Intentional arrival

- Aim to be on time (we know campus is large!)
- Sit down and say Hi – make friends and influence people
- Make a quick “to do” list from your previous class/day
- Log on to your iClicker app
- Send that last important text then turn your notifications off – be ready to be intentional in your learning

- Download pdf of notes before class, and annotate/make your own notes
- Ask questions!

EOSC 114 Fragile Systems
Lecture 2

Remember to download the lecture notes before class so you can use them in the activities and annotate with your own notes.

Remember - Don’t like this lecture? Try the Hybrid Version Or

EOSC 116 – Hybrid

Mesozoic Earth: Time of the Dinosaurs

UBC Add/drop date September 16th

EOSC 118 - Hybrid

Earth’s Treasures: Gold and Gems

Learning Goals (FS2)

a) Define the terms Force and Work
b) Explain how the force of gravity affects motion and energy.
c) List 4 types of energy important to disasters and describe what causes them to vary.
d) Explain how disasters are associated with concentration or dilution of energy.
e) Explain why disaster scales are based on the Order-of-Magnitude concept, and interpret graphs with logarithmic scales.
f) Discuss the return period of disasters and how/why we determine it.

Disaster

Substantial event causing

1) physical damage,
2) injury or loss of life, and/or
3) a drastic change to the environment

iClickers

We know that:

1. Some of you don’t have your app yet.
2. Your battery might die.
3. You might miss some classes

Don’t Panic.

iClickers - respond to >80% of the questions and receive the full iClicker Performance grade

[Recording grades from the start of Impacts]

Same iClicker course for BOTH sections – so max 50% attendance in the app

Disasters and Energy

Energy causes things to move or change

Disasters release immense amounts of energy

Cause catastrophic changes

Related to: force, work, power, pressure, stress, and others

Forces

Force (*F*) A force pushes or pulls.

SI unit is the Newton (N).

A Newton is defined as:

1 (N) = 1 (kg · m / s^2)

- How big is a Newton?

A 15 km/h breeze against your body pushes with a force of about 1 N

- The weight of Mt. Baker exacts a force on the Earth's crust of about 5 x 10^{14} N (500 trillion N)

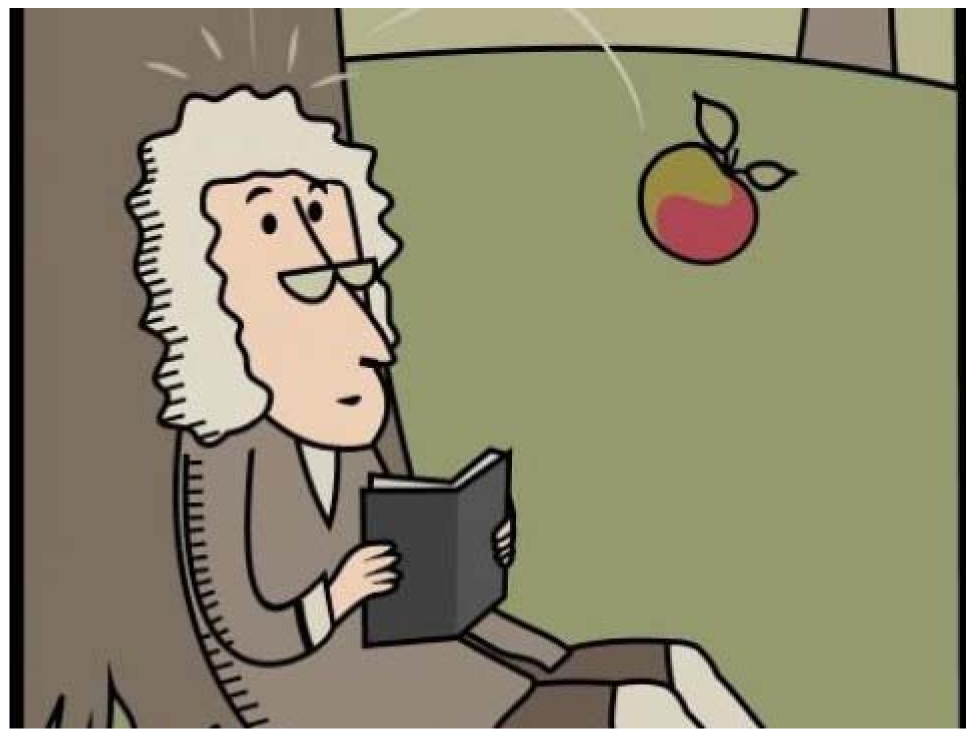
e.g. Gravity

Gravity

- A force that attracts matter (i.e. masses) to each other.
- Objects of mass *m* near the Earth's surface are pulled with force:

