MARVEL at Science

Inland Seas Comics

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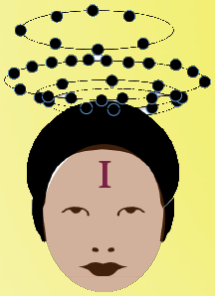
Winkler and *Dissolved Oxygen*



Lajos Winkler
1863-1939

In Budapest we never had things like this!

Our Cast of Characters

Meet the characters in our story

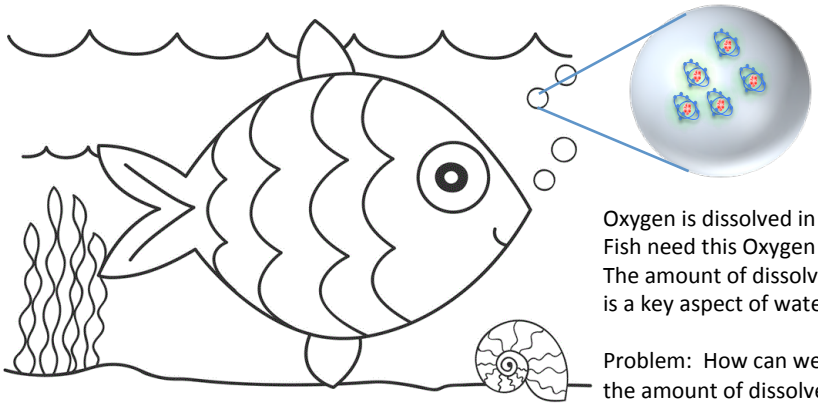
Oxygen, the breath of live for all animals.

"Manny" Manganese Sulfate, he captures bubbling Oxygen in water

Princess Iodine. A lady of many colors, and sometimes none.

Hypo Hugh (AKA Sodium Thiosulfate)
A magic potion that gives that turns Princess Iodine invisible.

Oxygen in Water

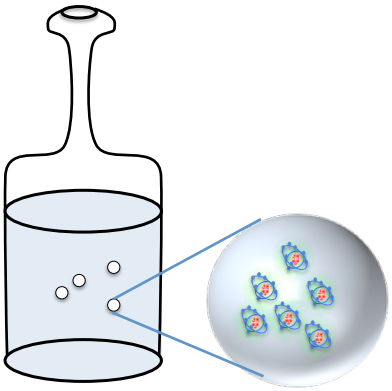


Oxygen is dissolved in water.
Fish need this Oxygen to live.
The amount of dissolved Oxygen is a key aspect of water quality.

Problem: How can we measure the amount of dissolved Oxygen?

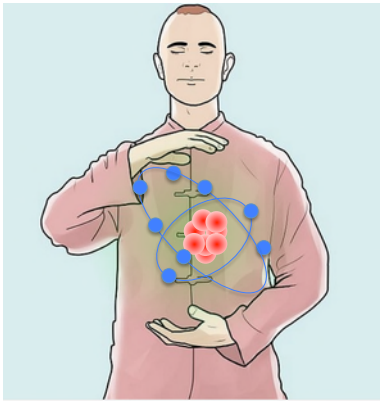
We start by taking a water sample in a bottle.

Oxygen
Dissolved in water is much too small to see. It also exists in very small amounts that is difficult to capture and measure.



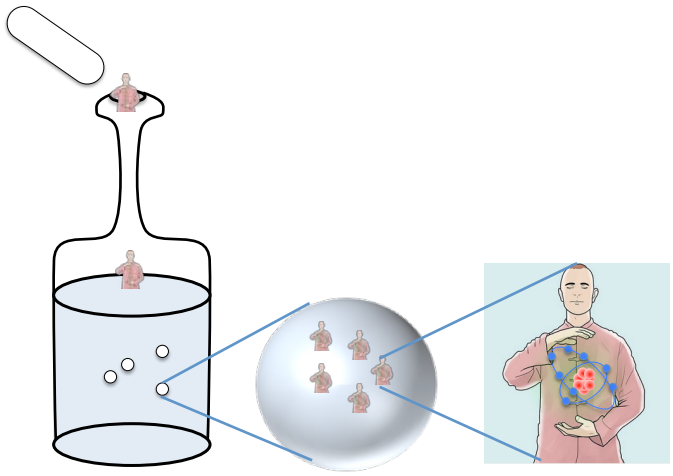
Oxygen Measurement
We have to use powerful detective work to capture and measure the Oxygen. First we must keep the Oxygen from bubbling away!

Enter Chemical 1. Capture the Oxygen

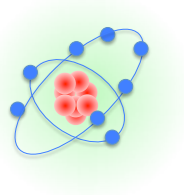


Enter "Manny" aka Manganese Sulfate. Manny is a chemical that captures Oxygen and keeps it from bubbling away.

