Name: _____ **Date:** _____

Answer Key: Solve the 9th Grade Climate Crisis Challenge

Challenge students to analyze albedo feedback loops, ocean acidification chemistry, and geopolitical mitigation strategies in this rigorous inquiry-based assessment.

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1. The melting of permafrost in the Siberian tundra releases vast amounts of organic matter. As this matter decomposes in anaerobic conditions, which potent greenhouse gas is released, creating a positive feedback loop?

Answer: B) Methane

Methane (CH_4) is produced during anaerobic decomposition in thawing permafrost; it is significantly more effective at trapping heat than CO_2 over a 20-year period.

2. Current ocean chemistry is shifting due to increased CO_2 absorption, a process known as _____, which reduces the availability of carbonate ions for calcifying organisms.

Answer: C) Ocean Acidification

Ocean acidification occurs when CO_2 reacts with seawater to form carbonic acid, lowering the pH and harming organisms like pteropods and shellfish.

3. The 'Albedo Effect' refers to a negative feedback loop where increased ice melt leads to more solar radiation being reflected back into space.

Answer: B) False

This is false; it is a positive feedback loop. Melting ice exposes darker ocean or land, which absorbs more heat, leading to further melting.

4. Which of the following describes a 'Climate Wedge' strategy as proposed by Pacala and Socolow to stabilize carbon emissions?

Answer: C) Implementing a series of existing technologies to reduce emissions by 1 gigaton each

The stabilization wedge theory suggests that using multiple available technological 'wedges' together can collectively achieve significant carbon reduction.

5. The slowing of the _____ (also known as the Ocean Conveyor Belt) due to freshwater influx from Greenland could drastically alter European climates.

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Answer: A) Thermohaline Circulation

Thermohaline circulation is driven by differences in temperature and salinity; melting glaciers dilute salt content, potentially stalling this heat-distributing current.

6. Stratospheric aerosol injection is considered a type of Solar Radiation Management (SRM) designed to cool the Earth by mimicking volcanic cooling effects.

Answer: A) True

SRM/Geoengineering involves reflecting sunlight away from Earth, though it does not address greenhouse gas concentrations or ocean acidification.

7. In the context of the Keeling Curve, what explains the annual 'sawtooth' oscillation of atmospheric CO2 concentrations?

Answer: B) Seasonal cycles of photosynthesis and respiration in Northern Hemisphere forests

The Northern Hemisphere has more landmass/vegetation; during spring and summer, plants pull CO2 from the air, causing the seasonal dip seen on the Keeling Curve.

8. The use of _____ (BECCS) involves growing crops to absorb CO2, burning them for energy, and sequestering the resulting emissions underground.

Answer: B) Bioenergy with Carbon Capture and Storage

BECCS is a 'negative emissions' technology that aims to remove carbon from the cycle while simultaneously producing usable energy.

9. Climate 'Adaptation' primarily refers to preventing global warming by switching entirely to wind and nuclear power generation.

Answer: B) False

This describes 'Mitigation.' Adaptation refers to adjusting to the changes that are already occurring, such as building floating cities or cooling centers.

10. How do Milankovitch Cycles differ from current anthropogenic climate change as drivers of global temperature?

Answer: A) They operate on timescales of tens of thousands of years rather than decades

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Milankovitch cycles (eccentricity, obliquity, and precession) are natural orbital variations that cause glaciation over long geological periods, unlike the rapid spike caused by human activity.