% 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

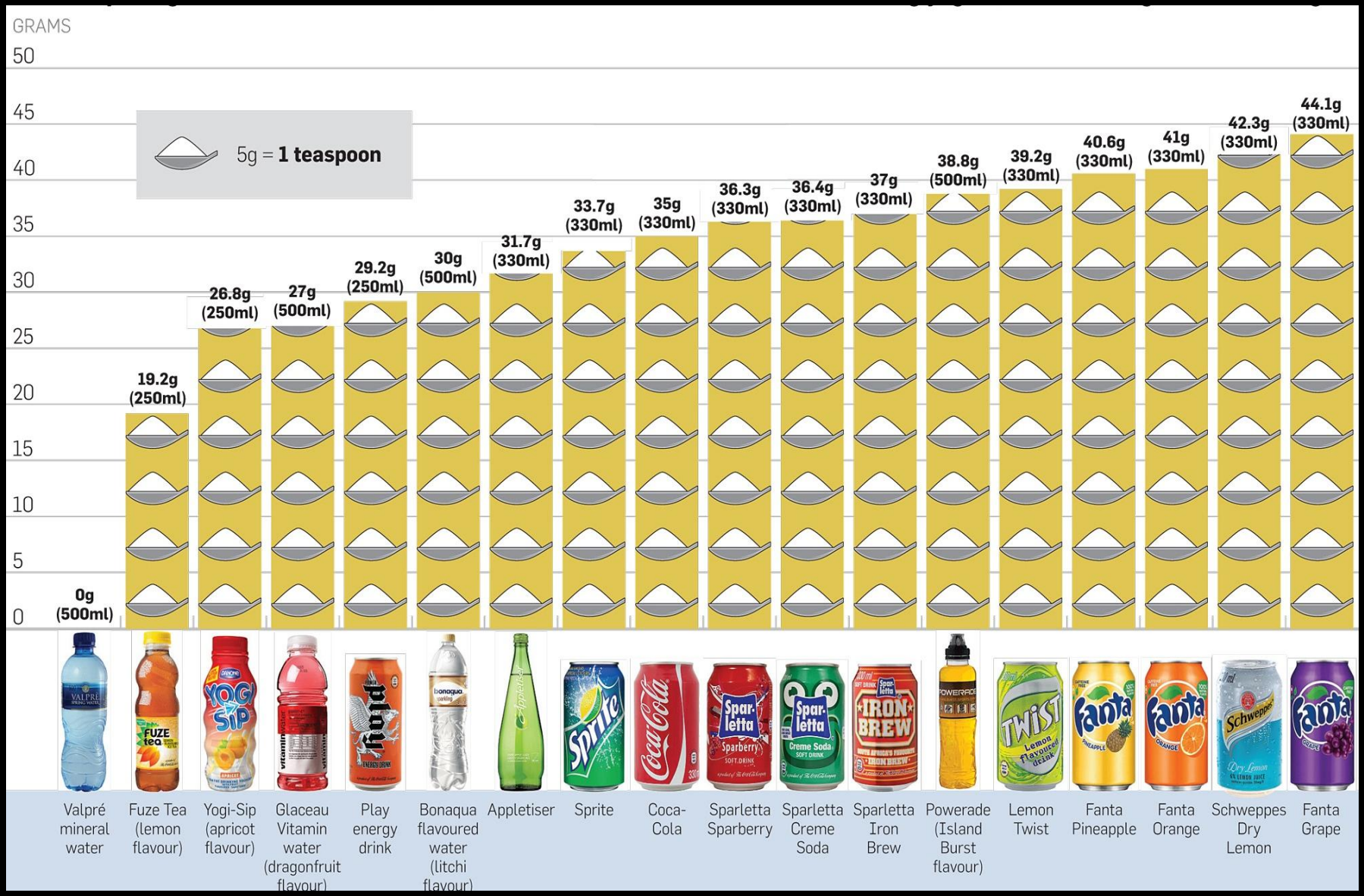
US annual sales ~ $ 73.9 billion (27% world market)

