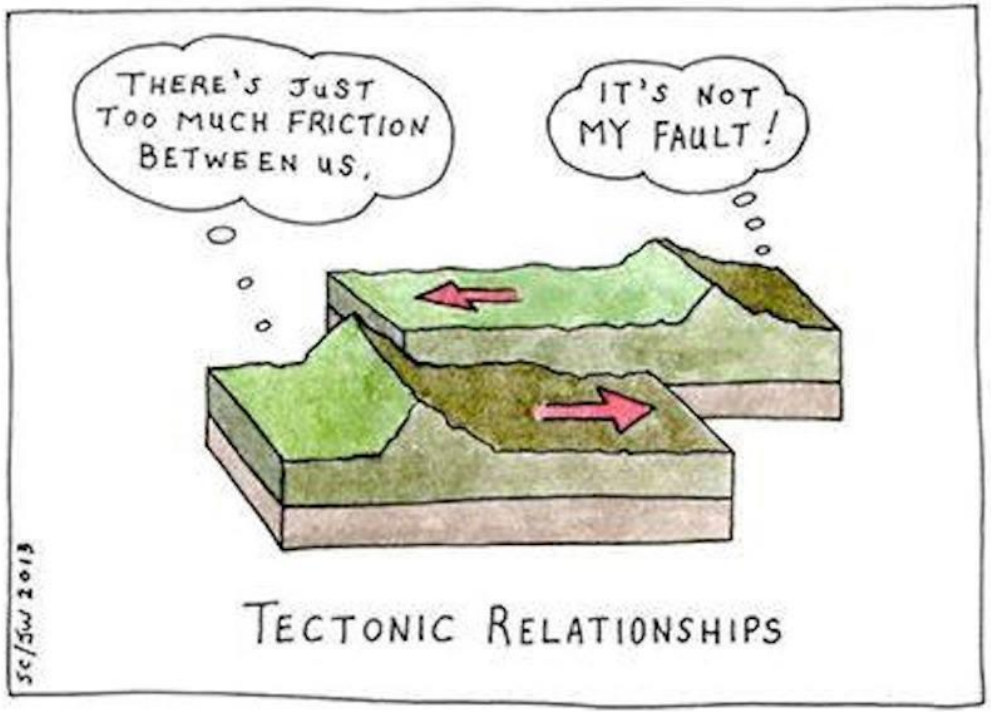
What makes earthquakes?


THERE'S JUST TOO MUCH FRICTION BETWEEN US.
IT'S NOT MY FAULT!
SC/SW 2018
TECTONIC RELATIONSHIPS

Real life earthquakes

Current earthquakes around the world: https://earthquake.usgs.gov/earthquakes/map/?extent=-60.58697,-308.67188&extent=82.94033,118.82813

Past earthquakes around the world: https://seismic-explorer.concord.org/

Find data on past earthquakes: https://www.usgs.gov/programs/earthquake-hazards/lists-maps-and-statistics

Remember to pick one earthquake in the past and research into that one earthquake.

Questions to research into about your earthquake:

1. When did it happen?

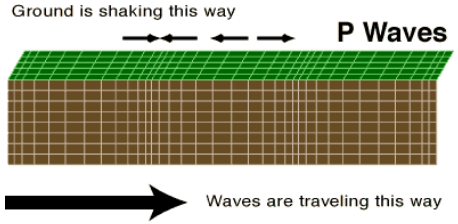
Sharing time

What earthquake did you research?

What did you find out about that earthquake?

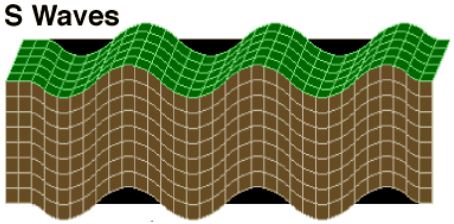
Bring a slinky and uncooked spaghetti noodles to class tomorrow.

Types of Seismic Waves



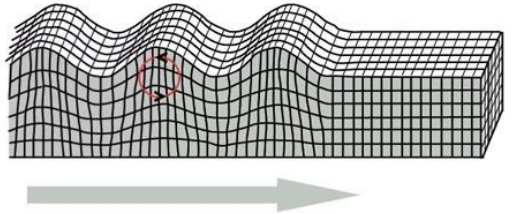
P Waves

First to show up and are compression waves



S Waves

Second to show up and move up or down/side to side



Surface Waves

Last to arrive but most destructive and are circular

Seismic Waves

Now let’s create the waves using a Slinky!

