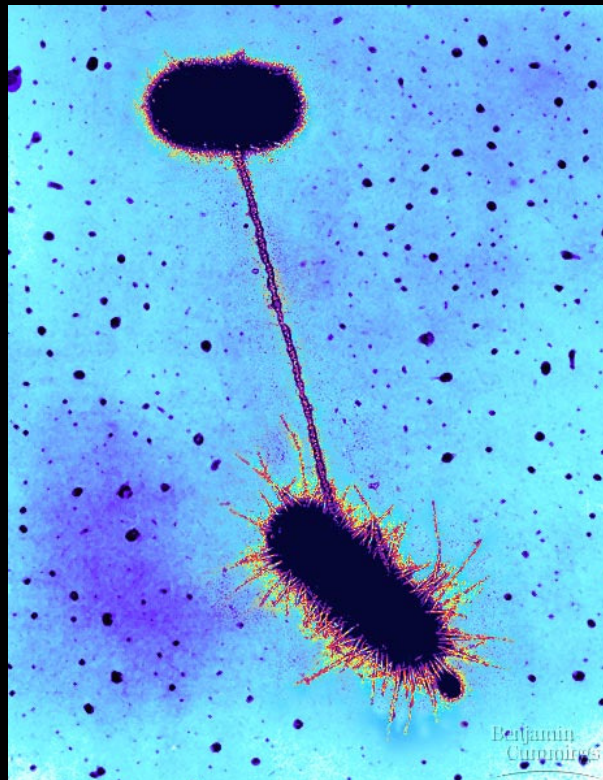


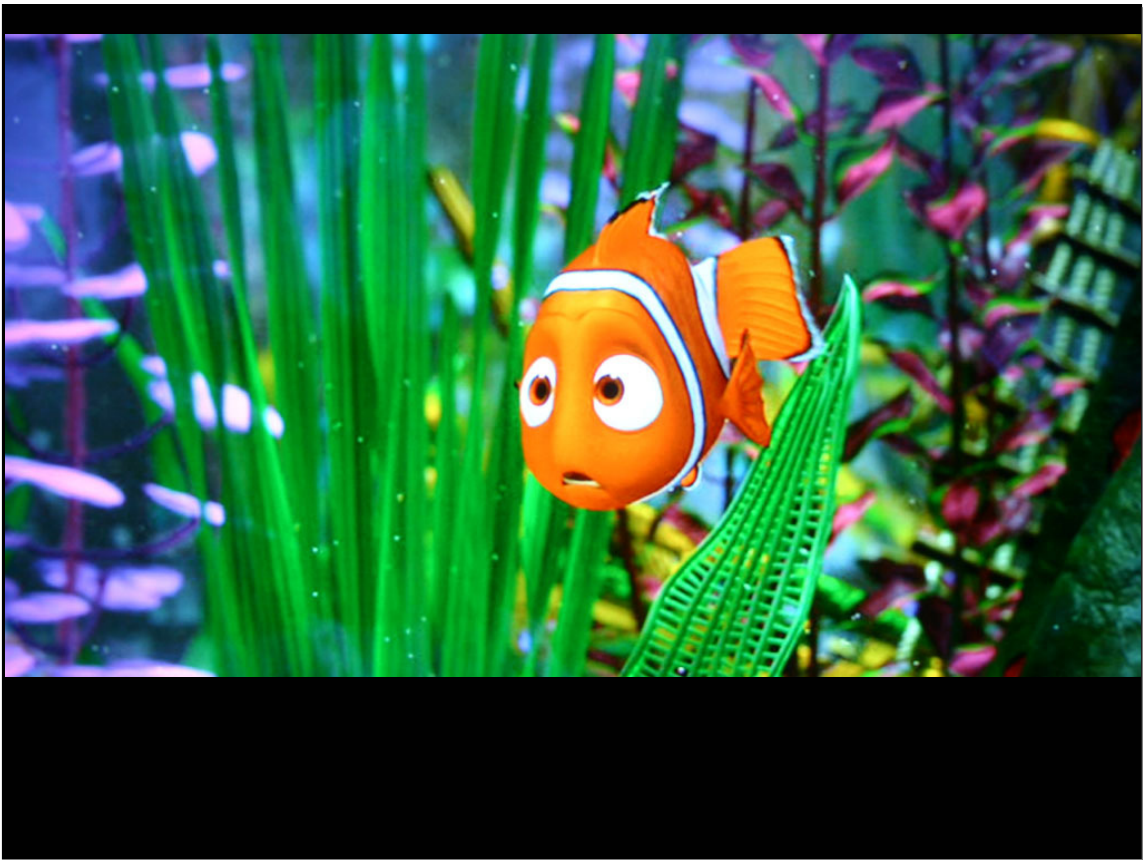
logarithms make
large and small
numbers manageable.