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

Sugar is Sweet



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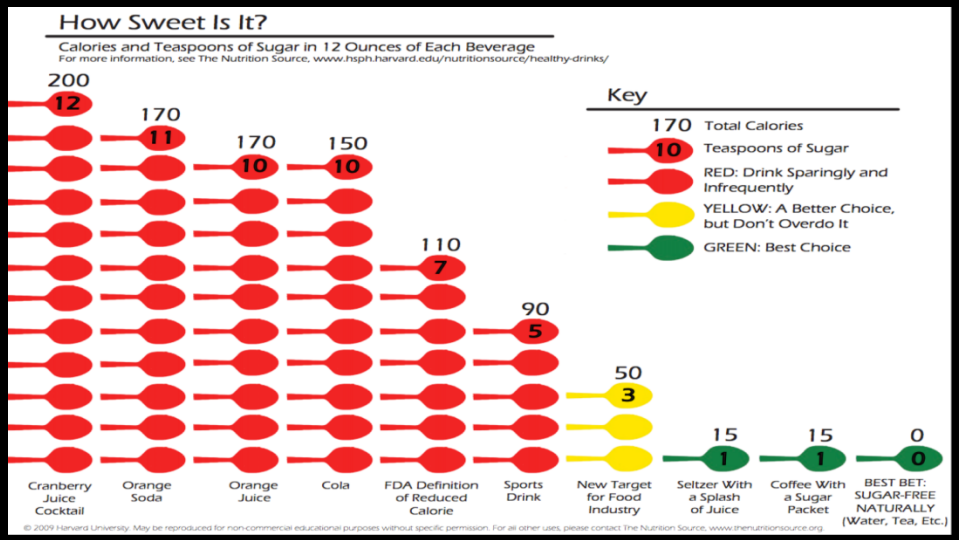
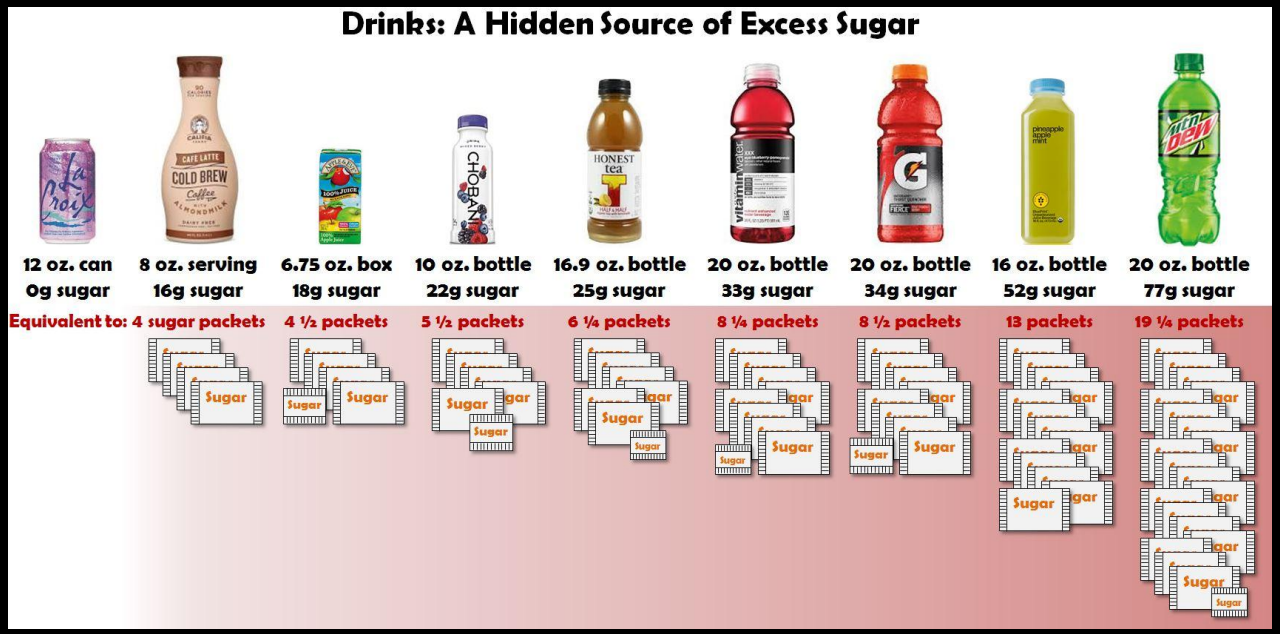
Sugar is Sweet





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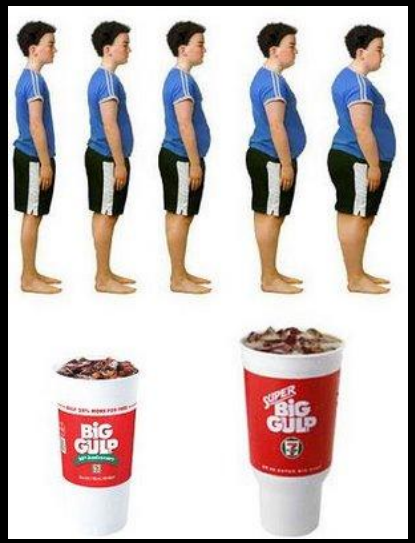
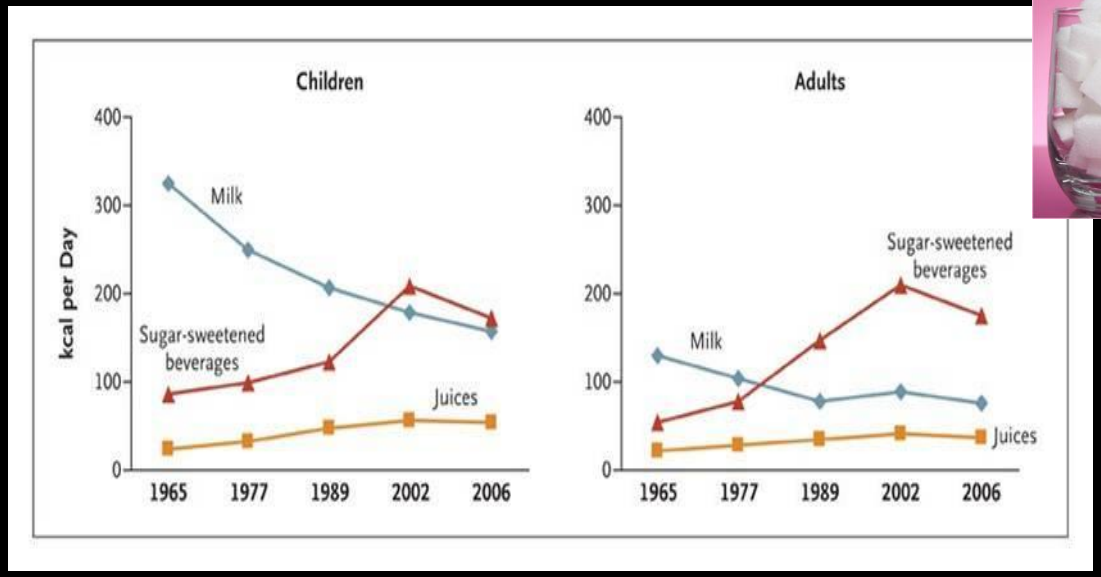
Sugar Consumption From Beverages