If you need to go grab one, I shall wait for you.

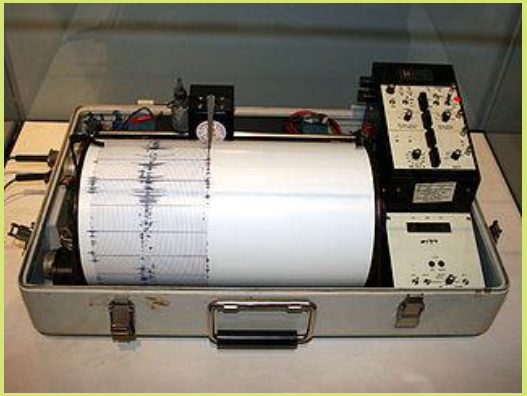
Don’t have one? Just watch!

Analyzation

What is accurate about this model?

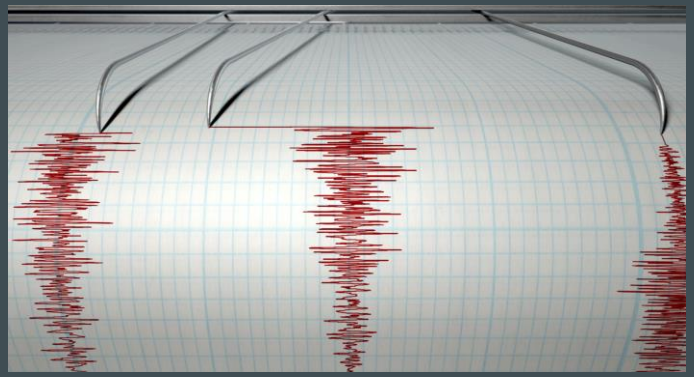
What is inaccurate about this model?

Visualizing Earthquakes



Seismograph

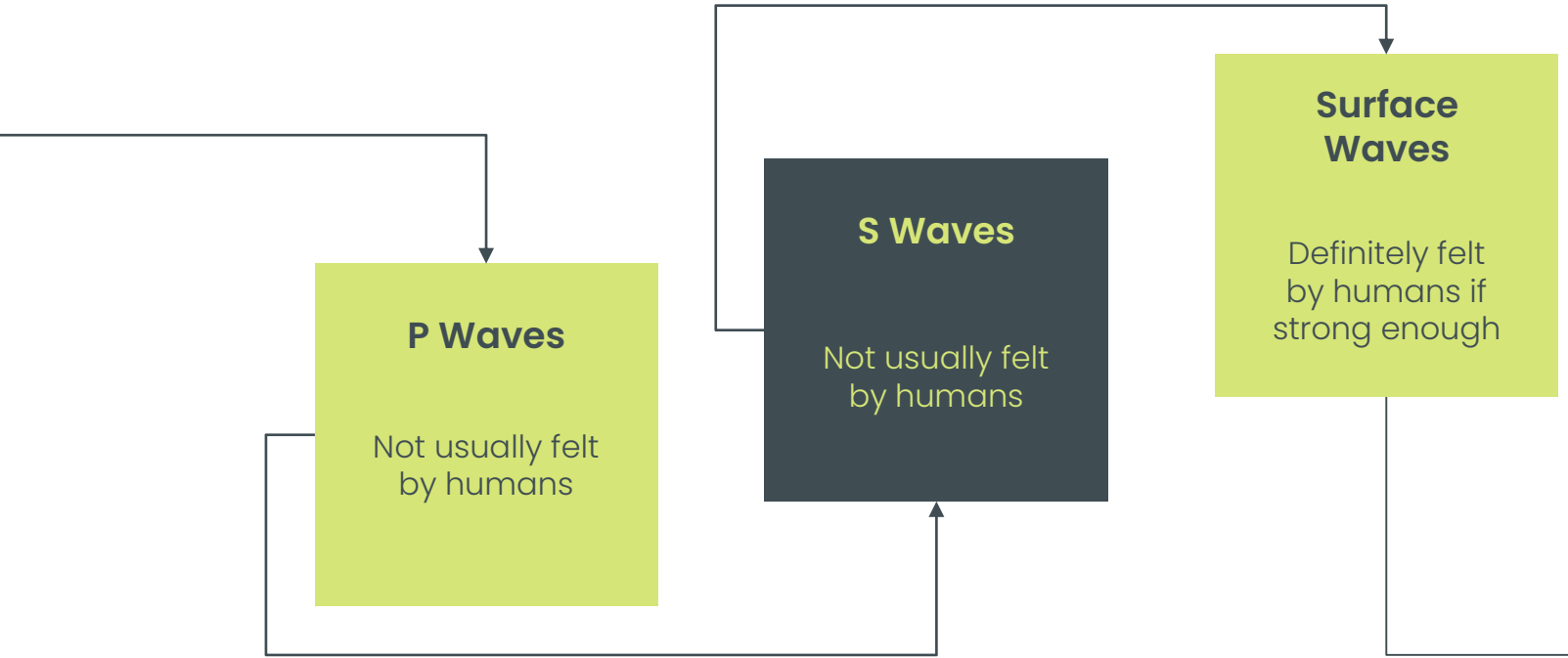
The machine that
records Earth's motions

