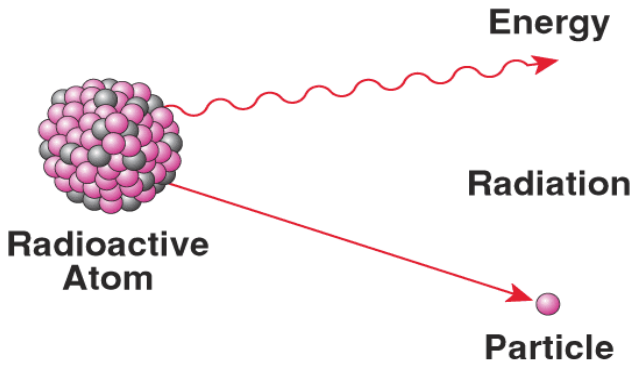
- Except for hydrogen *(1 proton / no neutrons),* every atomic nucleus in normal matter is made of both protons and neutrons.
- Typically, the number of protons and neutrons is the same.
- Protons in the nucleus are positively charged, and repel each other.
- Neutrons are neutral. They separate the protons slightly, making the atom stable.

Isotopes

- An **isotope** is a variant of an element, with a different # of _____ than is typical.
- This makes a nucleus unstable.

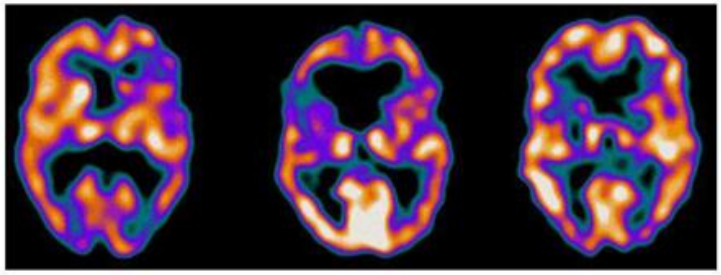
Image: Isotope, GRAC

Isotopes & Radioactivity

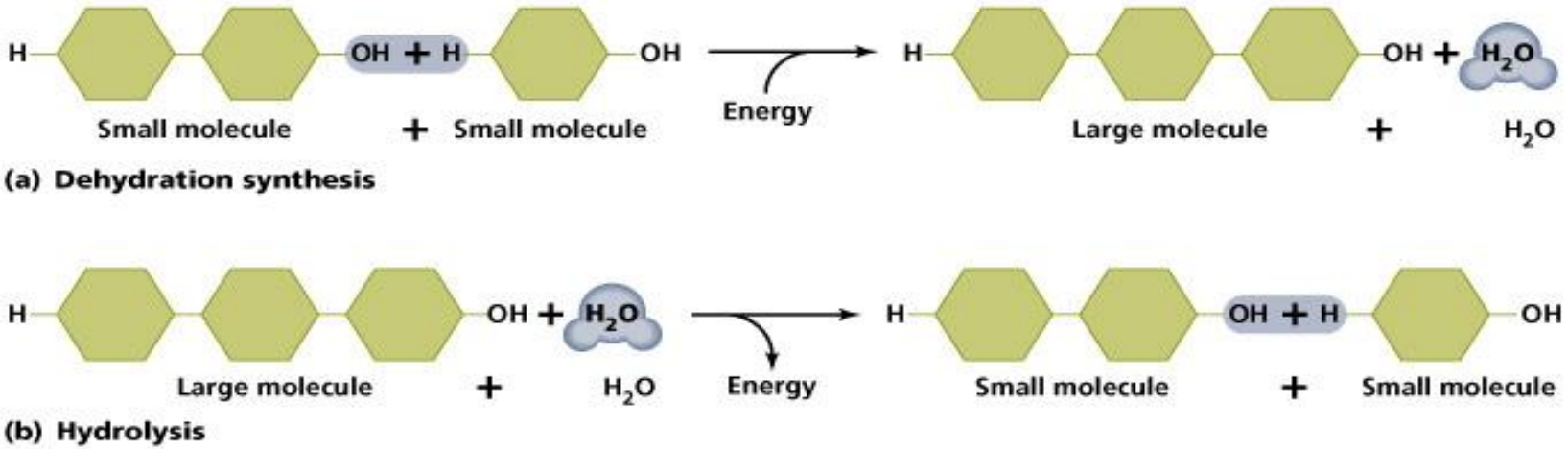


- Isotope is _____ if nucleus is unstable.
- Most isotopes disintegrate spontaneously with the release of energy by processes of ***nuclear or radioactive decay***.
- When the nucleus changes in structure, energy and/or subatomic particles are given off.
- Other than radioactivity, isotopes behaves similarly to the natural variant.
- When controlled, radioactive isotopes can be valuable medical tools. (Ex. Gamma camera can produce images of soft tissue when radiopharmaceuticals are injected into or ingested by patient.)

