

# ACT Science Practice Paper

Use this passage to answer the next 7 questions:

The presence of gases in earth's atmosphere is a constant. Certain gases can absorb and hold onto heat from their environment. These gases are typically comprised of three molecules held together tenuously, which causes them to vibrate when they absorb heat. The motion of their vibrations leads to the release of their stored heat to the outside environment. The heat they release is typically quickly absorbed by other similar gases nearby. These gases remain in earth's atmosphere for a long time after being introduced. Because of this they can trap heat within the atmosphere, preventing it from leaving, by absorbing heat and releasing heat to be absorbed by other nearby similar gases.

## Hypothesis 1

Gases such as methane and nitrous oxide trap heat in the earth's atmosphere. Trapping heat in the earth's atmosphere leads to a greenhouse effect, gradually increasing the temperature of the earth. This increase in the earth's temperature will lead to the melting of glaciers, increasing sea level.

## Hypothesis 2

Gases such as methane but not nitrous oxide trap heat in the earth's atmosphere. The heat methane traps in the earth's atmosphere is less than the heat that escapes the earth leading to a global cooling effect, gradually decreasing the temperature of the earth. This decrease in earth's temperature will lead to the development of more glaciers, decreasing sea level.

## Hypothesis 3

Gases such as nitrous oxide but not methane trap heat in the earth's atmosphere. The heat nitrous oxide traps in the earth's atmosphere is equal to the heat that escapes the earth leaving the temperature of the earth generally unchanged. The earth's environment will remain largely unchanged by the heat trapping properties of nitrous oxide.

**1. Which hypothesis, if any, asserts that the effect on temperature of heat trapping gases is negligible?**

- Hypothesis 1
- Hypothesis 2
- Hypothesis 3
- None of the hypotheses

**2. Which hypothesis, if any, asserts that the effects of methane but not nitrous oxide will increase sea levels?**

- Hypothesis 1
- Hypothesis 2
- Hypothesis 3
- None of the hypotheses

**3. According to the author of hypothesis 2, would it be possible for earth's temperature to increase if the amount of heat methane traps in the atmosphere increased?**

- Yes, the hypothesis claims that increasing the quantity of heat will subsequently increase the quantity of heat nitrous oxide will trap
- Yes, the hypothesis claims methane isn't currently trapping a sufficient quantity of heat
- No, the hypothesis claims the sea level will decrease
- No, the hypothesis claims the temperature will decrease

**4. Which statement, if true, would disprove hypothesis 3?**

- The sea levels of earth have been steadily rising over the past several years and will continue to do so into the foreseeable future
- Methane doesn't have a role in trapping heat, but can influence soil quality
- When the heat trapping effects of both nitrous oxide and the gas carbon dioxide are considered, more heat is trapped in the earth than escapes from
- The average temperature of the earth has steadily decreased over the past century, commensurate to the industrialization of the world

**5. Which hypotheses operate on the assumption that gases have the potential to trap heat in earth's atmosphere?**

- Hypothesis 1
- Hypotheses 1 and 3
- Hypotheses 2 and 3
- Hypotheses 1, 2, and 3

6. Gasses that exist in the atmosphere remain in it for varying amounts of time. Two gases mentioned in each hypothesis, nitrous oxide and methane, have different 'lifespans' in the earth's atmosphere. How do they relate?

- Nitrous oxide lasts longer than methane
- Methane lasts longer than nitrous oxide
- Both gases last a similar time in the atmosphere
- Methane technically never enters the atmosphere and therefore cannot be compared to nitrous oxide's lifespan within the atmosphere.

7. In which way is hypothesis 2 similar to hypothesis 1?

- Both hypotheses conclude changes in sea level can lead to problematic safety issues for cities near a sealine.
- Both hypotheses conclude the earth's temperature influences the type of heat trapping gases that can be found in the atmosphere.
- Both hypotheses conclude the earth's sea levels with change as a direct result of the heat trapping potential of nitrous oxide.
- Both hypotheses conclude the temperature of the earth will change as a result of the heat trapping potential of one or more gases.