$F = m \times g$

- *Where*
  $g =$



Work (W)

Work (*W*) is the force (*F*) that pushes an object, times the distance (*d*) the object moves.

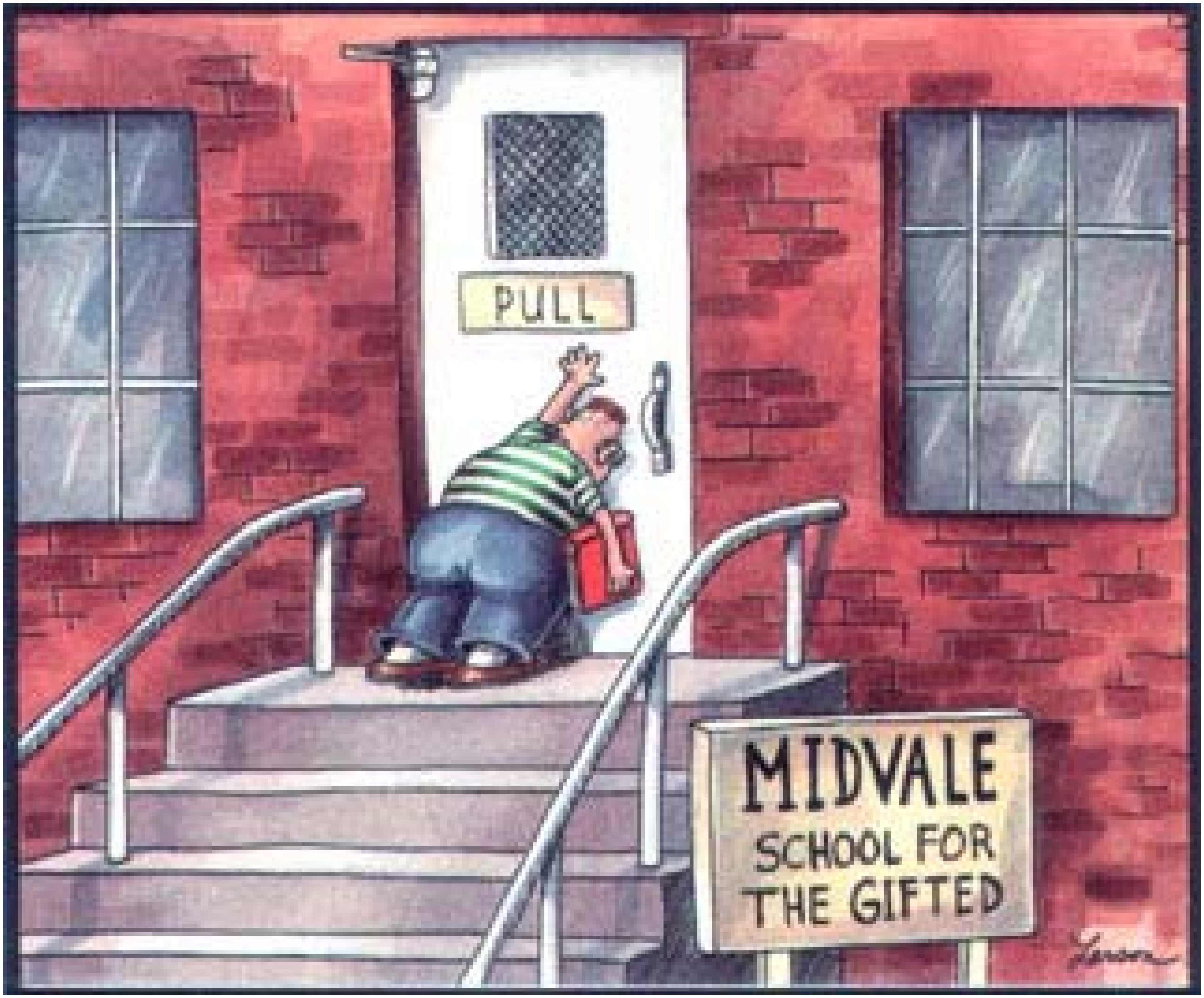
$W = F \times d$

The SI unit of work (and all energy) is the Joule (J)

