Student 1: Low Excellence

NZQA Intended for teacher use only

The past explains the future.

The issue:

Just how will the increases world wide of carbon dioxide in the atmosphere affect our weather, climate, and life in general? Rather than guess at or use models we need to look at the evidence for this in the geological record. Some of the best evidence comes from the PETM (Paleocene-Eocene Thermal maximum) 55.8ma when carbon dioxide levels rose quickly and there were major environmental effects. The warming lasted 100000-170000 years before the CO_2 levels stabilised. This carbon dioxide increase mirrors what is happening today. Geologists still don't know exactly where the carbon dioxide came from but come it did and we can read the rocks to show its effects. (1)

Evidence from the PETM (55.8ma)

During the PETM, around 5 billion tons of CO_2 was released into the atmosphere per year. The Earth warmed around 6°C over 20,000 years; although some estimates are that the warming was more like 9°C. Using the low end of that estimated range, the globe warmed around 0.025°C every 100 years. Today, the globe is warming at least ten times as fast, anywhere from 1 to 4°C every 100 years. In 2012, our fossil fuel burning released 35 billion tons of CO_2 into the atmosphere. How fast carbon enters the atmosphere translates to the how fast temperature increases, and the environmental and societal consequences of warming at such a break-neck speed could be devastating.

PETM Warming vs. Current Warming (final summary

Feature	**PEMT**	**Today**
Cause	Continental drift, volcanoes, methane hydrate melting, fires, permafrost melting	Anthropogenic burning of fossil fuels (oil, coal, natural gas, etc)
CO_2 emissions	Around 5 billion tons per year	At least 35 billion tons per year
Rate of warming	0.025°C per 100 years	1 to 4°C per 100 years
Environmental impact	Ocean circulation reversed, oceans acidified, oceans became toxic and oxygen poor, permafrost melted, peat and forests burned in wildfires	**Observed impacts**: significant sea ice decline, extreme drought, more wildfires, increase in glacier melt, more catastrophic floods, ocean acidification, ocean toxicity in deep oceans, sea level rise, shoreline erosion, degraded air and water quality global ocean circulation changes, more violent storms
Ecosystem & human impact	Migration of land mammals, extinction of some benthic foraminifera, coral bleaching	**Observed impacts**: Famine and malnutrition due to drought, coral bleaching, species endangerment (e.g. polar bears) **Potential impacts**: increased mortality

		from extreme weather and malnutrition, increase in disease vectors, decrease in agricultural yield, mass wildlife migration and extinction, total societal collapse.

1

My personal response:

We are told that increasing carbon in the atmosphere will have a detrimental effect on Earth. When we have a look in the past to the PETM we see this response is true. All the projections by scientists have happened in the past and are linked with large amounts of CO_2 going into the atmosphere. The effects in the Paleocene – Eocene boundary was dramatic and stressed the environment for over 100 000years. This was when only 5 billion tonnes was added to the atmosphere annually. Today we are adding 35 billion tonnes annually. The geological record says change the CO_2 in the atmosphere and the environments will become unstable.

My personal view is bad times are ahead of us. Now that we humans have introduced global warming, there are some useful lessons from the past we can show:

- The rapid pulse of PETM CO_2 followed by rapid warming indicates high climate sensitivity.
- CO_2 does indeed appear to have a long atmospheric lifetime.
- Ocean acidification (of the deep sea at least) can occur even under conditions of CO_2 release much slower than today.
- Present acidification of the ocean is far greater than the PETM, and is probably unprecedented in the last 65 million years.

2

A societal response:

Politicians need to take heed of the scientific evidence. Too often we hear “global warming is not happening” or that the “models are not correct” or “economics must come before environmentalism.” All of these are extremely dangerous stands made by burying our heads in the sand. The evidence is out there. The PETM shows us the long term effects of increased carbon dioxide and what we are doing to the atmosphere is about 15 times worse. We don’t have 200 000 years in which to stabilise the climate to about 300 parts per million of CO_2.

Society needs to realise we live in extremely dangerous times and global warming due to the burning of fossil fuels to release carbon dioxide into the atmosphere is happening now and very fast (geologically). The PETM event showed scientists that once a process is set in motion it can take a long time to right itself: right itself it will without any regard for us as a species. Could we become extinct? The answer is a definite yes. We need to respond now and maybe the United Nations is the way to go as an independent body that could unite the world. Is it too late? The evidence suggests that it may well be.

3