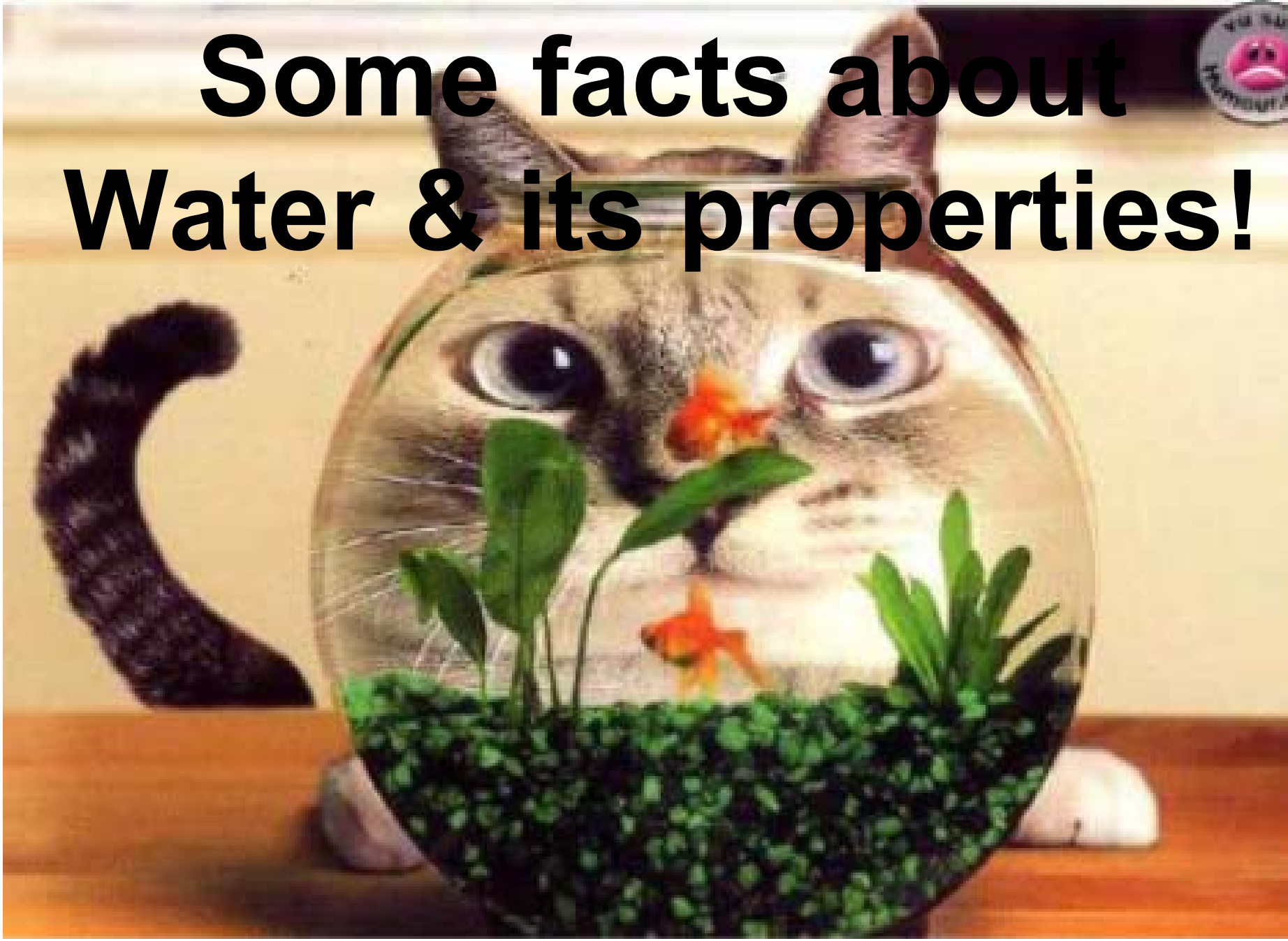
Some facts about Water & its properties!



What is the definition of water?

- a transparent, odorless, tasteless liquid, a compound of hydrogen and oxygen, H_2O, freezing at 32°F or 0°C and boiling at 212°F or 100°C, that in a more or less impure state constitutes rain, oceans, lakes, rivers, etc.: it contains 11.188 percent hydrogen and 88.812 percent oxygen, by weight.

What is hydrogen?

- a colorless, odorless, flammable gas that combines chemically with oxygen to form water: the lightest of the known elements. *Symbol:* H; *atomic weight:* 1.00797; *atomic number:* 1; *density:* 0.0899 g/l at 0°C and 760 mm pressure.

What is oxygen?

- a colorless, odorless, gaseous element constituting about one-fifth of the volume of the atmosphere and present in a combined state in nature. It is the supporter of combustion in air and was the standard of atomic, combining, and molecular weights until 1961, when carbon 12 became the new standard. *Symbol:* O; *atomic weight:* 15.9994; *atomic number:* 8; *density:* 1.4290 g/l at 0°C and 760 mm pressure.