Defined as:

1 (J) = 1 (N x m)

Example: You push with 30 N of force to move your refrigerator 3 m across your kitchen.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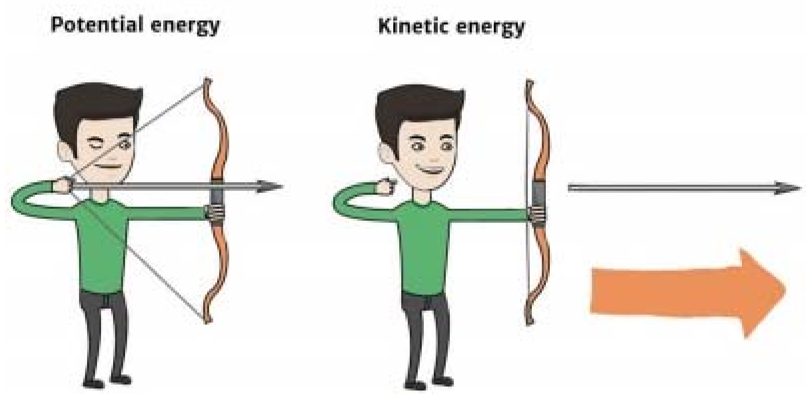
Energy

Many forms of energy (4 examples):

1. Potential Energy
2. Kinetic Energy
3. Sensible Heat
4. Latent Heat



Law of Conservation of Energy

1. Potential Energy (PE)

The work needed to raise an object of mass *m* (in Kg) a distance *z* (in metres) against the pull of gravity *g (9.8* m/s^2*)* is called potential energy (PE)

$PE = g \times m \times z$

E.g. 70 kg person who walks up from the beach a vertical distance of 50 m to UBC does work against gravity of

2. Kinetic Energy (KE)

Kinetic Energy (*KE*)

A moving object possesses kinetic energy: $KE = 0.5 \cdot m \cdot v^2$

Where m is the object's mass,
and v is its velocity

A typical car of mass 1300 kg moving at a speed 50 km/h (14 m/s) has a kinetic energy of about:

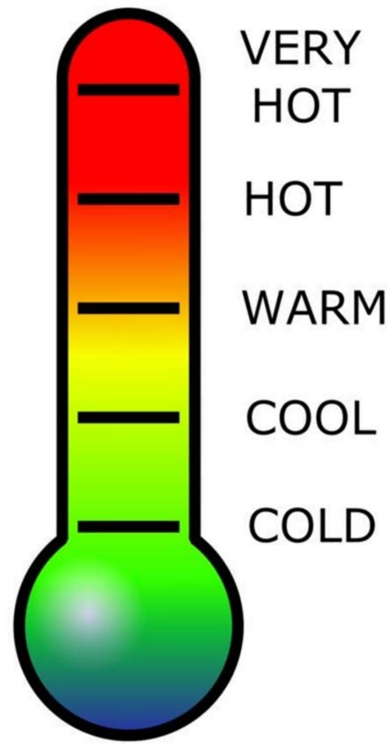
The 30 m diameter nickel-iron meteor ($m = 1.1 \times 10^8$ kg) that hit earth at 20 km/s (20000 m/s) to form Meteor Crater, AZ, had:

$KE = 2.2 \times 10^{16}$ J

3. Sensible Heat

Sensible heat

- Heat energy we can sense or feel (or measure)
- When we measure Temperature we are measuring sensible heat
- (On an atomic level this is really particle motion)