48 % of sugar consumption comes from beverages





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

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

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

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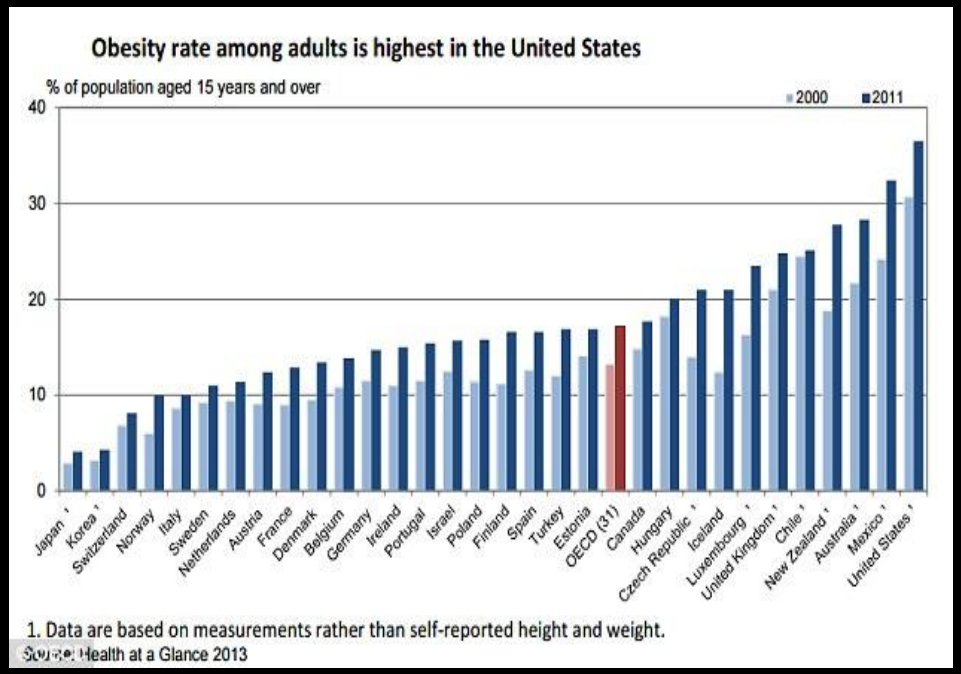
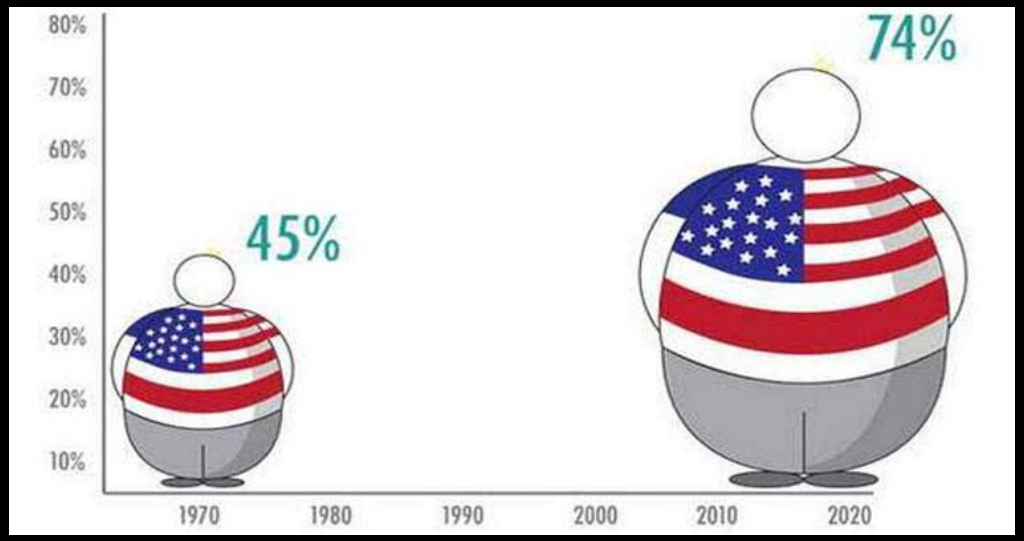
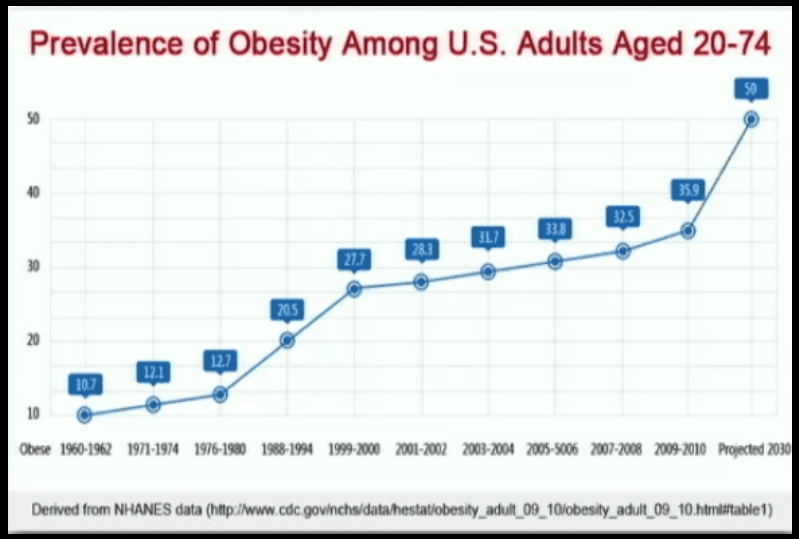
US: World's Most Obese Nation