Use this passage for the next 6 questions:

Researchers studied sprinting ability to better understand differences between individuals in performance. After completion of the first study, researchers performed two follow up studies to explore the movement economy of and physiological response to sprinting. The same five subjects were used for each study.

### Study 1

Five healthy adult subjects with similar body weight and height were familiarized with the sprinting technique. Each subject was instructed to sprint as fast as they could in a linear path for 20 yards. Infrared timing gates were placed at 5 yards (G1), 10 yards (G2), 15 yards (G3), and 20 yards (G4) into the route to record timing and later extrapolate speed.

	G1 (seconds)	G2 (seconds)	G3 (seconds)	G4 (s
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Subject 1	0.98	1.71	2.45	3
Subject 2	0.88	1.63	2.42	3
Subject 3	0.93	1.65	2.39	3
Subject 4	1.24	2.01	2.88	3
Subject 5	1.11	1.83	2.66	3

*Figure 1*

## Study 2

The five healthy adult subjects from Study 1 were instructed to sprint as fast as they could in a linear path for 15 yards. An in-ground force plate was inserted on the route at the 10-yard point with the capacity to measure peak propulsive and braking forces in newtons. Propulsive forces have vectors in the +y direction and contribute to acceleration while sprinting. Braking forces have vectors in the -y direction and contribute to deceleration while sprinting.

	Peak Propulsive Force (newtons)	Peak Braking Force (newtons)
Subject 1	85	13
Subject 2	79	17
Subject 3	88	12
Subject 4	102	50

Subject 5	65	10
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*Figure 2*

### Study 3

The five healthy adult subjects from Study 1 and Study 2 were instructed to sprint as fast as they could in a linear path until they could no longer do so. Immediately after completion of their route blood samples were extracted from subjects. Blood samples were analyzed to measure concentration of blood lactate: larger quantities are a known biomarker for muscular fatigue.

	Blood Lactate (mmol/l)
Subject 1	4.5
Subject 2	4.6
Subject 3	4.4
Subject 4	5.2
Subject 5	4.9

*Figure 3*

1. What is the most likely reason the same five subjects were used for each study?

- It was more convenient given the subjects were already familiarized with the sprinting technique from Study 1
- It prevents an out-group homogeneity effect
- It allows for within-subjects comparisons across studies
- It decreases external validity of the studies, making them more reliable

**2. In Study 2, which subject is suggested to be moving fastest based on peak propulsive and braking forces?**

- Subject 1
- Subject 3
- Subject 4
- Subject 5

**3. Suppose the peak propulsive force of Subject 3 had been lesser than their peak braking force between G3 and G4, what would this signify?**

- The subject would be traveling backwards.
- The subject would be traveling at a constant velocity.
- The subject would be accelerating.
- The subject would be decelerating.

**4. Based on the three studies, what can be observed about the role of local muscular fatigue on 20-yard sprint performance?**

- The fastest sprinters demonstrate more local muscular fatigue after sprinting according to blood lactate concentration.
- The fastest sprinters demonstrate less local muscular fatigue after sprinting according to blood lactate concentration.
- The fastest sprinters demonstrate more local muscular fatigue after sprinting according to peak propulsive forces produced.
- The fastest sprinters demonstrated less local muscular fatigue after sprinting according to peak braking forces produced.

**5. Which of the following is a major flaw in the design of Study 2?**

- Subjects ran 15 yards instead of 5 yards.
- The infrared timing gates were placed at positions different than in Study 1.
- Force data was only collected at a single point and was not representative of sprinting ability

over the entirety of a 20-yard distance.

- Blood samples were taken immediately after sprinting because subjects were still sweating and could contaminate the sample.

**6. In Study 1, which subject traveled fastest between G3 and G4?**

- Subject 1
- Subject 2
- Subject 3
- Subject 5