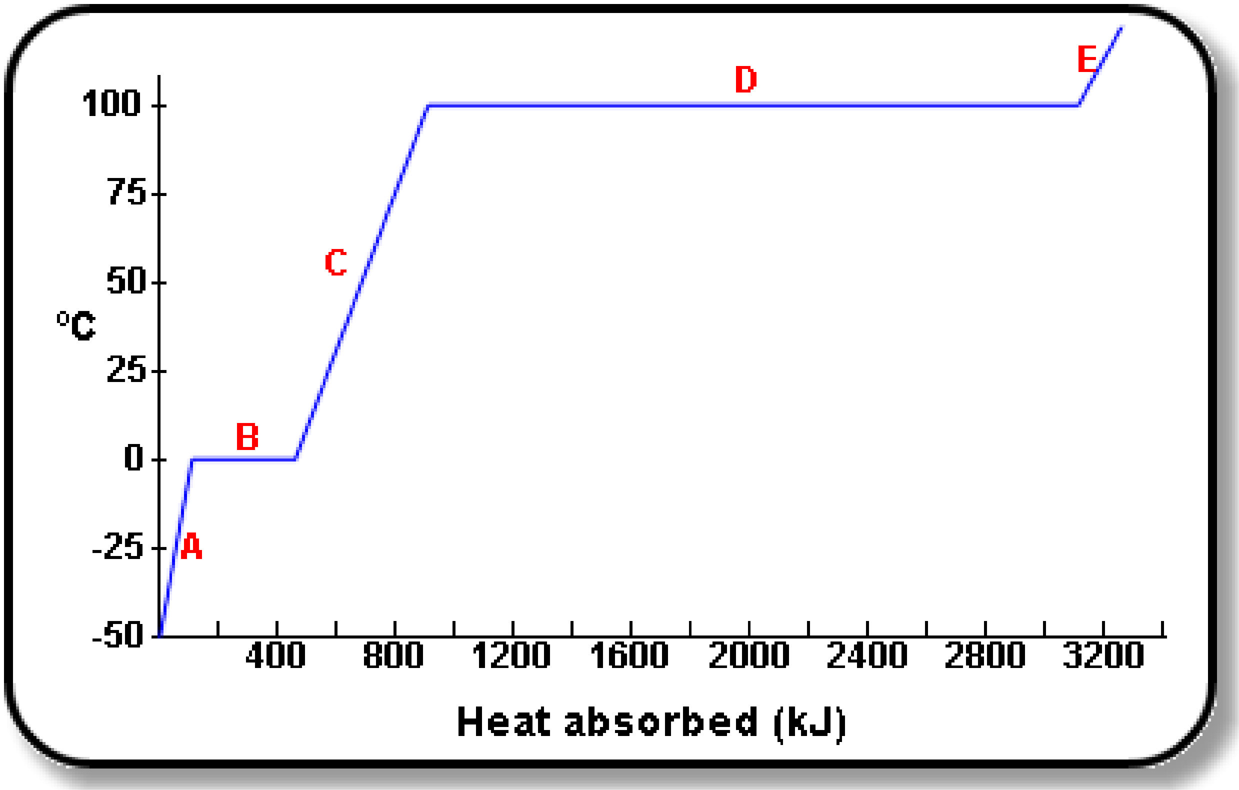
4. Latent Heat

Latent heat (a kind of potential energy)

- “Hidden” heat energy in chemical bonds between atoms
- Energy is “stored” as latent heat during melting or boiling (or sublimating)

- Latent heat released as sensible heat (or other energy) to the surroundings when condensing or freezing (or depositing, or crystallizing)