1. Schizophrenic female
2. Female with depression
3. Healthy female



Simple Reactions Types

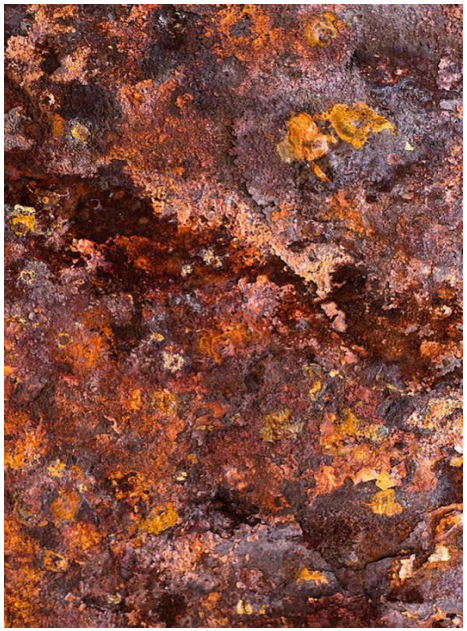


Synthesis, Decomposition & Exchange Reactions

_____ **Reaction** (Combination or Anabolic Reaction)

When two or more substances combine to form a single compound.

Requires energy in order to take place



The general form of a direct combination reaction is:

A + B → AB where A and B are elements or compounds, and AB is a compound consisting of A and B.

Examples of combination reactions include:

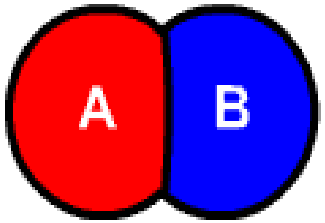
$2Na + Cl_2 \rightarrow 2\ NaCl$ (formation of table salt)

$4\ Fe + 3\ O_2 \rightarrow 2\ Fe_2O_3$ (iron rusting)

_____ **Reaction** (Catabolic Reaction)

The opposite of a composition reaction. A compound is broken down.

The generalized reaction formula for chemical decomposition is:
AB → A + B



_____ **Reactions** (Transfer Reaction)

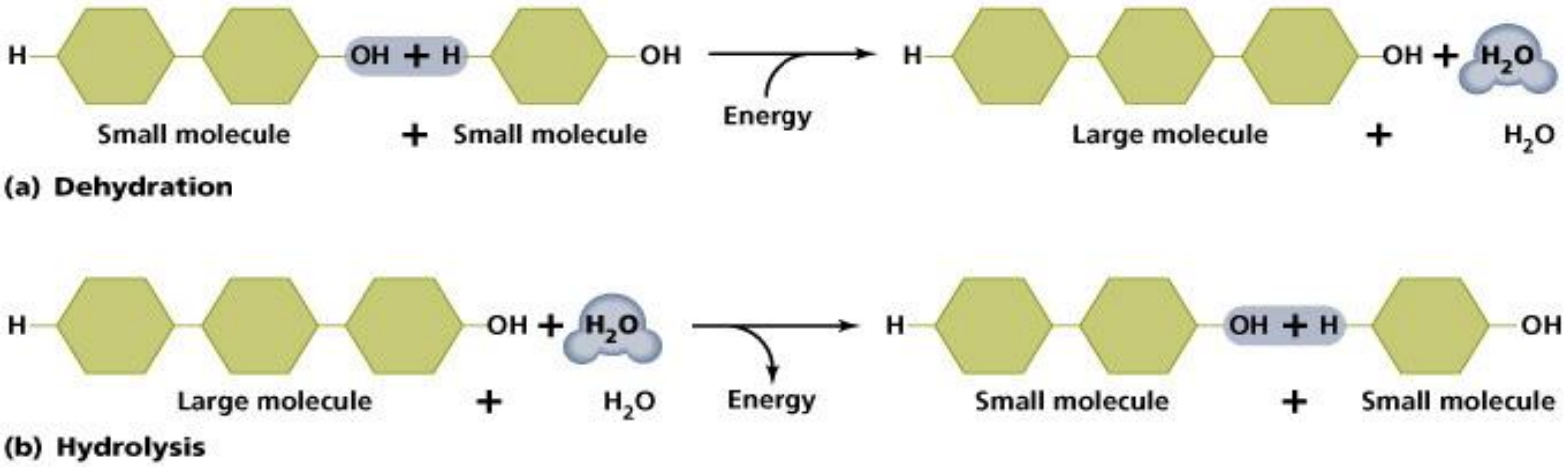
Atoms are moved from one molecule to another.

