

Name: _____ Date: _____

Interstellar Crisis: Collegiate Climate Synthesis

Challenge students to model feedback loops and planetary shifts in this high-stakes assessment of advanced thermodynamics and geochemical forcing.

1. Which mechanism best describes the 'clathrate gun hypothesis' and its potential impact on Quaternary climate sensitivity?

- A. Rapid sea level fall triggering the oxidation of marine organic matter
- B. The abrupt release of methane from permafrost and seafloor sediments via positive thermal feedback
- C. Increased albedo due to sudden cloud seeding from dimethyl sulfide emissions
- D. The sequestration of carbon through enhanced silicate weathering in tropical zones

2. The ____ refers to the phenomenon where the Arctic warms faster than the global average due to the loss of sea ice and subsequent change in surface reflectivity.

- A. Hadley Cell Expansion
- B. Thermohaline Slowdown
- C. Arctic Amplification
- D. Isostatic Rebound

3. Equilibrium Climate Sensitivity (ECS) is defined as the long-term rise in global temperature resulting from a doubling of atmospheric CO₂ concentrations.

- A. True
- B. False

4. In the context of the Atlantic Meridional Overturning Circulation (AMOC), what is the primary risk associated with increased freshwater flux from the Greenland Ice Sheet?

- A. Increased deep-water formation due to higher salinity
- B. A reduction in the density of North Atlantic surface waters, potentially halting the thermohaline conveyor
- C. The immediate cooling of the Southern Ocean via the 'bipolar seesaw' effect
- D. A decrease in the atmospheric pressure over the Icelandic Low

5. Which isotope ratio is primarily utilized in paleoclimatology to reconstruct sea surface temperature and ice volume from foraminifera shells?

- A. C-12 to C-13
- B. O-16 to O-18
- C. U-235 to Pb-207
- D. Be-7 to Be-10

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6. The _____ effect describes the cooling influence of sulfate particles in the stratosphere, which is often discussed as a potential but risky geoengineering pathway.

- A. Stratospheric Aerosol Injection
- B. Radiative Forcing
- C. Ocean Alkalinization
- D. Direct Air Capture

7. A 'Negative Emission' strategy refers specifically to the practice of reducing carbon footprints to zero through lifestyle changes like plant-based diets.

- A. True
- B. False

8. How does ocean acidification specifically inhibit the biological pump in pelagic ecosystems?

- A. By increasing the metabolic rate of deep-sea decomposers
- B. By lowering the saturation state of calcium carbonate, making it difficult for calcifying organisms to build structures
- C. By promoting the overgrowth of macroalgae that block sunlight
- D. By accelerating the rate of nitrogen fixation in the euphotic zone

9. In the Keeling Curve, the annual 'sawtooth' oscillation in atmospheric CO₂ concentration is primarily caused by _____ in the Northern Hemisphere.

- A. Industrial production cycles
- B. Seasonal vegetation growth
- C. Oceanic outgassing
- D. Volcanic activity

10. The RCP (Representative Concentration Pathway) 8.5 scenario represents a 'business-as-usual' world with high greenhouse gas emissions and significant warming by 2100.

- A. True
- B. False