

Welcome to Class 11: Extinction & Life Needs

Remember: sit only in the first 10
rows of the room

What are we going to discuss today?

Did an impact really kill the dinosaurs?

What is so special about water?



PRS: How often will an impact large enough to cause widespread (10s of miles of destruction) occur?

1. 10 years
2. 1,000 years
3. 100,000 years
4. 1 million years

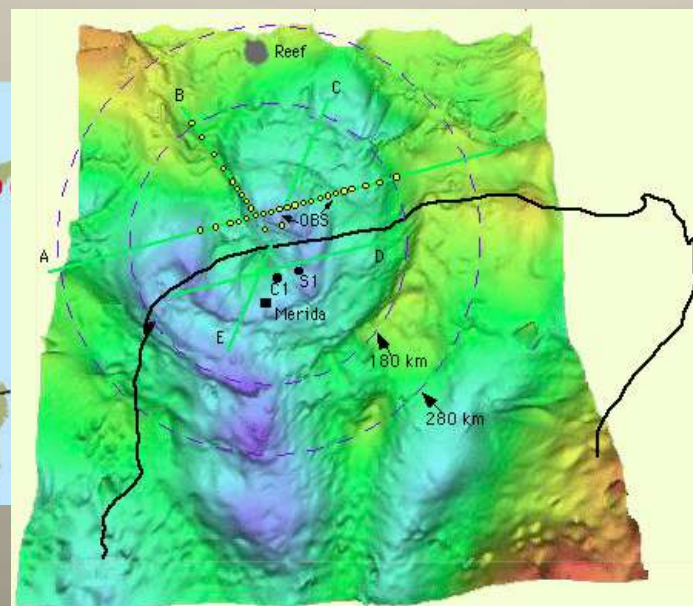
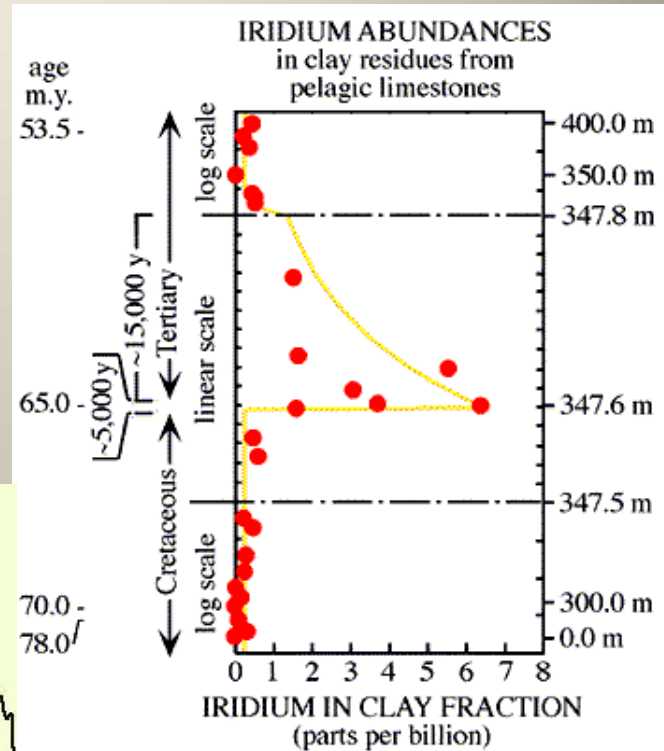
Remember to set your channel to 80!

Dinosaurs died out suddenly 65 m.y. ago

Initial Evidence linking to Impact

Iridium, rare on Earth but abundant in asteroids was found in K-T boundary layer where dinosaurs died out.

Adding up the iridium world wide, indicated a 10-15 km asteroid.



A 150 mile wide crater was found in Mexico

What else happened at the K-T Impact?

In the geological record (K-T layer, 65 m.y.a.):

- Unusual abundances of other metals
- Shocked quartz (created by high Temp & Press)
- Rock droplets, which solidified in air
- Soot, consistent with wide spread forest fires.