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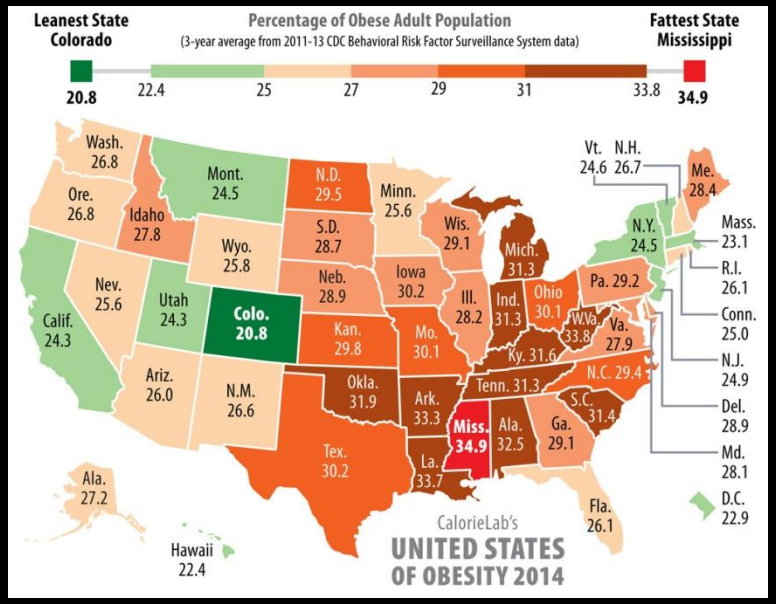
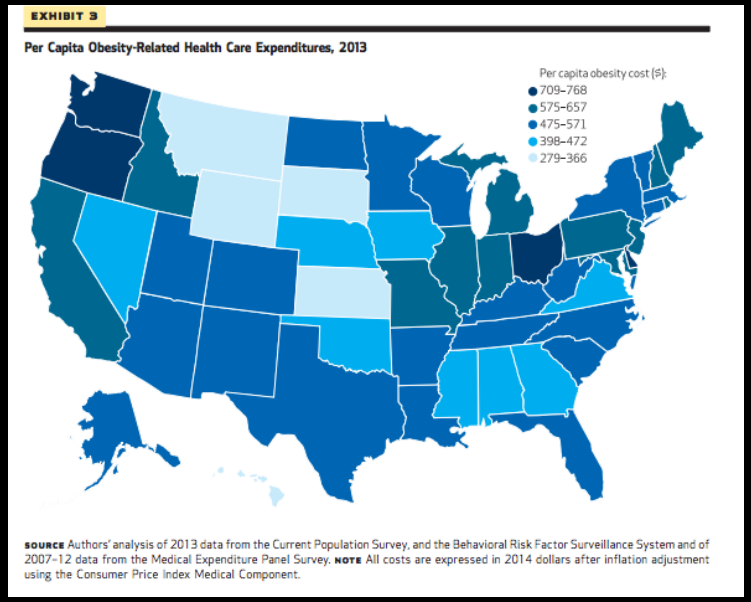
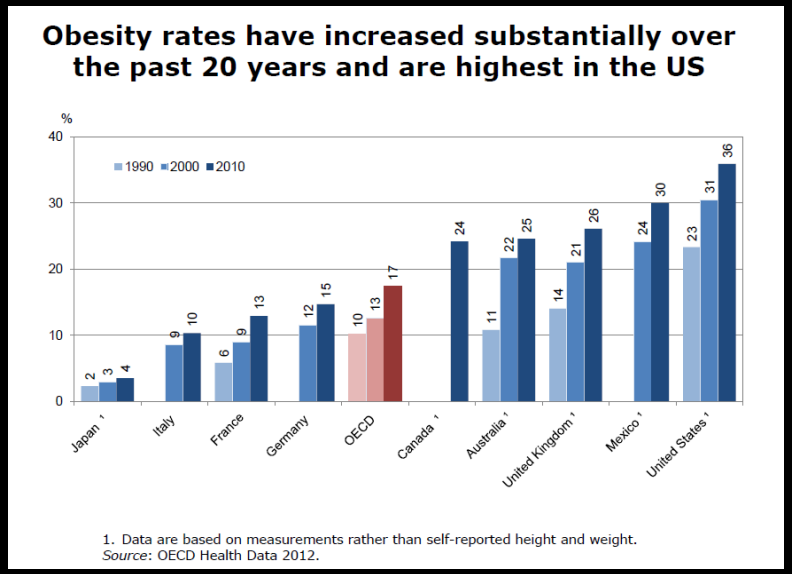
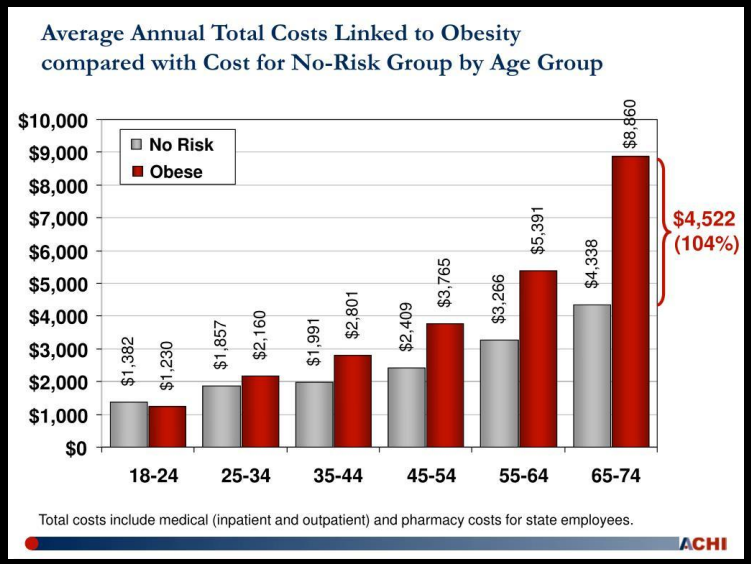
US: World's Most Obese Nation