We're going to talk about the
history of life on earth



in the beginning...







Event	Years ago the Event happened
Prokaryotic cell organisms develop	3,000,000,000
Eukaryotic cell organisms develop	1,500,000,000
Rise of the fish--first vertebrates	500,000,000
Winged insects have evolved	300,000,000
Appearance of mammals	200,000,000
Primitive monkeys have evolved	50,000,000
The chimpanzee and hominid lines evolve	15,000,000
<i>Homo erectus</i> exist	1,000,000
<i>Homo erectus</i> tames fire	500,000
<i>Homo sapiens sapiens</i> exist	50,000
<i>Homo sapiens sapiens</i> learn to use fire to cast copper	9,772
Writing is developed in Sumeria	6,000

You, science journalists, want to make a timeline of this data.

1. On a blank sheet of graph paper, draw a straight horizontal line. Label one end 3,000,000,000 and the other end 0.

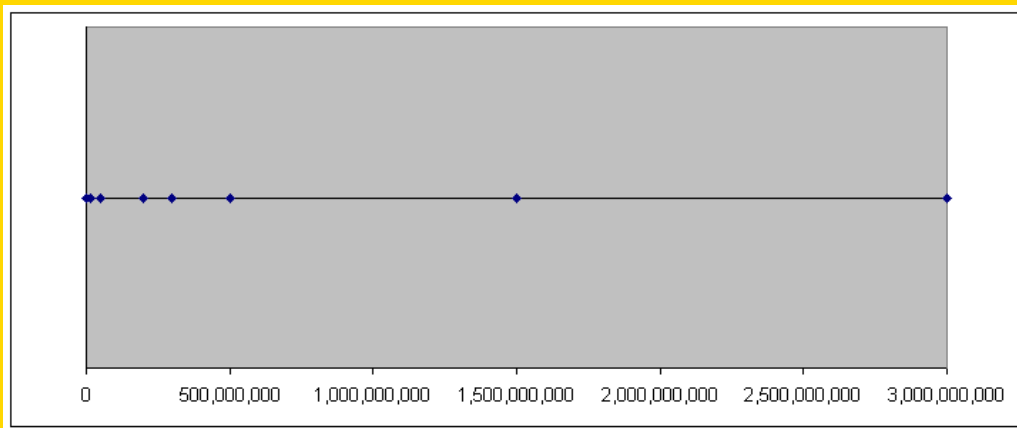
- 2.** Divide the timeline into intervals of 500,000,000 years.

- 3.** Start labeling the events on the timeline. Be VERY accurate.

Event	Years ago the Event happened
Prokaryotic cell organisms develop	3,000,000,000
Eukaryotic cell organisms develop	1,500,000,000
Rise of the fish--first vertebrates	500,000,000
Winged insects have evolved	300,000,000
Appearance of mammals	200,000,000
Primitive monkeys have evolved	50,000,000
The chimpanzee and hominid lines evolve	15,000,000
<i>Homo erectus</i> exist	1,000,000
<i>Homo erectus</i> tames fire	500,000
<i>Homo sapiens sapiens</i> exist	50,000
<i>Homo sapiens sapiens</i> learn to use fire to cast copper	9,772
Writing is developed in Sumeria	6,000

YESS!

You, **science journalist**, have done something amazing! You have represented this data so that it is useful to the public!



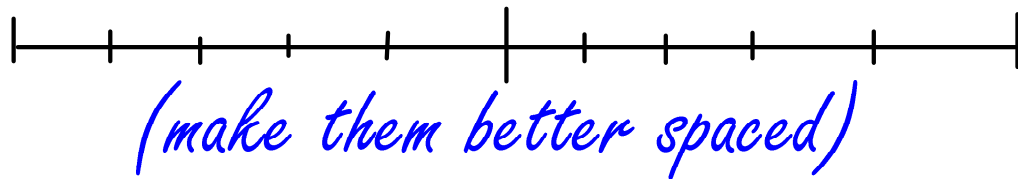
As readers, what will we take away from this chart?

WAIT!

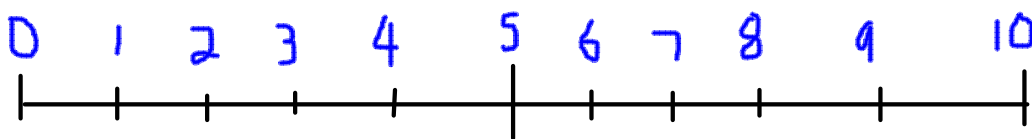
AAACK!

Make a new timeline.