We add Manny to the sample and he captures all of the Oxygen Atoms.
We add loads of Manny so that we know that all of the Oxygen Atoms are captured

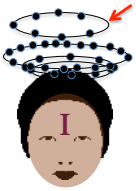


Some things to know about Oxygen and Iodine

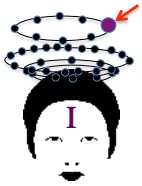


Oxygen is very hungry for more electrons.
It will readily accept electrons from others or make other elements share some of their electrons.

Princess Iodine and her Iodide Form



Princess Iodine has a crown of 53 electrons. In water she assumes her amber brown color.

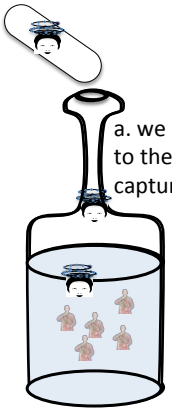


When Princess Iodine gets an extra electron in her crown she looses her amber brown color and we call her Iodide.

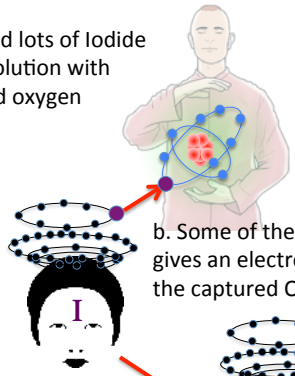
Iodide likes to share her extra electron, and when she does she turns visible again.

Hey wait a minute! Oxygen wants electrons, and Iodide is anxious to share hers so she can become visible. The Winkler plot thickens…

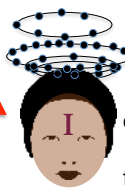
2. Iodide proves the presence of Oxygen



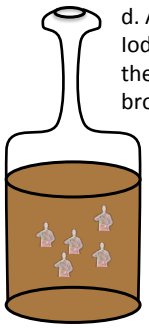
a. we add lots of Iodide to the solution with captured oxygen



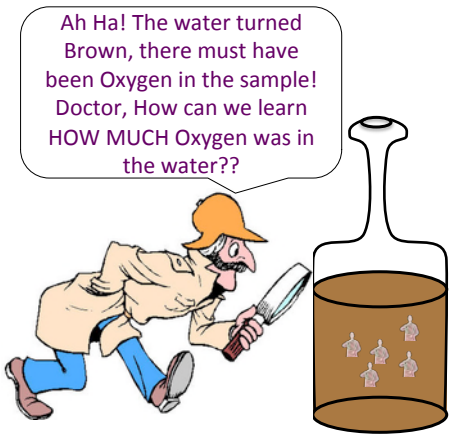
b. Some of the Iodide gives an electron to the captured Oxygen



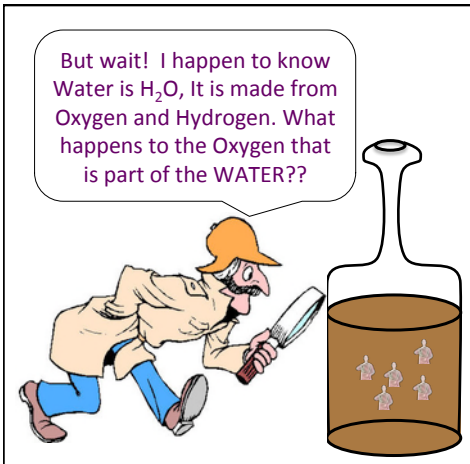
c. Without her extra electron, Iodide takes her **Iodine** form, gains her amber color and proves we had oxygen in the water!



d. Amber Iodine turns the water brown.



Elementary Chemistry Holmes, Iodide could only turn into **Iodine** if she had an Oxygen to accept her electron.
If we know how much Iodide turned into **Iodine** we know how much Oxygen there was in the first place.



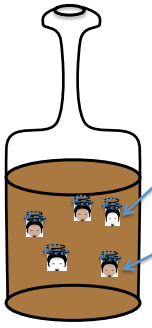
Good question Holmes! Oxygen bound to Hydrogen to make water cannot accept electrons from Iodide. That Oxygen is already sharing electrons with the Hydrogen. So only the bubbles of free Oxygen gas, captured by "Manny" can be used to change Iodide into **Iodine**