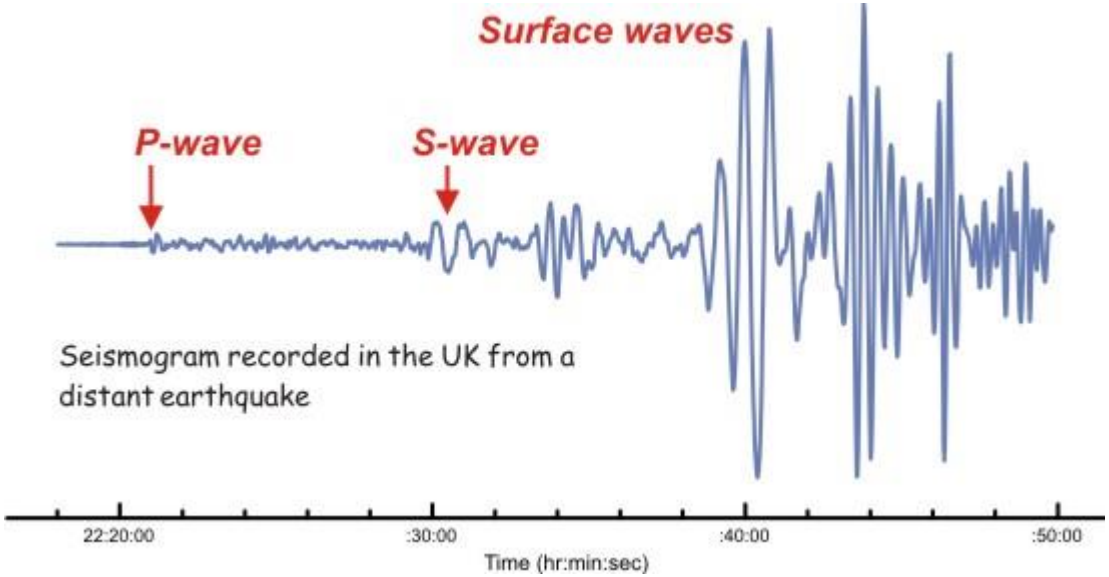


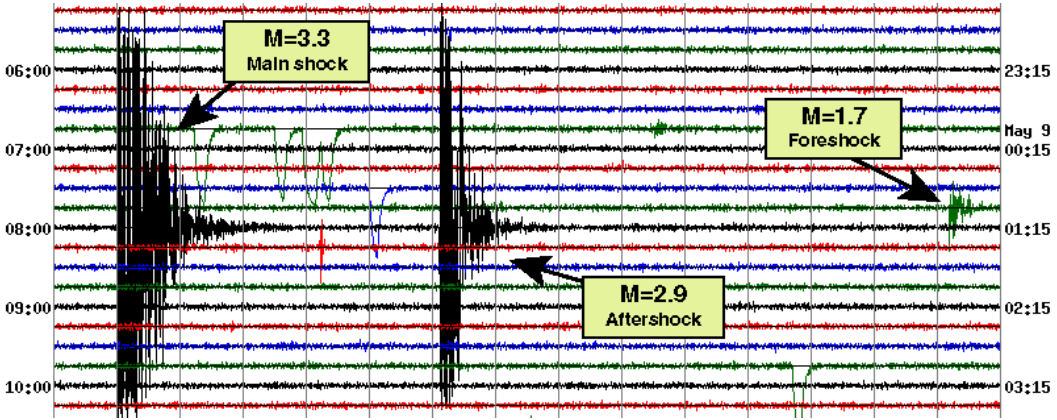
Seismogram

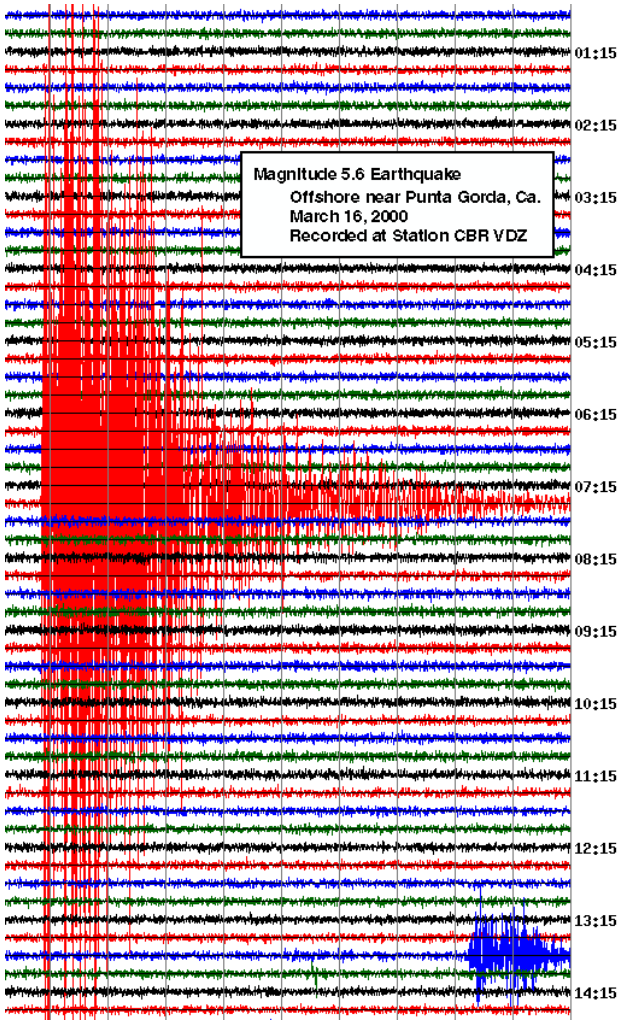
The actual visualization
of the motions

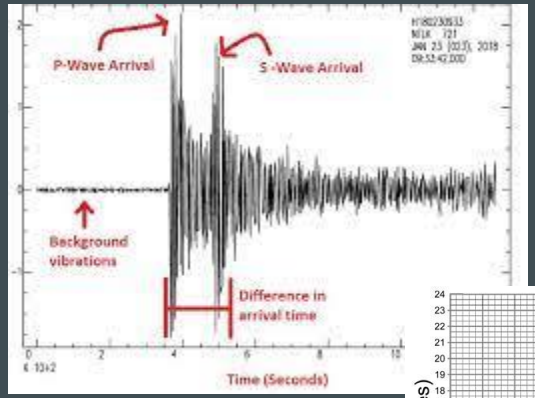
Earthquake Stages

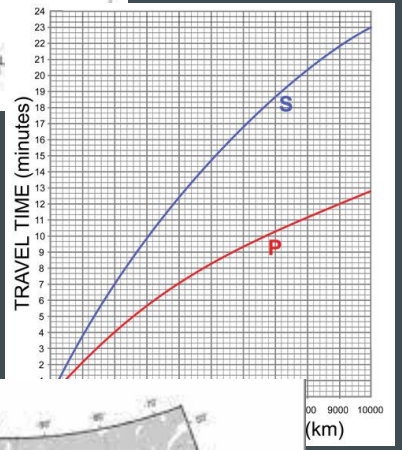


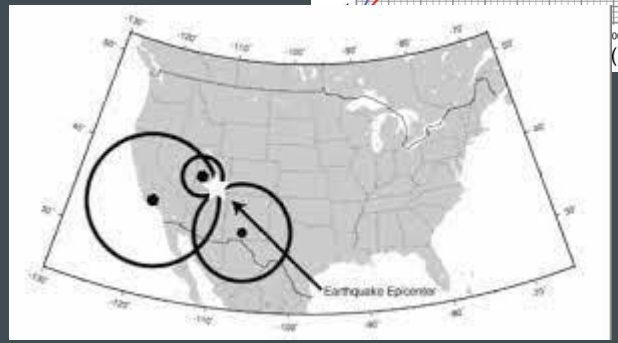

Surface waves
P-wave
S-wave
Seismogram recorded in the UK from a distant earthquake
22:20:00
:30:00