A + BC → AB + C

Images: Animation decomposition reaction, Armando-Martin; Rust, Later Keiwos From the Virtual Cell Biology Classroom on ScienceProfOnline.com

Q: *Based on the reaction types we just discussed, how would you categorize the reactions below?*

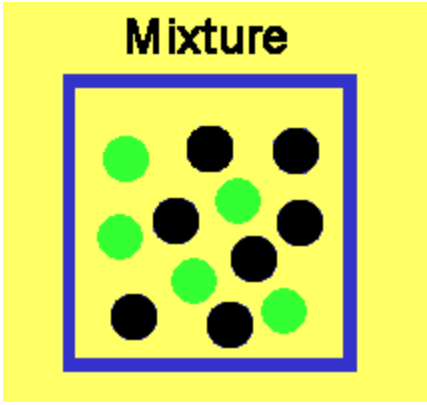
_____ Reaction



_____ Reaction

Mixtures, Compounds & Solutions

Mixtures & Compounds



_____ = ***Physical*** *combination* of two or more pure substances (i.e., elements or compounds).

_____ = ***Chemical*** combination of two or more pure substances in a fixed, definite proportion.

Examples:

Mixture - Iron & Sulfur
Iron filings may be mixed with powdered sulfur in any proportion.
The two components are easily separated by means of a magnet,
The magnet will draw out the iron from the mixture.

The components of a mixture usually can be separated by physical means such as distillation, evaporation, etc.

Compound – Iron sulfide (Pyrite or Fools Gold)
However, if:

a. seven parts iron filings or powder are mixed with four parts powdered sulfur
b. mixture is heated to a red glow
c. iron and sulfur form a compound - iron sulfide; chemically combined, not readily separated.

Solutions

Solutions are mixtures in which one substance is dissolved in another.

Solutions have two parts: **solute** and **solvent**

Q: *Which is the substance that is dissolved?*

So the substance that does the dissolving is called the _____.

(Remember water, the 'universal solvent'?)

_____ - A measure of how much of a given substance will dissolve in a liquid.

A substance that does not dissolve in water is called **insoluble**.

Example: *Oil is insoluble in water.*

A substance that does dissolve in water is called **soluble**.

Example: *Sugar is soluble in water.*

Confused?

Here are some links to fun resources that further explain Chemistry:

- Inorganic Chemistry Main Page on the Virtual Cell Biology Classroom of Science Prof Online.
- "She Blinded Me With Science" music video Thomas Dolby.
- "What Kind of Bonds Are These?" song and slide show by Mark Rosengarten.
- Chemical Bond Formation animated science tutorial.
- "Meet the Elements" music video by They Might Be Giants.
- Redox Reactions video lecture by Kahnacademy.
- Chem4Kids website by Rader.
- Neutron Dance …a so-bad-its-good '80s music video by The Pointer Sisters.

(You must be in PPT slideshow view to click on links.)