There is little doubt a major impact occurred at this time.

This led to enormous destruction, global winter killing most vegetation, then global summer (due to high CO₂)



Many scientists believe dinosaurs were in decline already

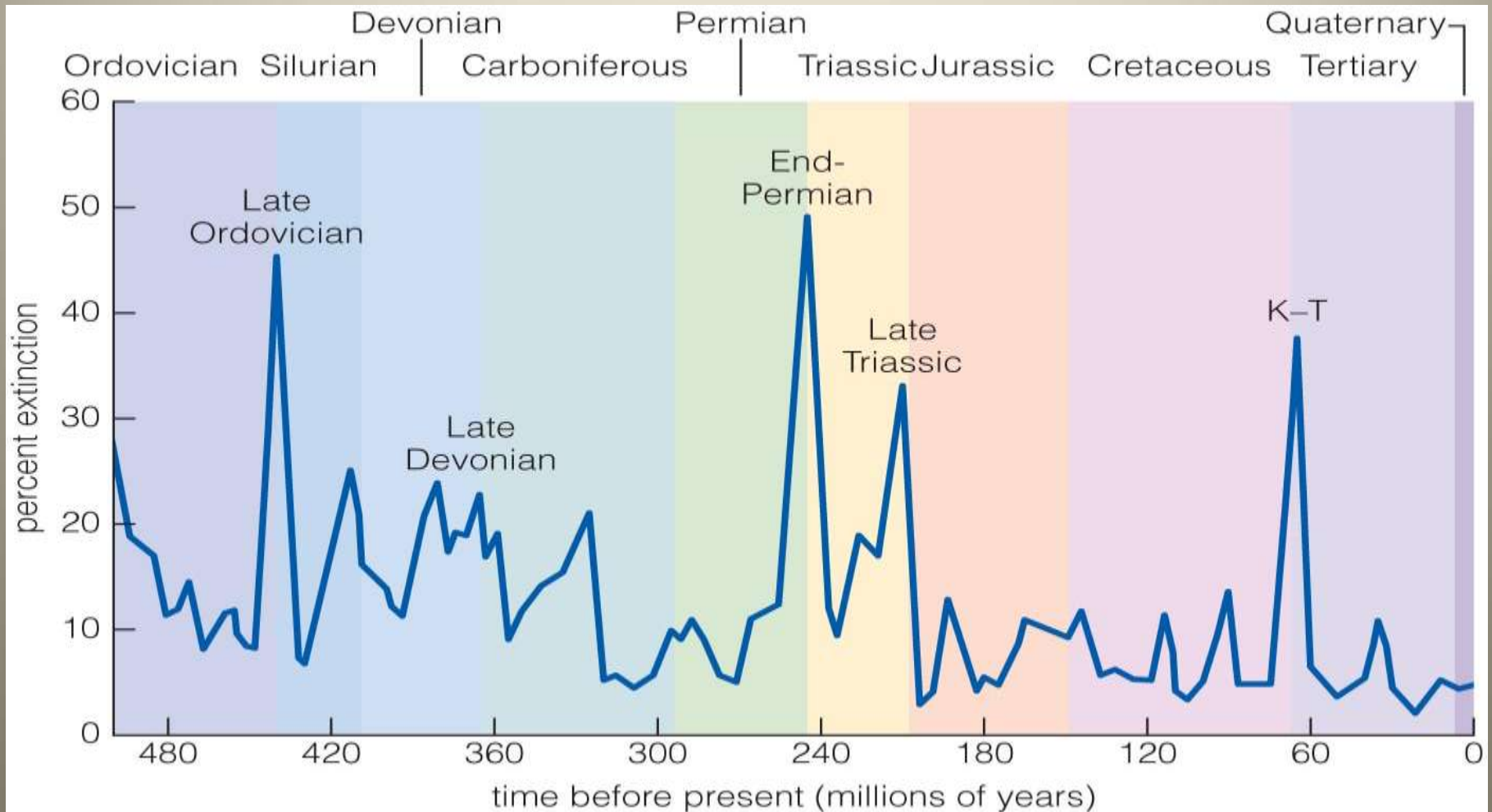
PRS: How did HUMANS personally benefit from the K-T impact?