:40:00
:50:00
Time (hr:min:sec)


M=3.3
Main shock
M=1.7
Foreshock
M=2.9
Aftershock
06:00
07:00
08:00
09:00
10:00
23:15
May 9
00:15
01:15
02:15
03:15

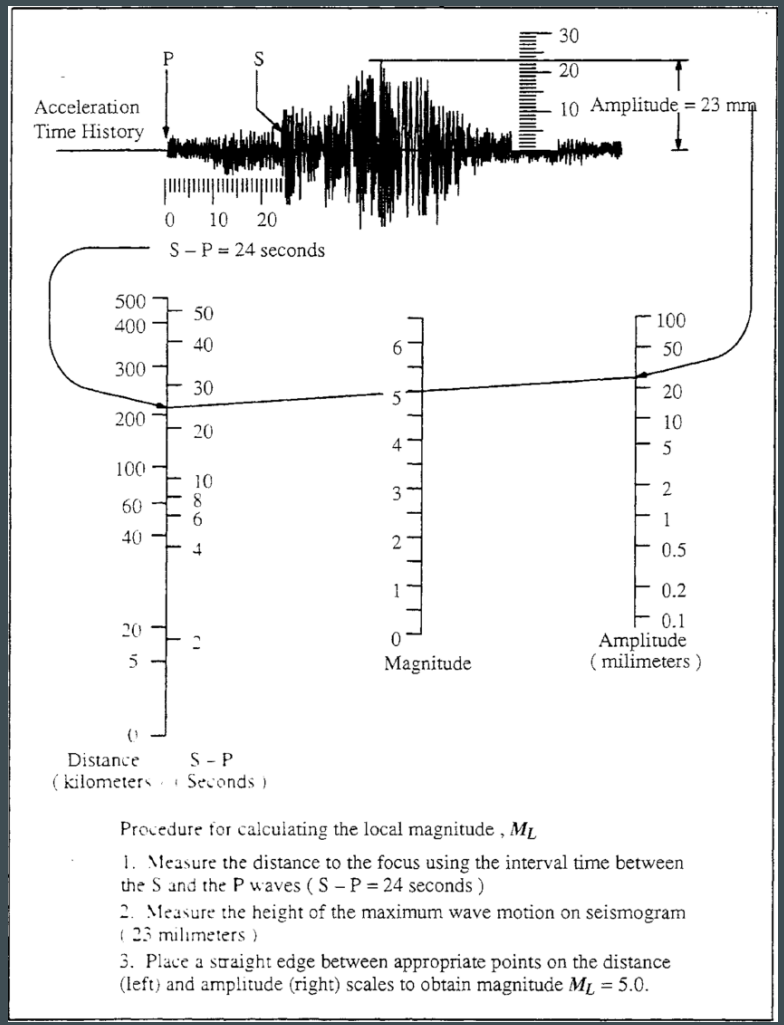

Magnitude 5.6 Earthquake
Offshore near Punta Gorda, Ca.
March 16, 2000
Recorded at Station CBR VDZ
01:15
02:15
03:15
04:15
05:15
06:15
07:15
08:15
09:15
10:15
11:15
12:15
13:15
14:15







You can use the seismogram to figure out how far away the earthquake was



Procedure for calculating the local magnitude , M_L

1. Measure the distance to the focus using the interval time between the S and the P waves (S – P = 24 seconds)
2. Measure the height of the maximum wave motion on seismogram (23 milimeters)
3. Place a straight edge between appropriate points on the distance (left) and amplitude (right) scales to obtain magnitude M_L = 5.0.