Group Discussion



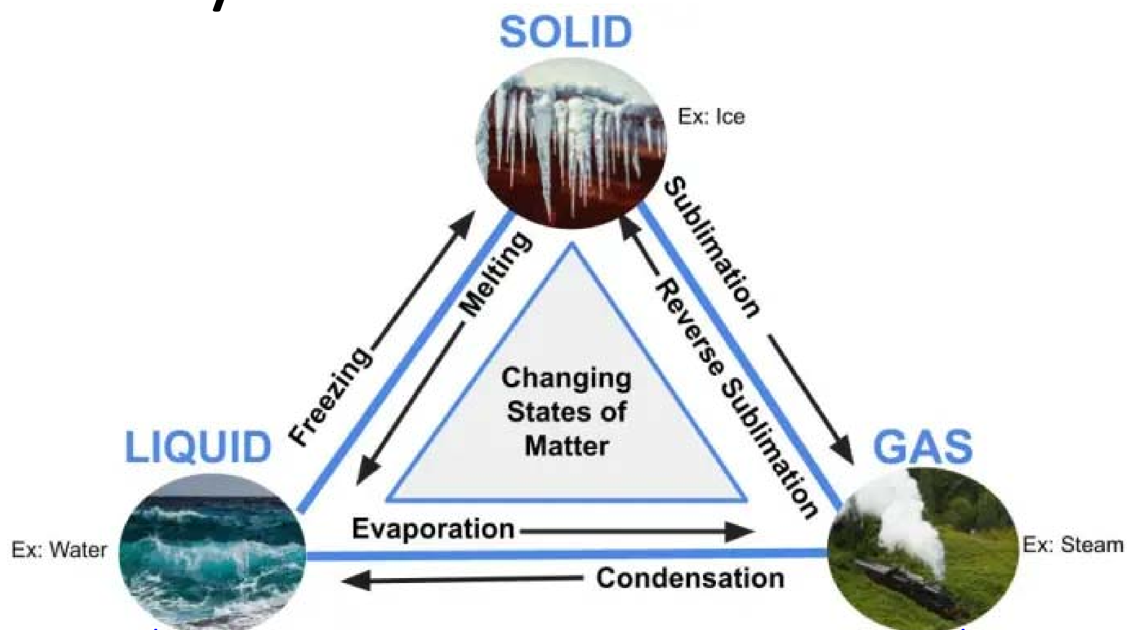
This graph shows how the temperature of water reacts as **heat energy** is put into a system (for example ice placed in a pot or kettle). Discuss what is happening both to the **state of water** and the **energy entering the system** at each of the following points A-E.

2 minutes – in groups

4. Latent Heat

Phase changes

- When liquid becomes gaseous - heat is taken from the surroundings
- When gases becomes liquid - heat is transferred/released to the surroundings



