



$$Q = K \frac{\text{Head Difference}}{\text{Distance between Heads}} \text{Area}$$

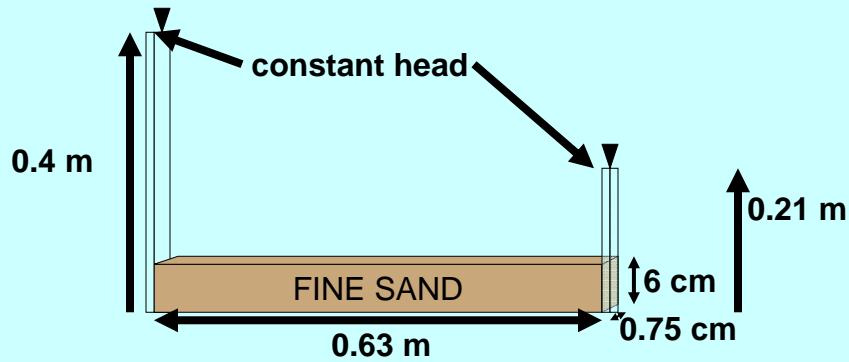
$$Q = \frac{0.01 \text{ cm}}{\text{sec}} \frac{0.19 \text{ m} \cdot 6 \text{ cm} \cdot 0.75 \text{ cm}}{0.63 \text{ m}} \frac{1 \text{ liter}}{1000 \text{ cm}^3} \frac{86400 \text{ sec}}{\text{day}} = 1.17 \frac{\text{liter}}{\text{day}} = \frac{1 \text{ liter}}{\text{day}}$$

*cm<sup>3</sup>/sec? how about liters? days?*

*Might vary up and down and order of magnitude* *significant figures?*

[http://en.wikipedia.org/wiki/Hydraulic\\_conductivity#Ranges\\_of\\_values\\_for\\_natural\\_materials](http://en.wikipedia.org/wiki/Hydraulic_conductivity#Ranges_of_values_for_natural_materials)

$$\frac{1 \text{ liter}}{\text{day}} \frac{0.26 \text{ GAL}}{1 \text{ liter}} \frac{1 \text{ day}}{1440 \text{ min}} = 0.0001 \frac{\text{GAL}}{\text{MIN}} \text{ (GPM) about } \frac{3}{4} \text{ teaspoons minute}$$



## Converting Units

3.6 feet >> to >> inches?

feet \* 12 = inches

$$3.6 \text{ feet} \cdot \frac{12 \text{ inches}}{1 \text{ foot}} = 43 \text{ inches}$$

3.6 cms = cubic meters per second ... to ... LPM = liters per minute?

cms \* ?

you may know some relationships and take a long route

$$\begin{aligned} 3.6 \frac{\cancel{\text{m}^3}}{\cancel{\text{sec}}} * \frac{\cancel{100 \text{ cm}}}{\cancel{1 \text{ m}}} * \frac{\cancel{100 \text{ cm}}}{\cancel{1 \text{ m}}} * \frac{\cancel{100 \text{ cm}}}{\cancel{1 \text{ m}}} * \frac{\cancel{1 \text{ ml}}}{\cancel{1 \text{ cm}^3}} * \frac{\cancel{1 \text{ liter}}}{\cancel{1000 \text{ ml}}} * \frac{\cancel{60 \text{ sec}}}{\cancel{1 \text{ min}}} = \\ = 216,000 \frac{\text{liter}}{\text{min}} \quad \sim 220,000 \frac{\text{liter}}{\text{min}} \end{aligned}$$

OR:

$$3.6 \frac{\cancel{\text{m}^3}}{\cancel{\text{sec}}} * \frac{1000 \text{ liter}}{\cancel{1 \text{ m}^3}} * \frac{\cancel{60 \text{ sec}}}{\cancel{1 \text{ min}}} = \sim 220,000 \frac{\text{liter}}{\text{min}}$$

### Get a “feel” for Units and Magnitudes

How many minutes do you manage each day?

$$1440 \frac{\text{min}}{\text{day}}$$

How many seconds each day?

$$86,400 \frac{\text{sec}}{\text{day}}$$

How many gallons are in a cubic foot?

$$7.48 \frac{\text{ft}^3}{\text{gal}}$$

How much does a cubic foot of water weigh?

$$62.4 \frac{\text{lbs}}{\text{ft}^3}$$

If you stand on the foot bridge over Clear Creek today,  
how many cubic feet of water pass under you each second?

“google” : streamflow Clear Creek Golden CO

[http://waterdata.usgs.gov/co/nwis/dv/?site\\_no=06719505&PARAMeter\\_cd=00060](http://waterdata.usgs.gov/co/nwis/dv/?site_no=06719505&PARAMeter_cd=00060)

How many gallons is that in a minute?