Ph

- the symbol for the logarithm of the reciprocal of hydrogen ion concentration in gram atoms per liter, used to express the acidity or alkalinity of a solution on a scale of 0 to 14, where less than 7 represents acidity, 7 neutrality, and more than 7 alkalinity.

Acidity

1. the quality or state of being acid.

2. sourness; tartness.

3. excessive acid quality, as of the gastric juice.

Alkalinity

- alkaline condition; the quality that constitutes an alkali.

1. Alkali – the aqueous solution of which is bitter, slippery, caustic

Ammonia

- a colorless, pungent, suffocating, highly water-soluble, gaseous compound, NH_3, usually produced by the direct combination of nitrogen and hydrogen gases

Nitrite

- a salt or ester of nitrous acid.
- Esters are a class of chemical compounds and functional groups. Esters consist of an inorganic or organic acid in which at least one –OH (hydroxy) group is ...

Nitrate

- a salt or ester of nitric acid, or any compound containing the univalent group $-ONO_2$ or NO_3.

- Nitric – containing nitrogen
- Nitrous – containing nitrogen
- Nitrogen – a colorless, odorless, gaseous element that constitutes about four-fifths of the volume of the atmosphere and is present in combined form in animal and vegetable tissues, esp. in proteins: used chiefly in the manufacture of ammonia, nitric acid, cyanide, explosives, fertilizer, dyes

Salinity

- the relative proportion of salt in a solution
- a concentration (as in a solution) of salt

Dissolved Oxygen

- the amount of oxygen dissolved in a body of water as an indication of the degree of health of the water and its ability to support a balanced aquatic ecosystem
- oxygen dissolved in water or other liquid, usually expressed in milligrams per liter, parts per million, or percent of saturation

Temperature

- a measure of the warmth or coldness of an object or substance with reference to some standard value.

Lets talk a little about pH

- On a scale of 0 to 14, where less than 7 represents acidity, 7 neutrality, and more than 7 alkalinity.
- Each unit is 10 times more base.
- pH greater than 7 is less acid and more base
- pH less than 7 is more acid and less base
- Base would be like lye, antacid's (like for the stomach) or toothpaste.
- Acids would be like vinegar, orange juice, the liquid in your car battery.

More on pH

- pH should be normally between 7.0 & 8.5
- Acceptable between 6.0 & 9.0
- Fish could probably tolerate 5.0, however your bio-converters bacteria can suffer damage.
- Above 9.0 long term can cause kidney damage.

Ammonia

- Is measured in PPM (parts per million)
- Determines the health of a bio-converter
- Ammonia dissolved in water becomes partially ionized depending on pH & temp.
- Ionized ammonia is called ammonium
- As pH increases, ammonium decreases, which increases toxicity.

Ammonia – cont.

- Assume water temperature @70 degree F
- 1ppm of ammonia with pH @7.0
- 10ppm of ammonia with pH @6.0
- 0.1ppm of ammonia with pH @8.0
- Pond containing fish – residual ammonia
- Bio-converter – each pass, residual ammo
- Residual level is determined by fish load, effectiveness of bio-converter, how often water is passed through it.

Ammonia effects

- Blocks oxygen transfer from the gills to the blood.
- Causes both immediate and long term gill damage.
- Mucus producing membranes destroyed, reducing both the external slime coat and damaging internal intestinal surfaces.

Ammonia source

- Fish gills as a metabolic waste from protein breakdown.
- Secondary sources – bacterial action on solid wastes and urea

Nitrite

- Measured in ppm
- Second measurement to determine the health of a biologic converter
- Low nitrite reading with significant ammonia reading indicates what?
- Low ammonia reading with detectable nitrite reading indicates what?

Nitrite – cont.

- Nitrite is produced by autotrophic bacteria combining oxygen and ammonia in the bio-converter.
- Also to a lesser degree on the walls of the pond.
- Change of fish load
- Spring water temperatures

Nitrite - cont

- Nitrite – invisible killer
- Concentrations as low as 0.25ppm can be deadly, especially to smaller fish
- Damages the nervous system, liver, spleen and kidneys of the fish
- Common indicator fish exposed in past – gill covers may be slightly rolled outward at the edges. Do not close flat against fish body

Dissolved oxygen

- Earths basic air envelope; 78% nitrogen, 21% oxygen, and 0.3% carbon dioxide and several other traces of elemental and molecular gasses.
- Concentrations of these gases within water is a whole different story. Concentrations are much smaller
- Measured in mg/l (milligrams per liter) or somewhat equivalently in ppm.

Dissolved oxygen - cont

- Typical pond @ 70 degrees F. will have concentrations of about 13 mg/l nitrogen, 9mg/l oxygen, and 35 mg/l carbon dioxide.
- As air components dissolve into the water, a point is reached that is called saturation. Saturation is different for each of the gases.
- Temperature is the most important factor.

Dissolved oxygen - cont

- Water temperatures increase, water cannot hold as much of each type of gas
- Example for oxygen;
- At 50 degrees F – oxygen is 11.5 mg/l
- At 70 degrees F – oxygen is 9.0 mg/l
- At 90 degrees F – oxygen is 7.5 mg/l
- Impurities, altitude will decrease saturation levels