https://dewwool.com/differences-between-evaporation-and-condensation/

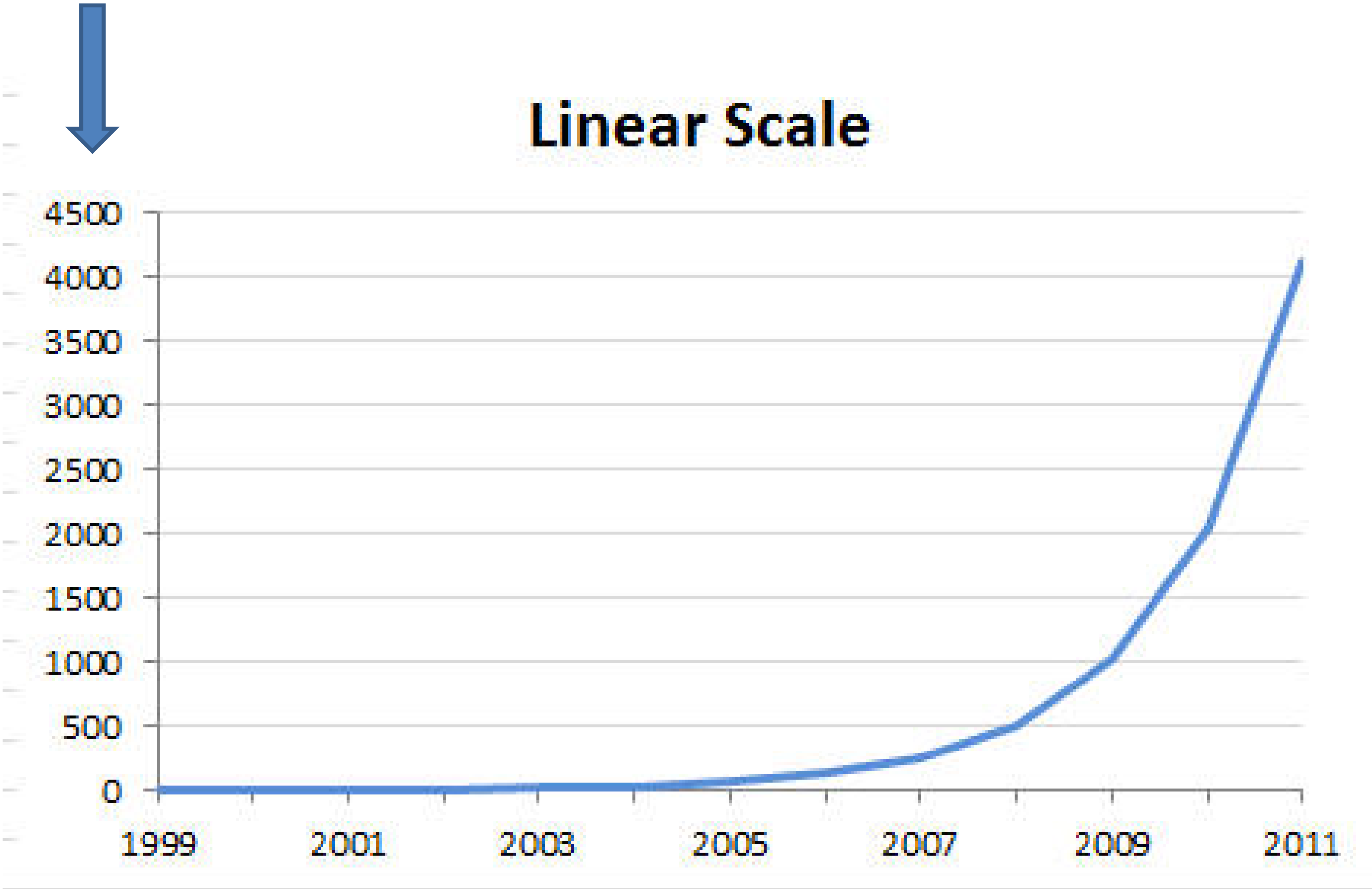
Time Scales for Disasters

Time Scales for energy to (concentrate)-> time to release:

Earthquakes:	centuries/years	-> minutes
Volcanoes:	centuries/decades	-> days
Hurricanes:	months	-> days
Thunder Storms:	hours	-> minutes
Rogue waves:	hours	-> seconds
Landslides:	Millennia	-> seconds
Tsunami:	minutes	-> hours
Floods:	hours	-> days
Impacts:	N/A	-> seconds (or less)

