

Suggested exam questions tied to Unit 1 learning goals:

### Multiple Choice

A global temperature anomaly of  $0.21^{\circ}\text{C}$  means:

- The global temperature averaged  $0.21^{\circ}\text{C}$  that year
- The globe was, on average,  $0.21^{\circ}\text{C}$  warmer than average that year**
- The globe was, on average,  $0.21^{\circ}\text{C}$  cooler than average that year
- Every location on the globe as  $0.21^{\circ}\text{C}$  warmer than average that year
- Every location on the globe as  $0.21^{\circ}\text{C}$  cooler than average that year

How would you describe the instrumental temperature record since 1880?

- A steady increase in temperature for the whole period
- Periods of warmer and cooler temperatures with an overall warming trend**
- Periods of warmer and cooler temperatures with no overall warming or cooling trend
- An increase in temperature during the 20<sup>th</sup> century followed by a recent cooling trend

How does energy from the Sun travel to Earth?

- Conduction
- Convection
- Electromagnetic radiation**
- Solar wind

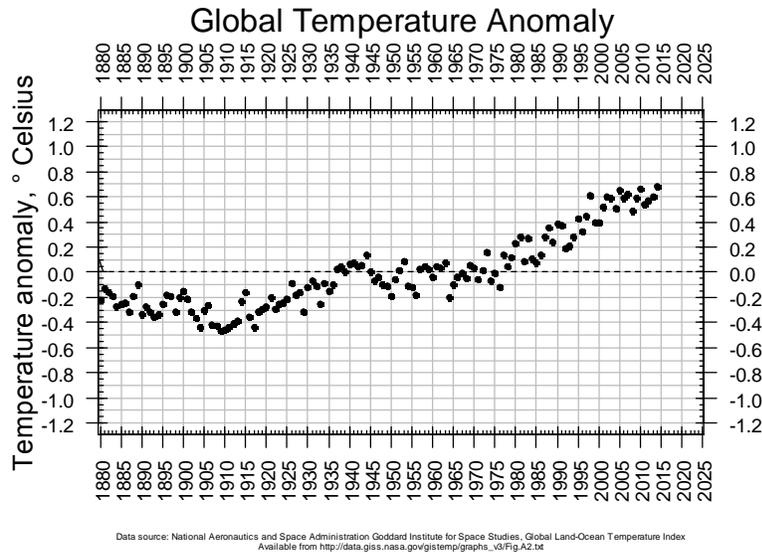
### Short Answer and Essay

Describe, in words, the relationship between Earth's temperature pattern since 1880 and the amount of incoming solar radiation over that time.

*The temperature pattern since 1880 shows an overall warming trend of approximately  $1.0^{\circ}\text{C}$ . Within this warming trend, there are many interannual and decadal variations, including periods where temperatures appear to be cooling (such as between 1900-1910) and staying constant (such as between 1960-1970). The pattern of solar irradiance shows a regular, cyclical pattern that repeats every 11 years or so (the solar cycle). Superimposed on this 11-year cycle are periods of slightly higher (1965-1985) and lower (1880-1910) irradiance. The overall increase in temperature seen in the data does not appear to match variations in solar irradiance.*

Describe, in words, what would happen to Earth's surface temperature if glaciers grew in size, increasing Earth's albedo.

*If Earth's glaciers grew in size, this would increase Earth's albedo, and more incoming solar energy would be reflected. As more energy is reflected, less would be absorbed by the surface of the earth. If all other factors were kept equal, Earth's surface temperature would decrease in response to the decrease in energy absorbed at the surface.*



Define anomaly as used in the graph above

*A temperature anomaly is the difference between a given year's global temperature and the long-term average.*

In 2007 J. Scott Armstrong (Professor of Marketing at the Wharton School) extended a bet to Al Gore that global temperatures would not rise over the next decade. Al Gore refused to take the bet. If you were offered a similar bet today would you take it (assuming that you would wish to win)? Use the temperature record above to explain why you chose your answer. Your answer will be evaluated on how well it interprets the data to support your conclusion.

*Students could successfully argue either position (taking the bet or not); it would depend on their risk tolerance and interpretation of the graph's trend. Key points are that the trend is clearly positive since 1970, but decadal variation is quite large. 2007 was one of the ten warmest years on record. (This would be hard to decipher from the graph, but from 2007 through 2013 the mean annual temperature anomaly was nearly flat, but 2014 and 2015 were record warm years, so it looks like Gore might have won...)*