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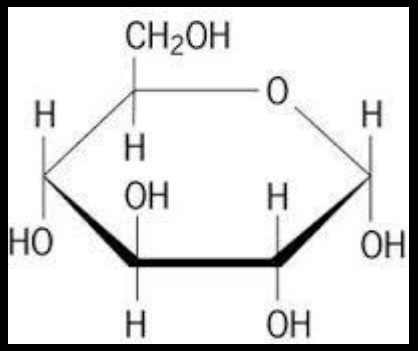
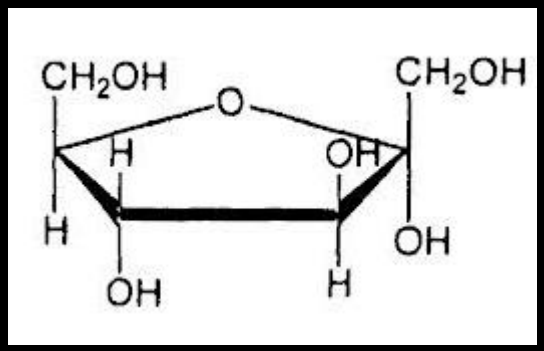
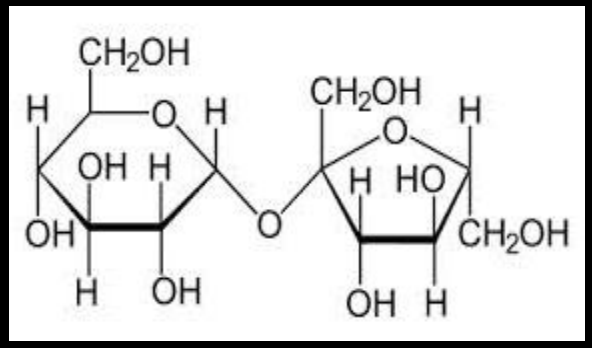
Common Sugars