Disaster Scales

Measuring disasters



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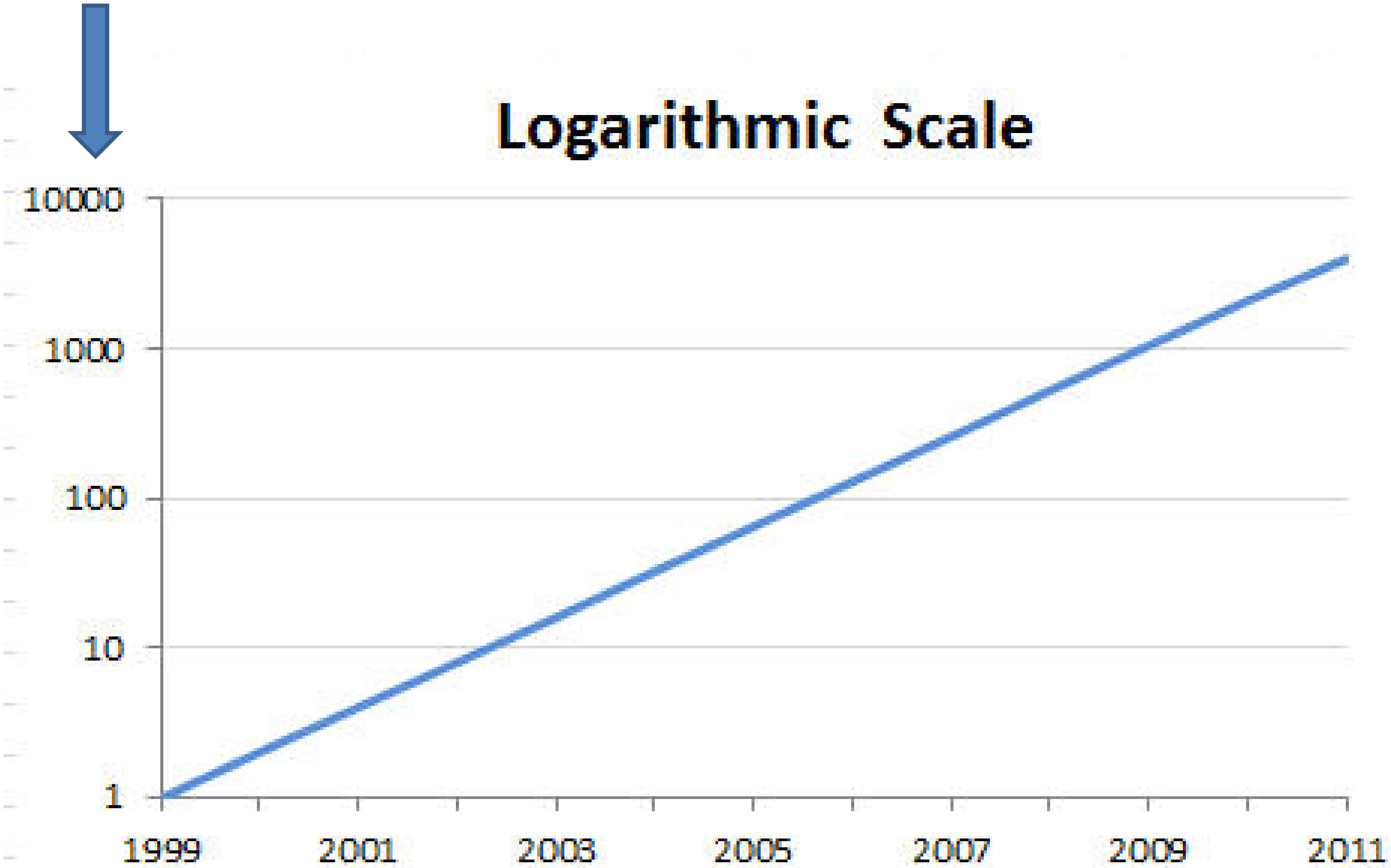

https://www.forbes.com/sites/naomirobbins/2012/01/19/when-should-i-use-logarithmic-scales-in-my-charts-and-graphs/?sh=24ff09685e67

Disaster Scales

"Order of Magnitude"= powers of ten.

Disasters happen at many magnitudes:

$10^{-1}=0.1$

$10^0 = 1$

$10^1 = 10$

$10^2 = 10x10 = 100$

$10^3 = 10x10x10 = 1,000$

$10^4 = 10x10x10x10 = 10,000$ etc.

e.g. $6 \times 10^3 = 6x10x10x10 = 6,000$

Disaster Scales

Logarithmic Scale

Steps by powers of 10.

Use the power (to which 10 is raised)

For example, instead of 1,000 use “3” (i.e. 10^3)

... and 4 for 10,000 etc.

Order-of-Magnitude Scales

Richter Scale (Earthquakes)
Moment Magnitude Scale (Earthquakes)
Volcanic Explosivity Index
Beaufort Scale (Wind and Waves)
Saffir-Simpson Scale (Hurricanes)
Enhanced Fujita Scale (Tornadoes)
Torro Scale (Tornadoes)
Torino Scale (Impacts)