Chapter 3 Enter Hypo Hugh

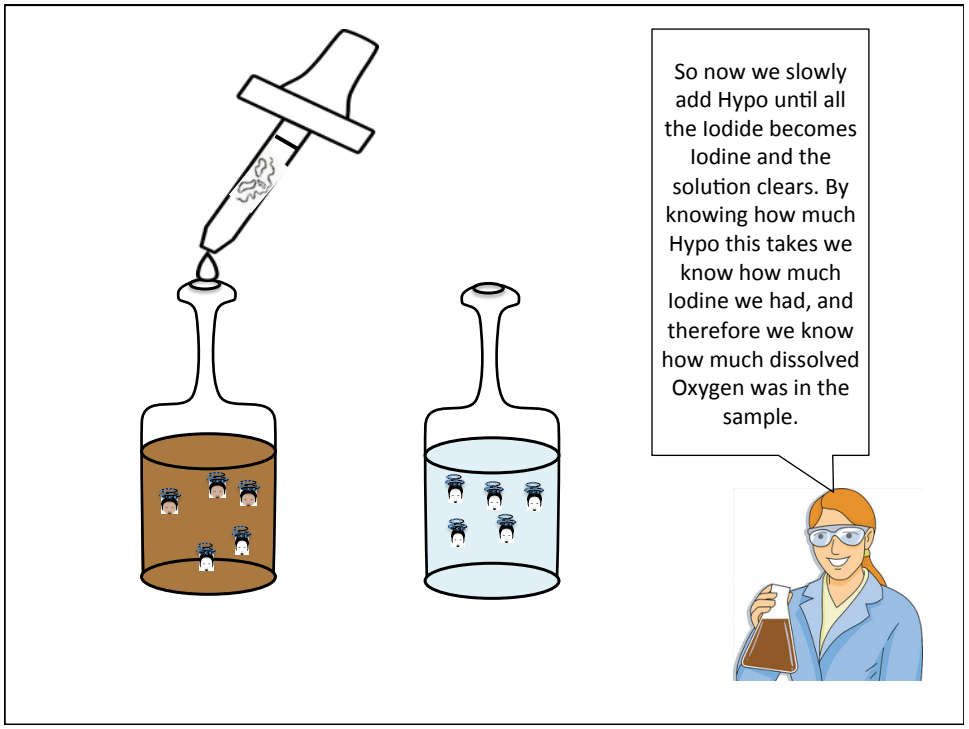
I have many names*, most folks call me Hypo.

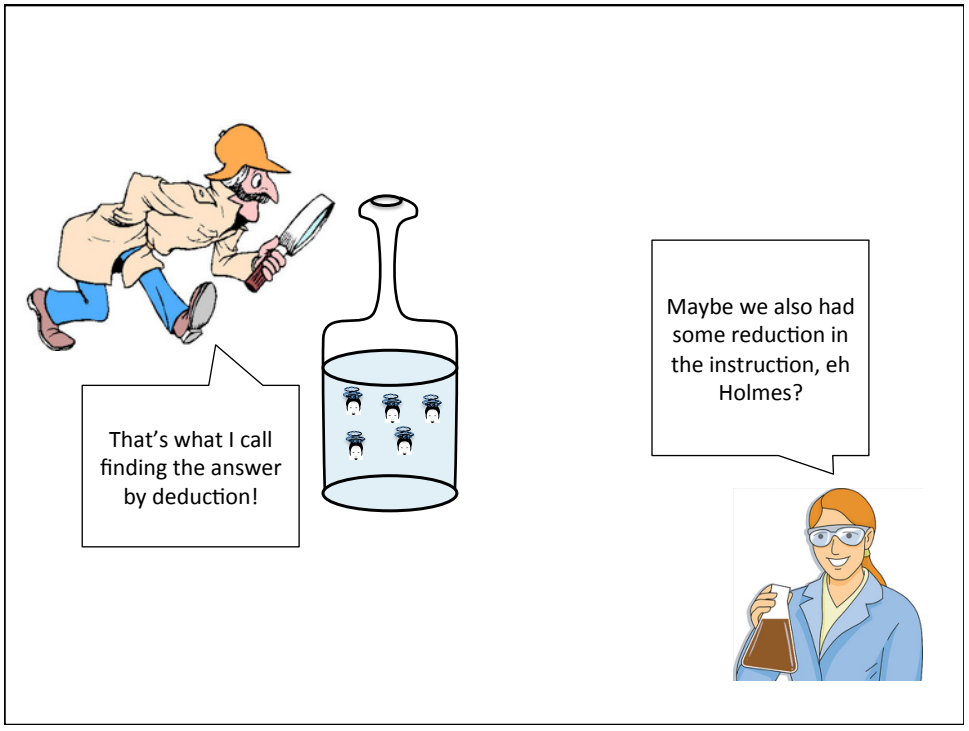
I like giving electrons to Iodine and turning her invisible! I always love a change of hue, call me Hypo Hugh!

*I got the name Hypo from my old name Hyposulfite. Modern chemists call me sodium thiosulfate ($Na_2S_2O_3$, but that is way to formal for me)



Remember, In the sample we added lots of Iodide. But only the atoms of Iodide that could find an atom of Oxygen to whom they gave an electron could change into **Iodine.** So we now have exactly as many atoms of **Iodine** as we had atoms of free Oxygen in the sample.


So now we slowly add Hypo until all the Iodide becomes Iodine and the solution clears. By knowing how much Hypo this takes we know how much Iodine we had, and therefore we know how much dissolved Oxygen was in the sample.


That's what I call finding the answer by deduction!
Maybe we also had some reduction in the instruction, eh Holmes?