% Sugar in Soda

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Soft Drinks

Average American drinks 53 gallons a year

US annual volume ~ 9.4 billion cases of soft drinks

US annual sales ~ $ 73.9 billion (27% world market)

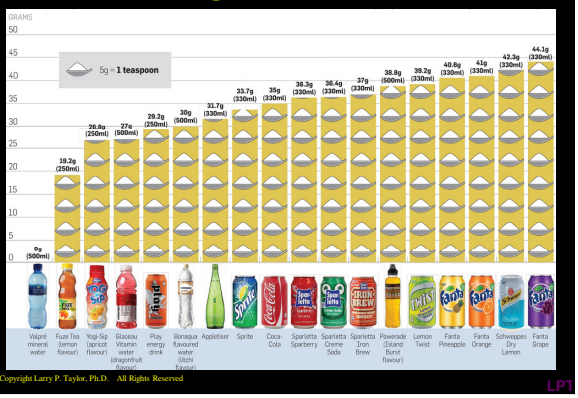
Coca Cola claims world-wide consumption: 16,000 drinks / sec

Coca Cola world's second most recognized trademark

Carbonation from American beverages annually add 800,000 tons of CO_2 to atmosphere

LPT

Sugar is Sweet



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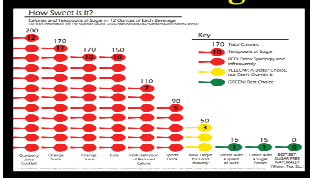
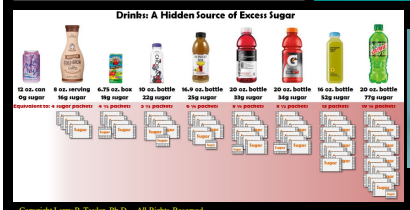
Sugar is Sweet





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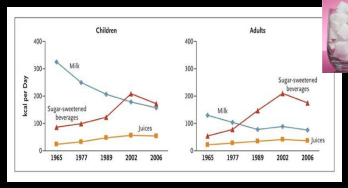
Sugar Consumption From Beverages

48 % of sugar consumption comes from beverages



Ave. Annual Consumption in US: 70,000 calories per person

$$70{,}000\ C \times \frac{1\ \text{pound of fat}}{3500\ C} = 20\ \text{pounds of fat}$$

$$70{,}000\ C \times \frac{1\ \text{mile}}{100\ C} = 700\ \text{miles}$$

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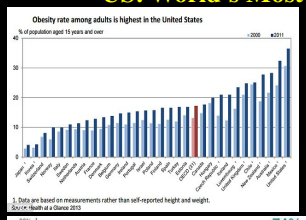
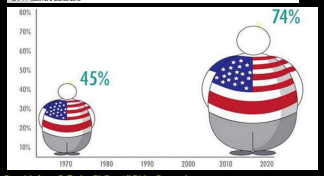
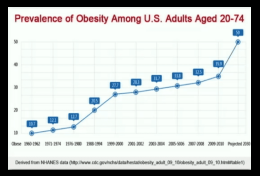
US: World's Most Obese Nation







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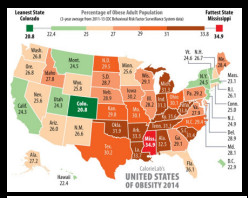
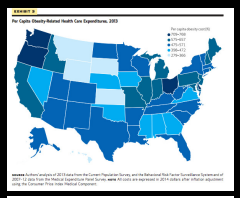
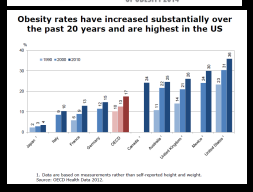
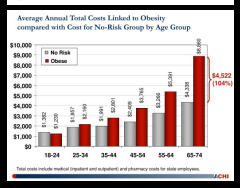
US: World's Most Obese Nation









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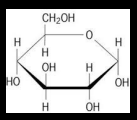
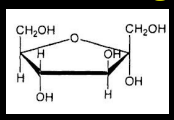
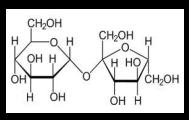
Common Sugars







Glucose	Fructose	Sucrose
Density: 1.54 g/cm^3	Density: 1.64 g/cm^3	Density: 1.59 g/cm^3
Sweetness: 74	Sweetness: 174	Sweetness: 100
$19.56 / kg	$10.00 / kg solid $0.54 / kg syrup	$57.60 / kg

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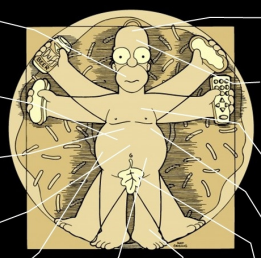
Fructose Physiological Issues



1. Tooth Decay
Mouth bacteria require Fructose to destroy teeth enamel. Without it decay is minimal

2. Leaky Gut
Fructose increases gut permeability leading to intestinal inflammation

3. Fatty Liver (and ultimately cirrhosis)
Fructose is metabolised to fat by the liver and stored in liver cells

4. Type II Diabetes
Fructose-fat increases insulin resistance which leads to high blood glucose and Type II Diabetes

5. Obesity
Prolonged insulin resistance leads to excess fat storage. Fructose also interferes directly with appetite control hormones

6. Kidney Failure
Fructose metabolism produces significant quantities of uric acid. Excess uric acid ultimately destroys kidney function.