Glucose

Density: 1.54 g/cm^3

Sweetness: 74

$19.56 / kg

Fructose

Density: 1.64 g/cm^3

Sweetness: 174

$10.00 / kg solid
$0.54 / kg syrup

Sucrose

Density: 1.59 g/cm^3

Sweetness: 100

$57.60 / kg

Fructose Physiological Issues

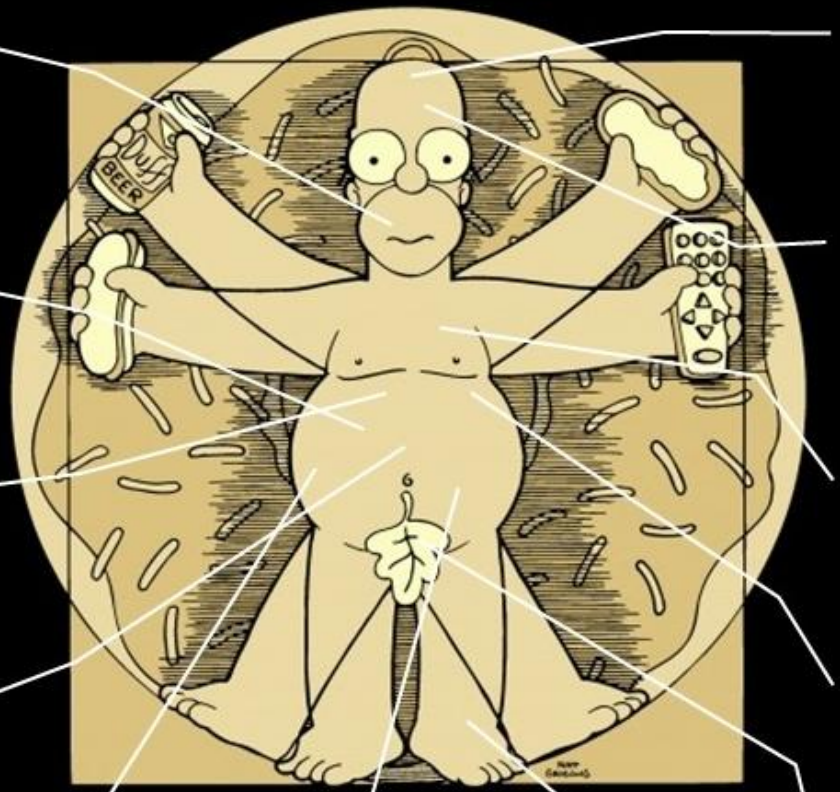
1. Tooth Decay
Mouth bacteria require Fructose to destroy teeth enamel. Without it decay is minimal

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

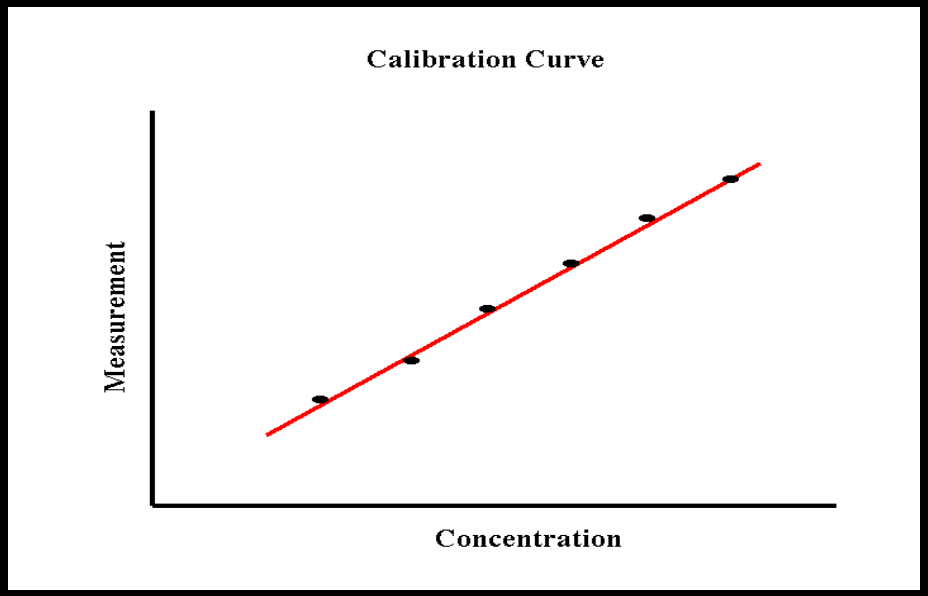
Radiator Protection

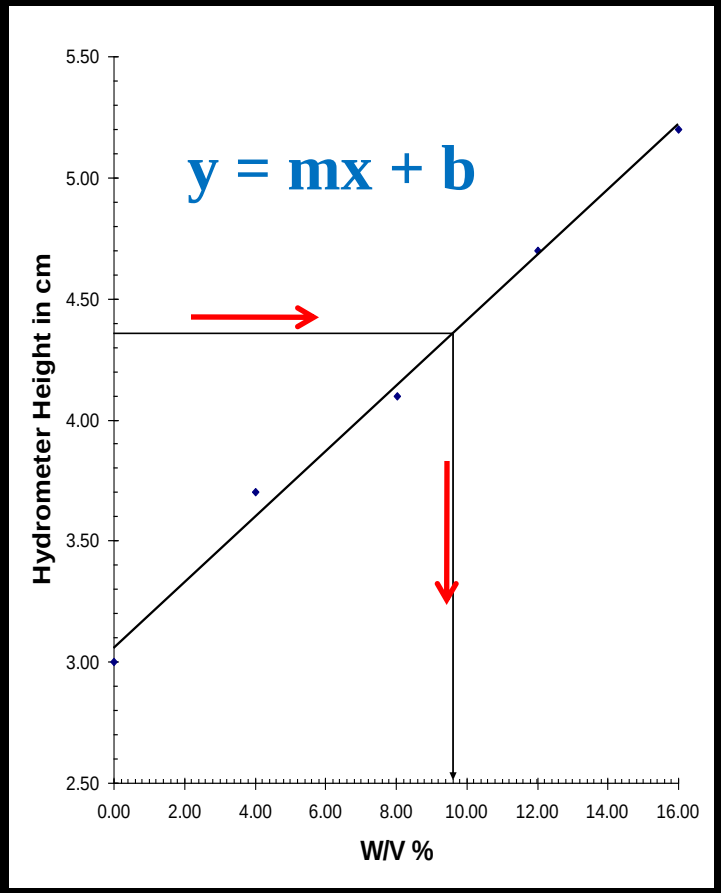
Sugar in Maple Syrup

Alcohol in Moonshine

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

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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Keep this customer happy

Do a good analysis!