1. Good geology jobs
2. Source of gold
3. Small mammals survived
4. Got rid of those nasty dinosaurs.

Extinction rates past 500 million years

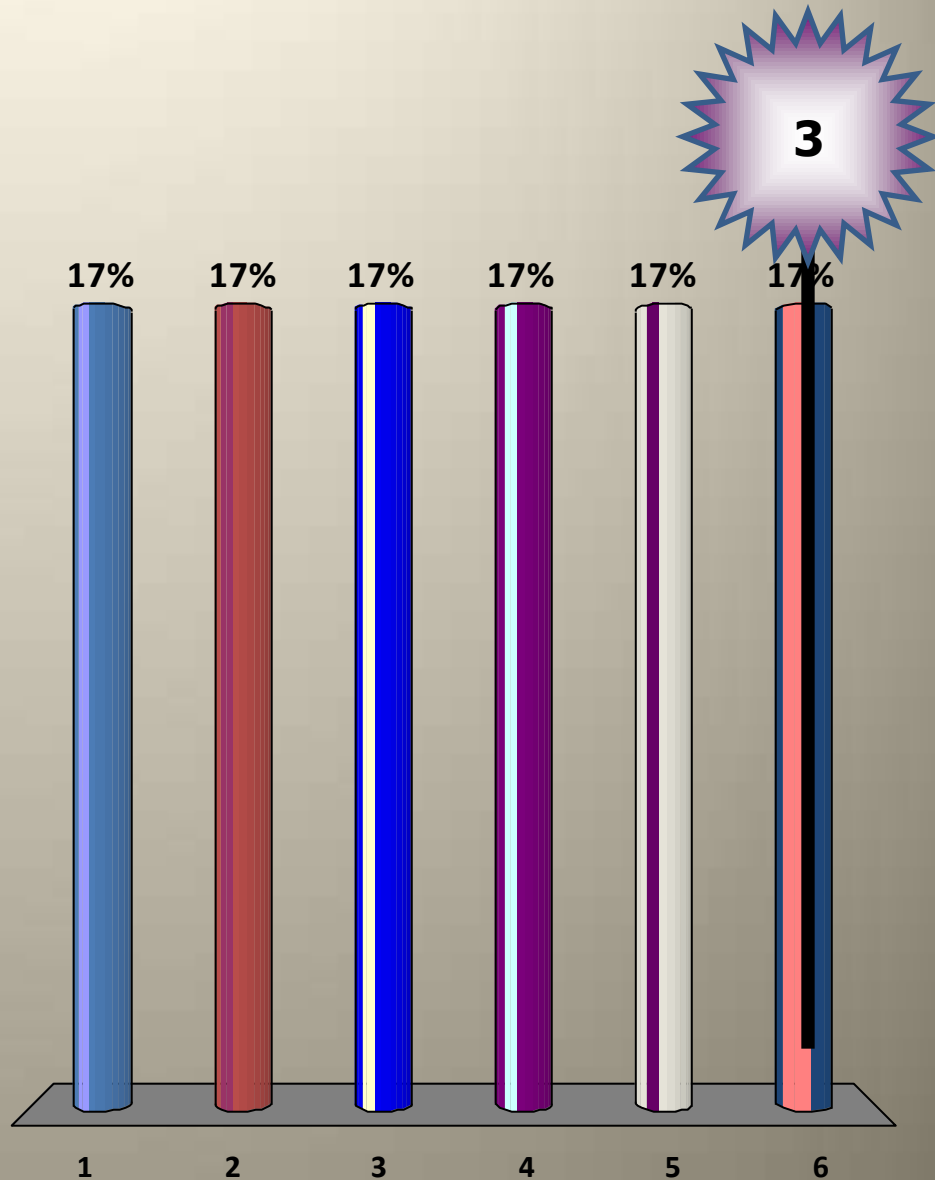
Why do you suppose we have such good `data' on extinction rates for this period?