Intensity vs. Frequency

More intense disasters occur less frequently

Energy and Frequency

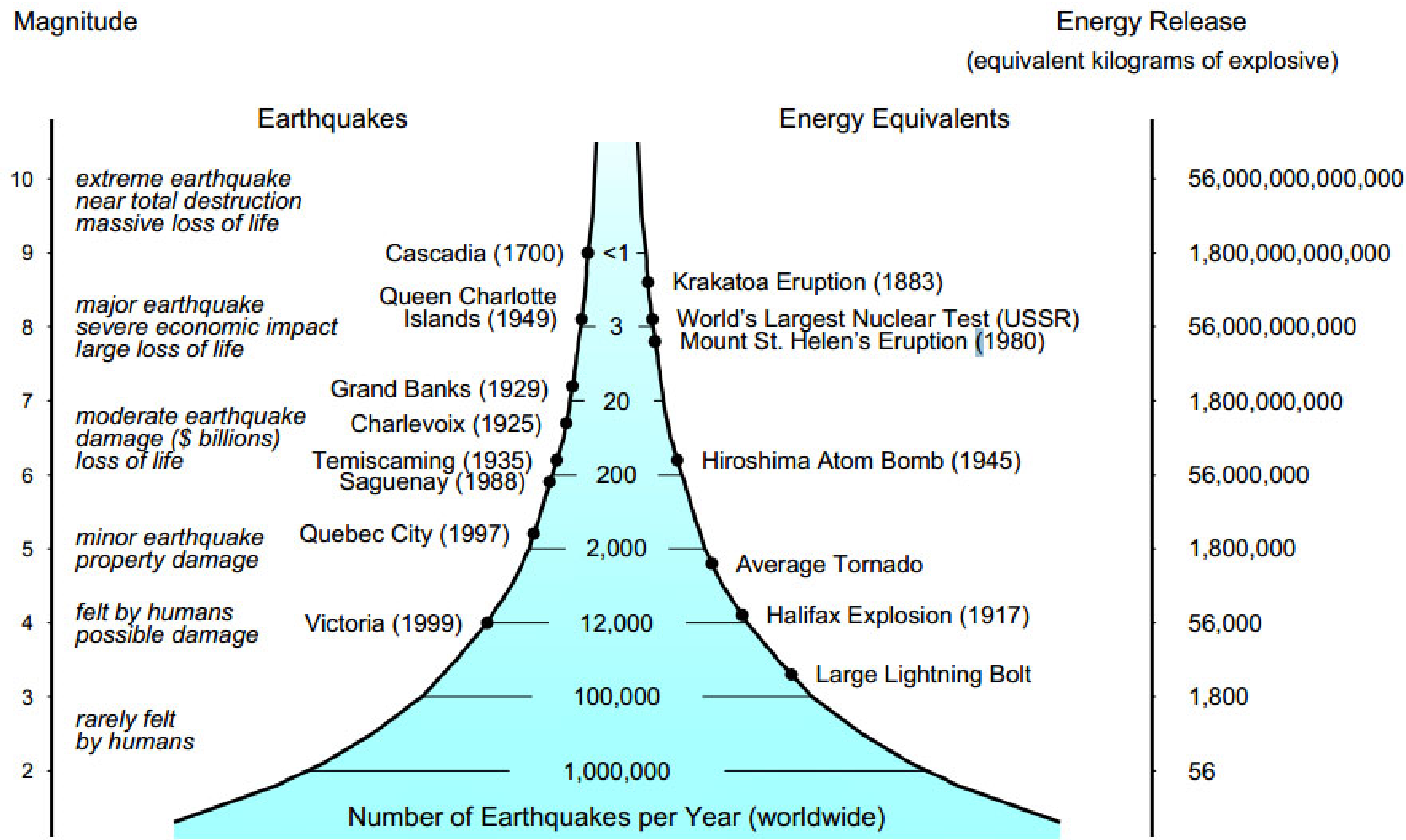

Image: NRCan

Natural Disasters are Rare Events

Return Period (RP)

RP = **average** number of years between disaster events of the same magnitude (M)

Example Saffir-Simpson Category 5 Hurricane

$$RP(M) = \frac{\text{time span of data}}{\text{\# of cases of mag. M}}$$

$$RP(5) = \frac{\text{70 years}}{\text{2 cases}}$$

$$RP(5) =$$

Example Saffir-Simpson Category 5 Hurricane

$$RP(M) = \frac{\text{time span of data}}{\text{\# of cases of mag. M}}$$

$$RP(5) = \frac{\text{70 years}}{\text{2 cases}}$$

$$RP(5) =$$

Actual data:
Since 1924 there have been 40 Category 5's
RP = 2.5 years

Upcoming Deadlines

- Due September 15th - Complete the "Explore Your Background Part A" homework
- Add/drop date September 16th
- Due September 22nd – "Explore Your Background Part B"(read feedback and try again for a better mark – top mark from Part A/B will count)
  Register your iClicker in Canvas iClicker Cloud
- Midterm 1 September 25th in normal class time

See you on Monday!