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% Sugar in Soda Lab

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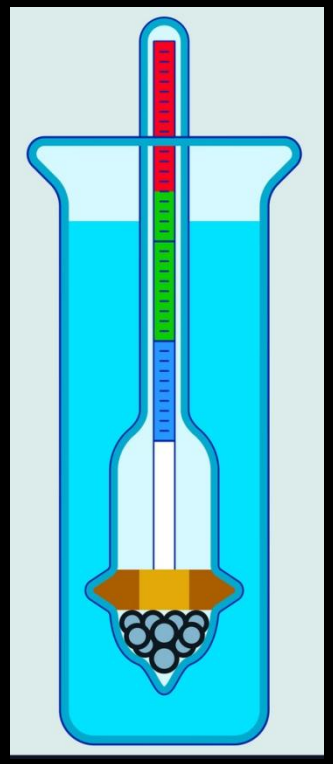
Eye Dropper As Hydrometer Lab

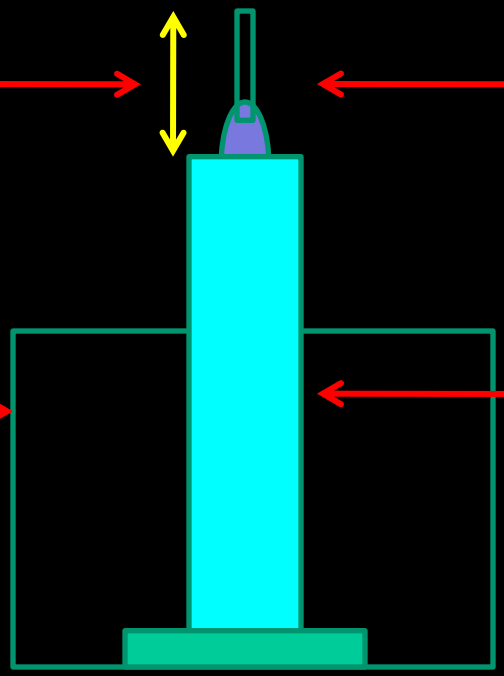
Handout describes procedures for:

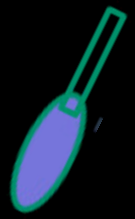
Preparing solutions for analysis

Known concentrations

Measuring density (for each solution)







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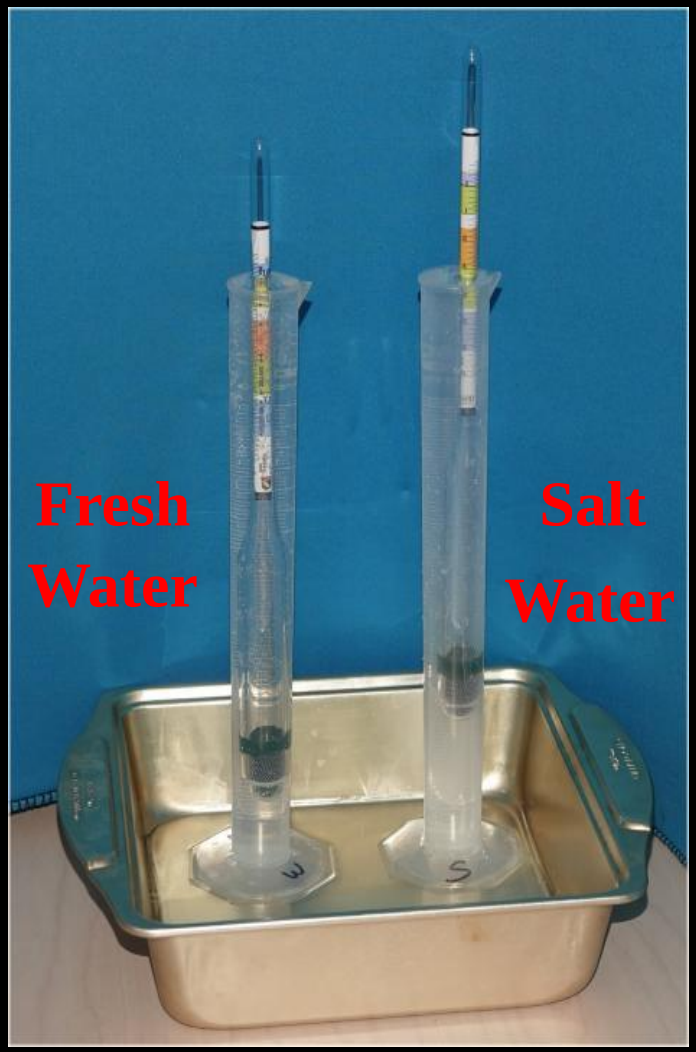
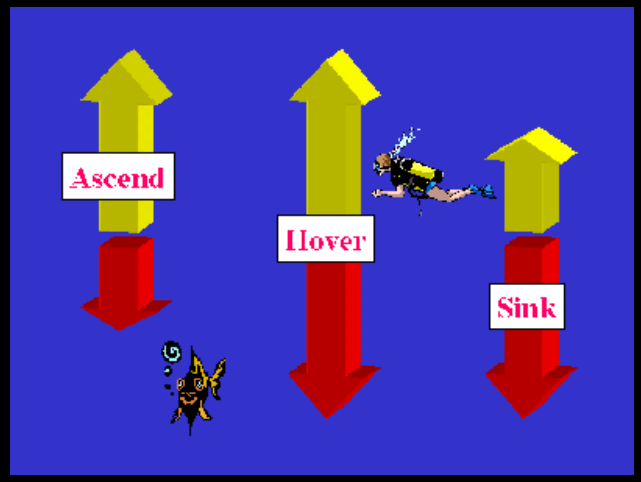
Remember Archimedes