Large Volumes of Water are better understood in alternate units  
Such as Acre-Feet

Work with someone nearby - Take 5 min to convert

**5000 AFY = Acre feet per year > to > GPM Gallons per minute**

Conversion books / Dictionary / Web Search

AFY \* ? .... One source of information:

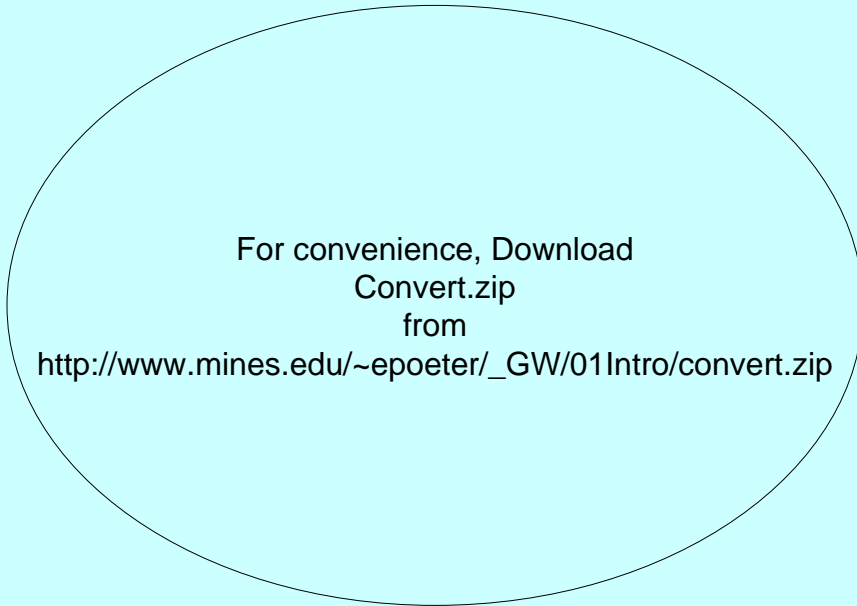
<http://www.unc.edu/~rowlett/units/dictA.html>

$$5000 \frac{\text{acre-ft}}{\text{yr}} * \frac{43560\text{ft}^2}{1 \text{ acre}} * \frac{7.48 \text{ gallons}}{1 \text{ ft}^3} * \frac{1 \text{ hr}}{60\text{min}} * \frac{1\text{day}}{24\text{hr}} * \frac{1 \text{ yr}}{365\text{day}}$$

~ 3000 gallon  
min or with 1440min & ~200gal enough for  
day home-day ~22,000 homes

**Handy Hydro Conversions:**

$$\frac{7.48 \text{ gallons}}{1 \text{ ft}^3} \quad \frac{62.4 \text{ lb}}{1 \text{ ft}^3} \quad \frac{8.34\text{lb}}{1 \text{ gal}} \quad \frac{86,400\text{sec}}{1 \text{ day}} \quad \frac{1440 \text{ min}}{1 \text{ day}} \quad \frac{1 \text{ m}}{3.28\text{ft}}$$



**ESTIMATE:**

**Flow from your kitchen faucet**

**Flow from your garden hose**

**Flow from a gasoline pump at a gas station**

**Flow in Clear Creek Today**

**ESTIMATE:**

**Flow from your kitchen faucet ~ 2-3 GPM**

**Flow from your garden hose ~ 2-5 GPM**

**Flow from a gasoline pump ~ 10 GPM Flow in**

**Flow Clear Creek Today – what was it?**



## Significant Figures

Non-zero digits are always significant.

Any zeros between two significant digits are significant.

A final zero or trailing zeros in the decimal portion ONLY are significant.

### Adding and Subtracting:

Count the number of significant figures in the decimal portion of each number

Add or subtract in the normal fashion.

Round the answer to the LEAST number of significant figures in the decimal portion of any number in the problem.

$$16.204 + 2.3 = 18.504 \quad * \quad 18.5$$

### Multiplying and Dividing:

The LEAST number of significant figures in any number of the problem determines the number of significant figures in the answer.

$$16.204 * 2.3 = 37.2692 \quad * \quad 37.$$



## Rounding-Off

Examine the figure to the right of the figure that you are rounding off to.  
If it is less than 5, drop it and all the figures to the right of it.  
If it is more than 5, increase the last figure of the number by 1.  
If it is 5 and any nonzero figures follow the 5, increase the last figure of the number by 1.  
If it is 5 and NO nonzero figures follow the 5, then:  
if the last figure is even leave it unchanged, while  
if the last figure is odd increase it by 1.

**Round off the following to 3 significant figures**

	34.38	→	34.4	
	34.35	→	34.4	
note	34.34	→	34.3	
difference				
here	34.48	→	34.5	
	34.45	→	34.4	
	34.44	→	34.4	

as is often expected