7. Gout
Failure to remove uric acid results in it accumulating in the lower limbs and causing an acute arthritis called gout.

8. Erectile Dysfunction
Uric Acid depresses Nitric Oxide production. Nitric Oxide is necessary for proper erectile function

9. Hypertension
Uric Acid depresses Nitric Oxide production. Nitric Oxide is necessary to relax blood vessels and reduce blood pressure.

10. Heart Disease
Fructose consumption reduces LDL particle size, a known pre-cursor to heart failure.

11. Depression
Fructose produces a dopamine response which leads to a reduction in serotonin receptors leading to depression and anxiety.

12. Alzheimers
Fructose produces Advanced Glycation End products which result in Alzheimer's Disease (and aging).

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Density Depends On Concentration

Aquarium Salinity

Radiator Protection

Sugar in Maple Syrup

Alcohol in Moonshine

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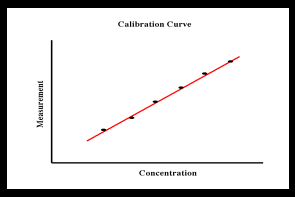
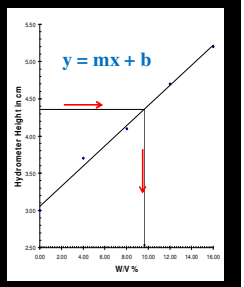
Calibration Curves
Plot Physical Property vs. Concentration





Plot is basis for analysis of unknowns
Measure physical property
Use substance to be analyzed
Find corresponding concentration

A Standard Curve is Common Technique of Chemical Analysis

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Quality Control

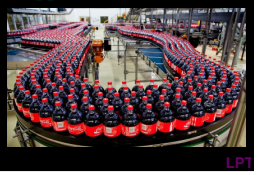
Important Commercial Process

Too little sugar → beverage bitter
Too much sugar → expensive syrup

Consequences of Analytical Error:

Too low – manufacturing adds sugar to product
Too high – Manufacturing removes sugar from process

Good quality control keeps everyone happy!



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I Like Sugar!
Keep this customer happy
Do a good analysis!
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Cravings
Cavities
Obesity
Diabetes
Allergy
% Sugar in Soda Lab
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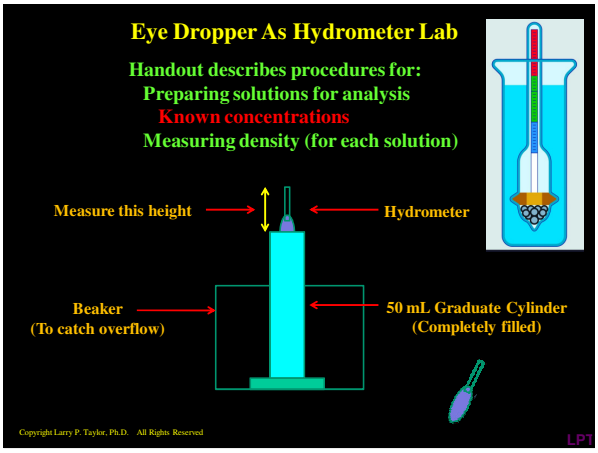
Eye Dropper As Hydrometer Lab
Handout describes procedures for:
Preparing solutions for analysis
Known concentrations
Measuring density (for each solution)
Measure this height
Hydrometer
Beaker
(To catch overflow)
50 mL Graduate Cylinder
(Completely filled)
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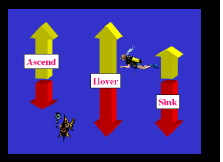
Remember Archimedes

An object partially or wholly immersed in a fluid, is buoyed up by a force equal to the weight of the fluid displaced by the object

Buoyancy

Weight



Objects Float Higher In More Dense Solutions

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Data

The mass / volume of the prepared solutions
The height of the hydrometer
Given to you (called doing a "dry lab")

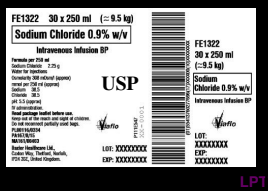
Calculations

% Sugar for each solution:

$$\frac{\text{Mass Sugar (grams)}}{\text{Volume of solution (mL)}} \times 100$$

Unit = % (m:v)

Solute: determined by weight (mass)
Solvent: determined by volume



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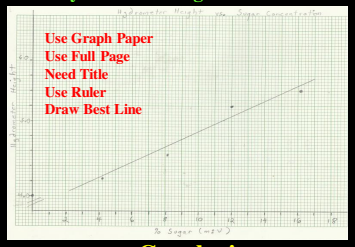
Results

Summary of calculations
Plot Hydrometer Height vs. Concentrations



Use Graph Paper
Use Full Page
Need Title
Use Ruler
Draw Best Line

Conclusion

Give % Sugar value of unknown

Questions

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Let's Boldly Go Explore Today's Lab

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