1. Divide the timeline into 10 equally spaced regions. (11 tickmarks)
2. Below each tickmark, label: 1st tickmark 10^0 ; 2nd tickmark 10^1 ; 3rd tickmark 10^2 ; ... ; 11th tickmark 10^{10}



3. above each tickmark, label the exponent!



We're going to label each of these data points using the amazing logarithmic property!

logarithms make
large and small
numbers manageable.

Recall, logarithms are exponents!

$a^x = b$ is the same thing as saying: $x = \log_a b$

What exponent do we raise 10 to for each historic event?

Prokaryotic organisms develop

$$10^{???} = 3,000,000,000$$

Prokaryotic organisms develop

$$10^{???} = 3,000,000,000$$

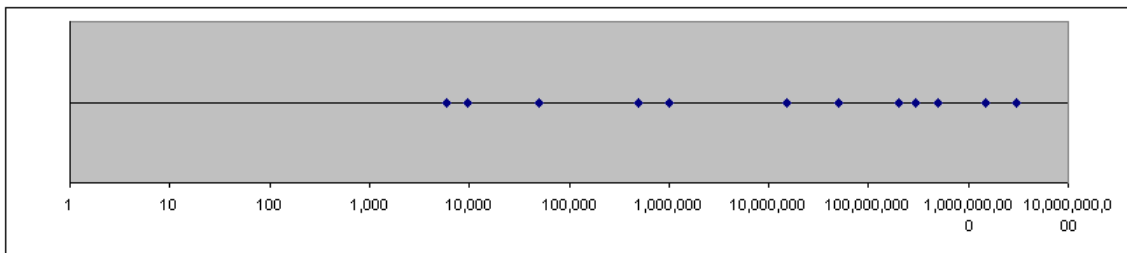
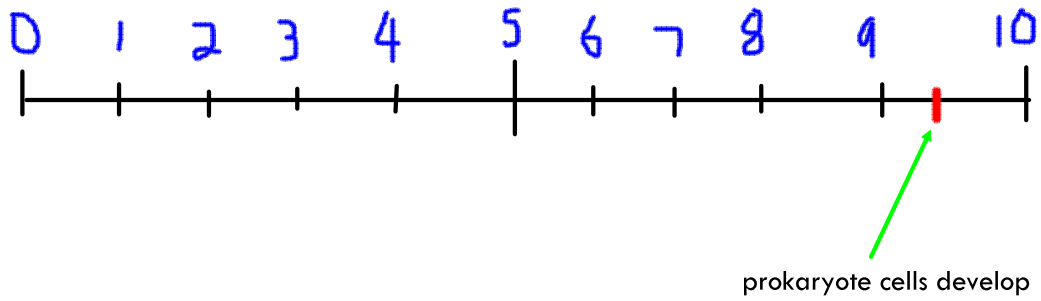
$$??? = \log_{10} 3,000,000,000$$

$$??? \approx 9.477121255$$

Prokaryotic cell organisms develop	3,000,000,000
Eukaryotic cell organisms develop	1,500,000,000
Rise of the fish--first vertebrates	500,000,000
Winged insects have evolved	300,000,000
Appearance of mammals	200,000,000
Primitive monkeys have evolved	50,000,000
The chimpanzee and hominid lines evolve	15,000,000
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<i>Homo erectus</i> tames fire	500,000
<i>Homo sapiens sapiens</i> exist	50,000
<i>Homo sapiens sapiens</i> learn to use fire to cast copper	9,772
Writing is developed in Sumeria	6,000

9.477121	Prokaryotic cell organisms develop	3,000,000,000
9.176091	Eukaryotic cell organisms develop	1,500,000,000
8.69897	Rise of the fish--first vertebrates	500,000,000
8.477121	Winged insects have evolved	300,000,000
8.30103	Appearance of mammals	200,000,000
7.69897	Primitive monkeys have evolved	50,000,000
7.176091	The chimpanzee and hominid lines evolve	15,000,000
6	<i>Homo erectus</i> exist	1,000,000
5.69897	<i>Homo erectus</i> tames fire	500,000
4.69897	<i>Homo sapiens sapiens</i> exist	50,000
3.99	<i>Homo sapiens sapiens</i> learn to use fire to cast copper	9,772
3.778151	Writing is developed in Sumeria	6,000

4. Plot these points on your new graph!



As readers, what will we take away from this chart?

Which chart is better?

The first one or the second one?

Why?

NASDAQ

Look at the following graph.

When did the market crash?



I'm going to plot this data on a logarithmic scale.

What years did the market crash?



MORAL:

Plotting on a logarithmic scale is useful when you have very large and very small data.

3 or more orders of magnitude!

homework questions?