Note mass extinctions often correspond to end/start times of geological periods. Why?



PRS: What else can cause mass extinctions besides impacts?

1. Unusually active Volcanism
2. Snowball Earth
3. Excess UV radiation
4. Reversals in Earth's magnetic field
5. Supernova/Gamma-ray Bursts
6. All of the above.



The Tunguska event

In 1908, something blew up over Tunguska, Siberia. It flattened 80 million trees



There has been no crater found. It may have been a 10-15 meter (not km!) size comet.

PRS: Which of the items below is not so critical to life.

1. Protection
2. Building blocks
3. Liquids
4. Energy

The elements: H, C, N, O

These make up 96% of the mass of living organisms on Earth.

They also happen to be 4 of the 6 most abundant elements in the Universe. Coincidence?

What's more, these elements are naturally occurring in organic molecules found in space (comets and asteroids.. And planets). Of course, it needs to be readily available for life to use.

Fulfilling THIS requirement is perhaps the easiest of the three.

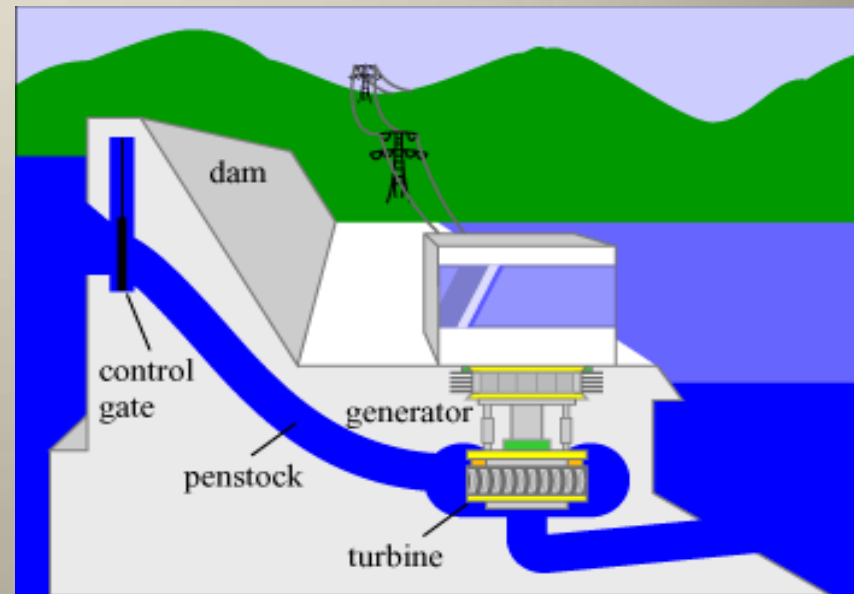
Finding a source of



Any place where chemistry or physics is 'out of balance' one can harness the energy released when it 'rights itself'.

Consider the potential energy in wind or water (e.g. hydro plants).

Chemical potential energy requires bringing reactants together: mixing. This suggests a liquid or gas (solids mix too slowly)



And of course, SOLAR energy, can be tapped directly OR through one of the indirect means above.

PRS: Which below is NOT a reason for life to need a `liquid`?