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

Data

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

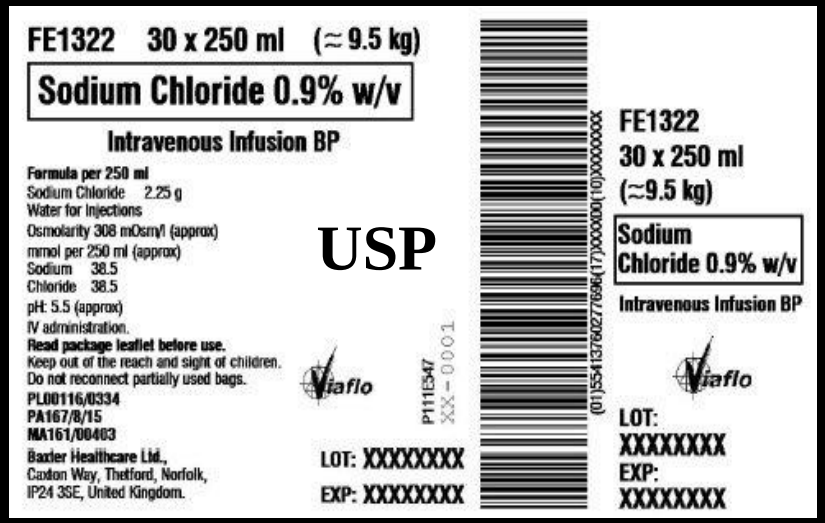
Calculations

% Sugar for each solution:

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

Unit = % (m:v)

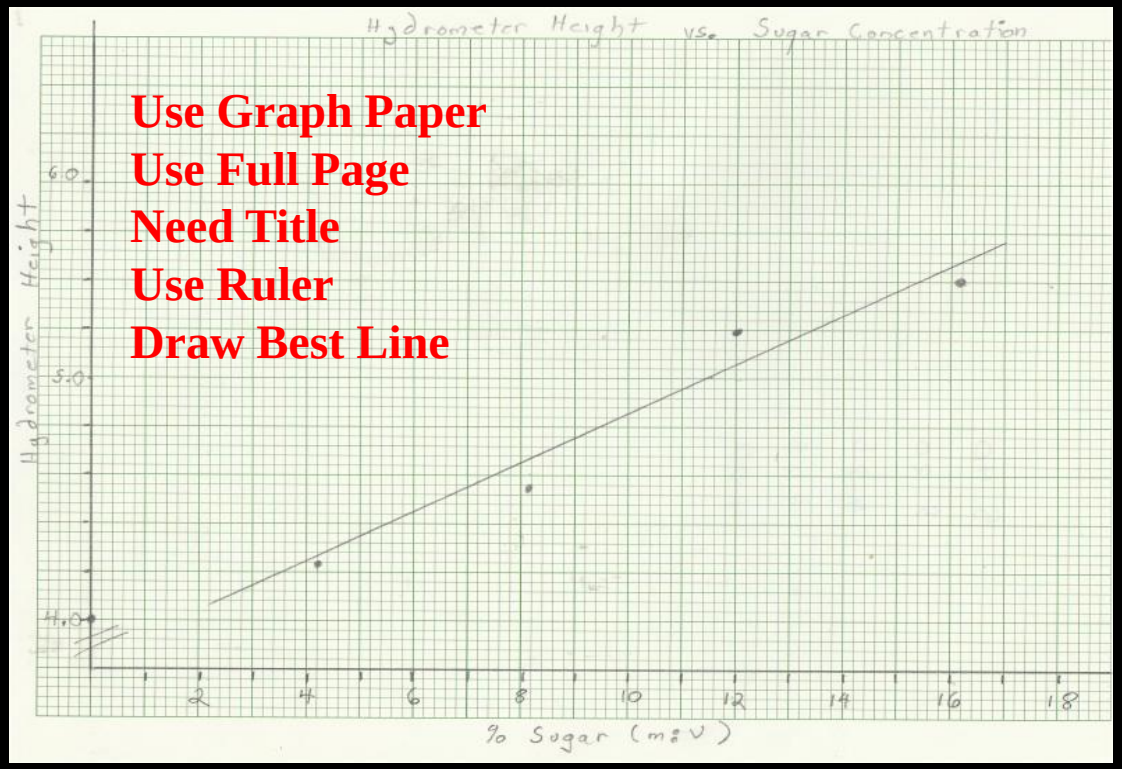
Solute: determined by weight (mass)
Solvent: determined by volume



Results

Summary of calculations

Plot Hydrometer Height vs. Concentrations



Conclusion

Give % Sugar value of unknown

Questions

Let’s Boldly Go Explore Today’s Lab