You can also use the seismogram to figure out the earthquake's magnitude

Magnitude

Used to describe how big an earthquake was

Magnitude

Different scales have been used to describe how big an earthquake was:

- ~~Mercalli Scale (1902)~~
- ~~Richter Scale (1934)~~
- Moment Magnitude Scale (1979)

Based on total distance a fault moved and the force required to move it

Based on a logarithmic scale (base 10)

- for every number you go up, the ground shakes ten times as much
- for every number you go up, 32 times as much energy is released

Let's model this!

Magnitude

Magnitude 1 Earthquake: break 1 spaghetti

Magnitude 2 Earthquake: break 32 spaghetti

Magnitude 3 Earthquake: break 1,024 spaghetti...

... Imagine a magnitude 7 then!

In terms of TNT:

- magnitude 1 earthquake releases around as much energy as six ounces of TNT

- magnitude 8 earthquake releases as much energy as detonating 6 million tons of TNT

Earthquake Magnitude Scale

Magnitude	Earthquake Effects	Estimated Number Each Year
2.5 or less	Usually not felt, but can be recorded by seismograph.	900,000
2.5 to 5.4	Often felt, but only causes minor damage.	30,000
5.5 to 6.0	Slight damage to buildings and other structures.	500
6.1 to 6.9	May cause a lot of damage in very populated areas.	100
7.0 to 7.9	Major earthquake. Serious damage.	20
8.0 or greater	Great earthquake. Can totally destroy communities near the epicenter.	One every 5 to 10 years

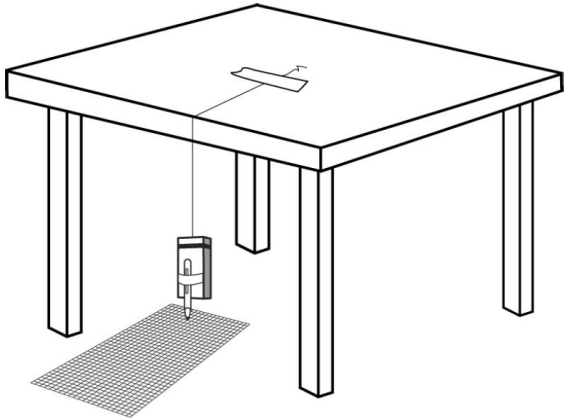
Earthquake Magnitude Classes

Earthquakes are also classified in categories ranging from minor to great, depending on their magnitude.

Class	Magnitude
Great	8 or more
Major	7 - 7.9
Strong	6 - 6.9
Moderate	5 - 5.9
Light	4 - 4.9
Minor	3 -3.9

All of this data from the seismogram!

Let's make our own!