1. To move in
2. Transport nutrients
3. Dissolving molecules
4. For chemical reactions

Of all liquids: WATER is the best

Among 'astronomically abundant' molecules:

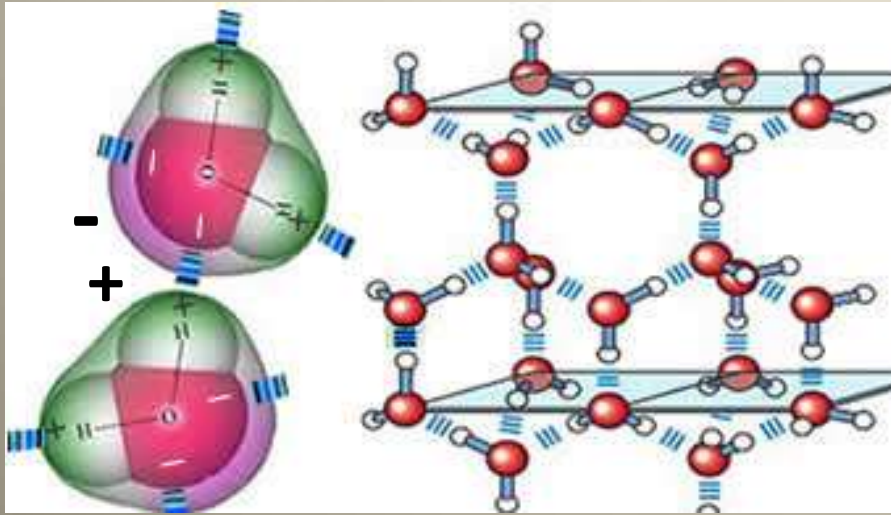
Substance	Freezing Temp	Boiling Temp	Liquid Range
Water (H ₂ O)	0°C	100°C	100°C
Ammonia (NH ₃)	-78°C	-33°C	45°C
Methane (CH ₄)	-182°C	-164°C	18°C
Ethane (C ₂ H ₆)	-183°C	-89°C	94°C

Now consider two important points about life:

1. Life is better protected if it doesn't easily boil or freeze.
2. Biological metabolism **STRONGLY** increases with temperature

Another critical and unique property of Water: It's polar nature

Nearly all molecules have a more dense structure when solid over when liquid.



The water molecule is 'polar'.
One side '+', the other side '-'

Because of this charge imbalance , water:

- 1) Forces the molecules FURTHER from each other in the solid phase making the density lower as a solid.
- 2) Dissolves charged molecules (salts, etc.) but not 'oils' (no charge).

What would happen if ice sunk?

1. As the temperature above the water dropped below freezing, the surface would start to solidify.
2. The frozen portions would start to sink, revealing underlying liquid water.
3. The new liquid water at top would be exposed to freezing temperatures and begin to freeze.
4. The frozen portion at top would sink, revealing underlying liquid water....

With time the entire lake/ocean would freeze solid!

All life in the oceans and lakes would be dead.

But water ice floats at top, insulating the liquid below.

PRS: Which is NOT one of the three environmental requirements for life?

1. Source of energy.
2. Source of motion.
3. A liquid medium.
4. A source of molecules to build cells.

Put all your materials on the floor and
place your PRS clicker in front of you.

Please: use just one clicker for yourself.

Take care that others can not
view your selection

1. What was the initial evidence linking an impact with the demise of the dinosaurs?

1. Soot was found at the K-T boundary
2. Rock droplets were found at the K-T boundary.
3. A large crater was found in the Yucatán
4. Iridium was found at the K-T boundary

2. How many major extinction were named in your textbook?

1. Two
2. Three
3. Four
4. Five

3. An impact similar to Tunguska happens about how often to Earth?

1. Once a year
2. Every 100 years
3. Every 10,000 years
4. Every million years

4. Which of the Life necessities below is easiest to find in outer space?

1. Molecules to build cells
2. Source of Energy
3. Source of Liquid medium

5. What characteristic of water keeps lakes/oceans from freezing over?

1. It dissolves salts
2. It has a large liquid temperature range
3. It's solid structure is less dense than liquid
4. It is liquid at relatively warm temperatures

TEST 2 next class (Tuesday, Feb 16th)

- Look at review sheet on class website (I will post later today)
- Re-read all assigned pages in textbook and be sure you can answer all learning objectives
- Bring a #2 pencil to class (and know your M#)