

Elementary Preservice Teachers' Ideas About Global Climate Change

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Naïve or alternative conceptions previously identified in the literature

- confusing the kind & source of radiation involved in the greenhouse effect
- not being able to differentiate between the GH Effect and GCC
- confusion between weather & climate
- thinking the ozone layer is involved in GCC either by additional holes letting in more radiation or by a build up of ozone preventing heat from exiting the atmosphere

We found the following alternative conceptions on 4 different constructs.

I. Greenhouse Effect Misconceptions

The most common misconception was that GHG are trapped in the atmosphere instead of these gases actually being the trappers or absorbers of the infrared radiation.

Examples of students' conceptions

"CO₂ is trapped on Earth & can't escape."

"GH Effect allows CO₂ to come in the atmosphere but not escape."

"Radiation is released onto Earth, then released back into the atmosphere as CO₂"

"The GH Effect is caused by gases released onto Earth & get trapped. When they can't get released into space, they cause CO₂ to be released into the atmosphere causing damage to the Earth."

Another area of confusion came in the linking of ozone and the layer of GHG.

"When the sun's rays warm the Earth, it releases heat. The GHG in the ozone layer trap more of the Earth's heat, so less escapes through the Ozone Layer. This trapping of heat raises temperatures on Earth,"

II. Carbon Cycle Misconceptions

A limited number of students could describe processes related to the carbon cycle on the pretest. Later most demonstrated partial understanding. A few students thought the carbon cycle acts as a filter.

Examples of alternative conceptions

"The Carbon Cycle helps to clean the air we breathe – photosynthesis & respiration"

"The carbon cycle filters harmful elements in the air through respiration and photosynthesis as well as getting absorbed in the water. There is so much CO₂ gases that it can't be filtered fast enough so global warming occurs."

Some students tried to integrate the Carbon Cycle with the GH Effect.

"The carbon cycle is connected to the GH Effect because when trees/plants decompose, it releases CO₂ into the air but it cannot escape thus it just lingers over and then reflects back down to Earth. The Greenhouse Effect has a dense layer in the air in which the gases cannot escape."

III. Causes of Global Climate Change Alternative Conceptions

On the pretest students had no idea how scientists studied climate from the distant past. Later they understood and no misconceptions were evidenced on the posttest.

Other confusions were found, such as weather frequently described as a local event & climate as a regional event, with little association of climate with precipitation patterns, but some reference to temperature.

In terms of natural causes of climate change, students revealed a few interesting misconceptions that seemed linked to Al Gore's attempt to simplify a complex process. He makes the statement: 'It's like the Earth takes a giant breath each year'

Students' naïve conceptions:

"The Earth takes breaths each year giving off CO₂ into the air."

"The yearly carbon inhale and exhale due to the vegetation between the northern and southern hemispheres"

"During the summer and spring, the plants take in CO₂ and during the fall & winter they release CO₂."

There were a few alternative conceptions expressed when students were asked what scientists thought was causing the warming trend. The one below is related to ozone.

"Gases and pollution from the earth escape through the ozone layer making holes which allow more radiation from the sun to enter the planet and cause warming."

Another is related to the GH Effect, where about 10% of the students thought that GHG are trapped in the atmosphere and causing warming and some said that CO₂ is trapped by infrared radiation, mixing up the process.

IV Consequences of GCC

A variety of misconceptions were revealed on the posttest for this construct, including confusion about the ocean thermohaline or deep-density driven ocean circulation with the water cycle. Sample misconceptions revealed were:

- Currents moving weather patterns
- Salinity causing storms, volcanoes and typhoons
- Tsunamis related to GCC
- Confusions about the ocean conveyor belt

Sample of student's alternative conceptions:

"If the ocean has cool dense water interrupting the conveyor belt, like melting glaciers, the water cycle stops and another ice age could begin."

"As a result of acidification, the oceans are becoming warmer and it is not producing as many tidal waves and ocean currents."

In terms of potential impacts of GCC, a majority of students could give a partial answer on the pretest and some were able to answer with complete understanding on the posttest. No misconceptions were evidenced.