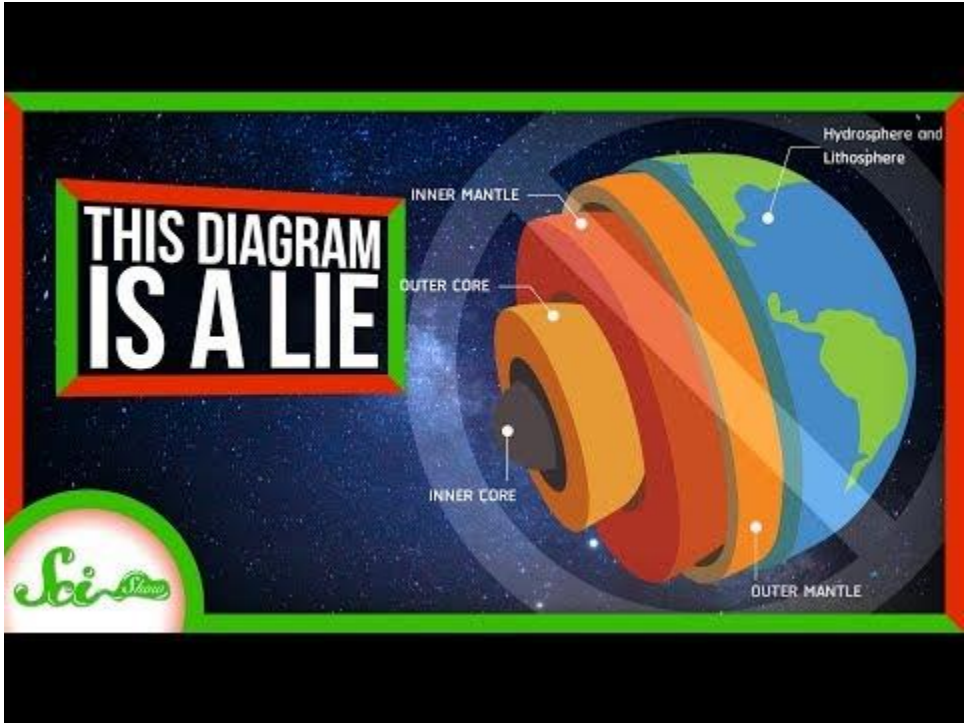


Analyzation

What happened?

Does it actually look like a seismogram?

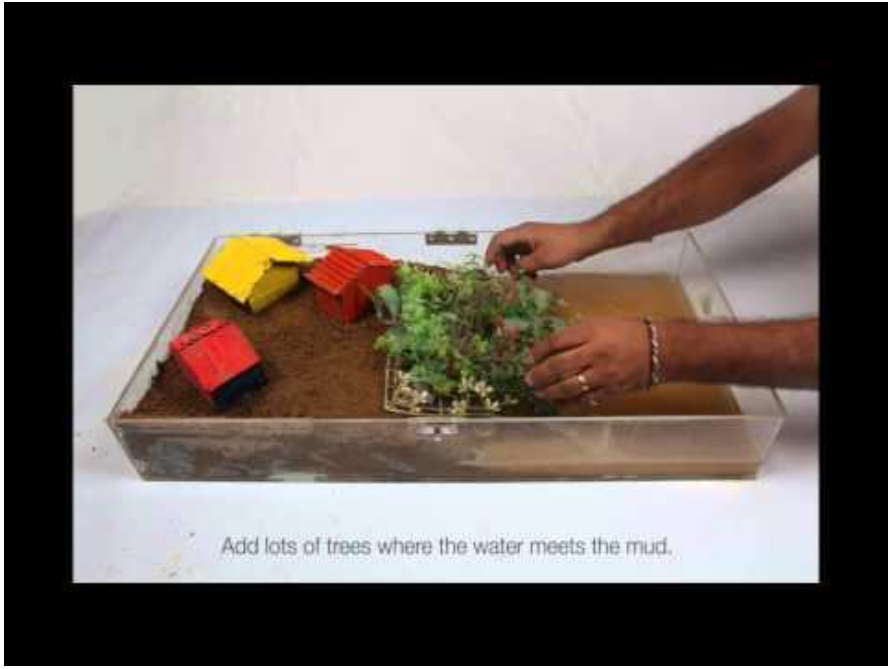
What could be improved to make it better?


THIS DIAGRAM
IS A LIE
INNER MANTLE
OUTER CORE
INNER CORE
Hydrosphere and
Lithosphere
OUTER MANTLE
SciShow


101
TSUNAMI

Tsunamis

1. What are the four causes of tsunamis?
2. How fast can a tsunami travel?
3. How high can a tsunami wave get?
4. Do tsunamis have multiple waves or just one?
5. What was the deadliest tsunami in history?


Add lots of trees where the water meets the mud.

Tsunamis

Your job is to research into tsunamis and then create your own in a plastic container like what is seen in the video, or your bathtub. Fill it with a shallow amount of water, create a wave, and then watch what happens when the wave gets to the shallow part of the tub. (Side note: Don't put sand and such in your bathtub cause that's a bad idea.)

US Tsunami Warning System: https://tsunami.gov/

NOAA Tsunami Program: https://www.tsunami.noaa.gov/

What to do in a tsunami: http://itic.ioc-unesco.org/images/docs/where_the_first_wave_arrives_in_minutes_sml.pdf

Maps of tsunami data: http://itic.ioc-unesco.org/index.php?option=com_content&view=article&id=1672&Itemid=2698


EARTHQUAKE
PROOFING