Smart Links

Want to see me sing the Element Song?

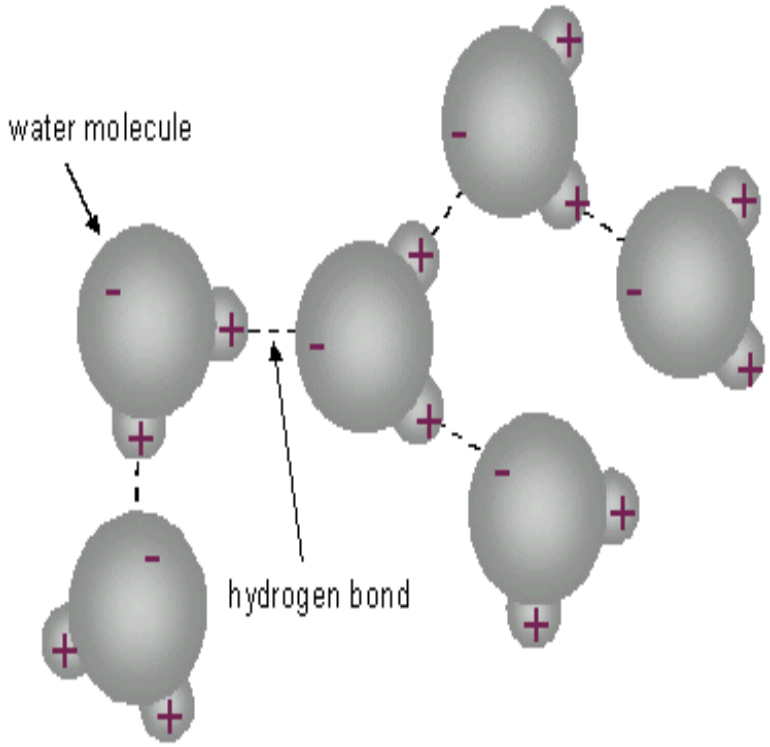
Image: Daniel Radcliff by Joella Marano

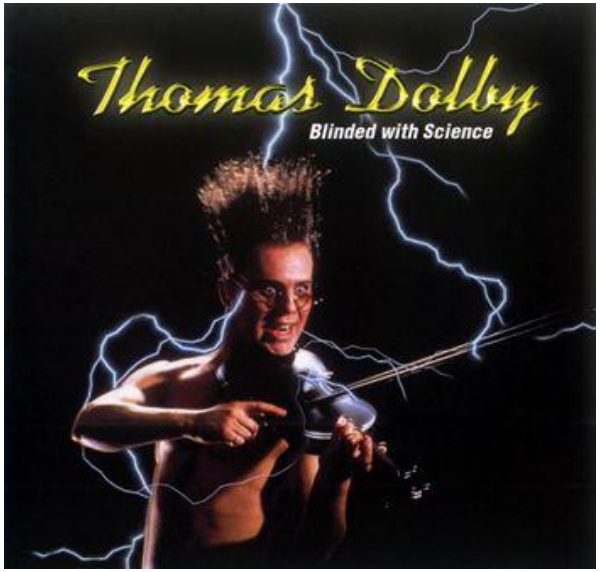
From the Virtual Cell Biology Classroom on ScienceProfOnline.com

Assignment

See the ScienceProfOnline Virtual Cell Biology Classroom: **Inorganic Chemistry Lecture** for a printable Word .doc of this assignment.

- At the end of most lectures, I will give you some type of in-class assignment or homework to evaluate your understanding of that day's topic.
- This assignment will always be open-book.
- Today, if assigned, you will be completing an *essay question* on the topic of **Inorganic Chemistry**.





Are you feeling blinded by science?

Do yourself a favor. Use the…

Virtual Cell Biology Classroom *(VCBC)*!

The VCBC is full of resources to help you succeed, including:

- practice test questions
- review questions
- study guides and learning objectives
- PowerPoints on other topics

You can access the VCBC by going to the Science Prof Online website
www.ScienceProfOnline.com

Images: Blinded With Science album, Thomas Dolby; Endomembrane system, Mariana Ruiz, Wiki