



Exploring the World of Science

Meteorology

HOLT INVITATIONAL 2018

SCHOOL: _____ TEAM # _____

TEAM MEMBERS: _____ & _____

SCORE: _____ TIME COMPLETED: _____

PLACE: _____

DIRECTIONS:

All answers must be written on the Meteorology Answer Sheet. All other answers will not be graded.

There are three pre-identified tiebreakers on the test. If a tie is not broken with the tie breakers, then team that completed the test in the shortest amount of time will place above the other team.

Meteorology Answer Sheet

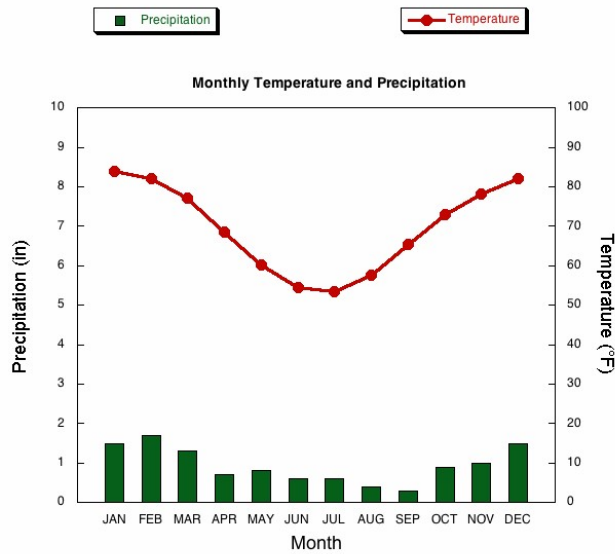
Holt Invitational 2018

- | | | | |
|-----------|-----------|-----------|------------|
| 1. _____ | 13. _____ | 25. _____ | 37. _____ |
| 2. _____ | 14. _____ | 26. _____ | 38. _____ |
| 3. _____ | 15. _____ | 27. _____ | 39. _____* |
| 4. _____ | 16. _____ | 28. _____ | 40. _____ |
| 5. _____ | 17. _____ | 29. _____ | 41. _____ |
| 6. _____ | 18. _____ | 30. _____ | 42. _____ |
| 7. _____ | 19. _____ | 31. _____ | 43. _____ |
| 8. _____ | 20. _____ | 32. _____ | 44. _____ |
| 9. _____ | 21. _____ | 33. _____ | 45. _____ |
| 10. _____ | 22. _____ | 34. _____ | |
| 11. _____ | 23. _____ | 35. _____ | |
| 12. _____ | 24. _____ | 36. _____ | |

* Tiebreaker Question

Short Answer:

Use the climate graph for the following city to classify the climate according to the Köppen Classification system. Provide an explanation. (4 points) (Tiebreaker #2)



Classification: _____

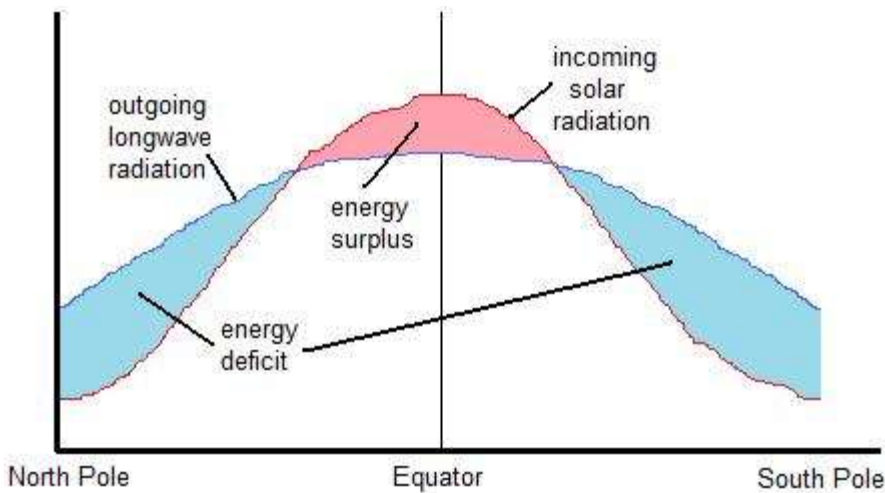
Explanation:

In reference to the equator, where would you find this city? Use evidence from the graph to support your answer. (2 points)

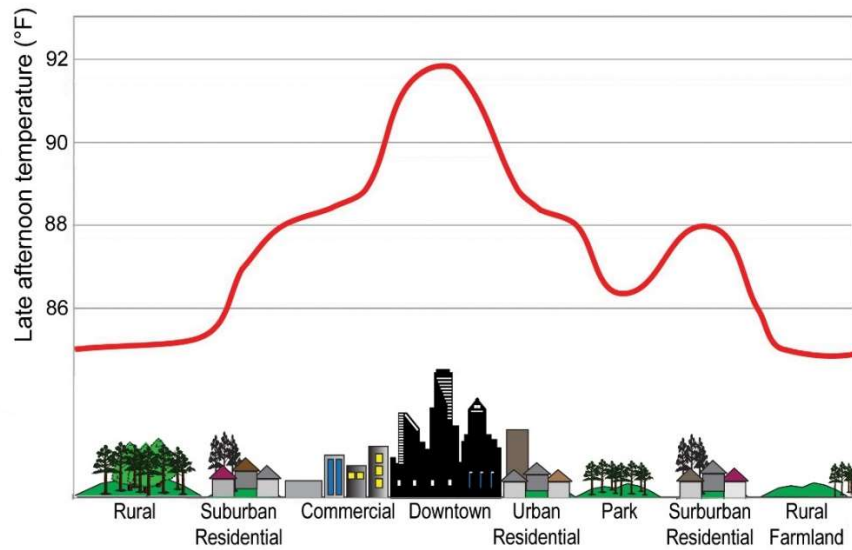


Explain how the ocean is a large factor in shaping climate zones on earth. (3 points)

Annual Radiation Budget

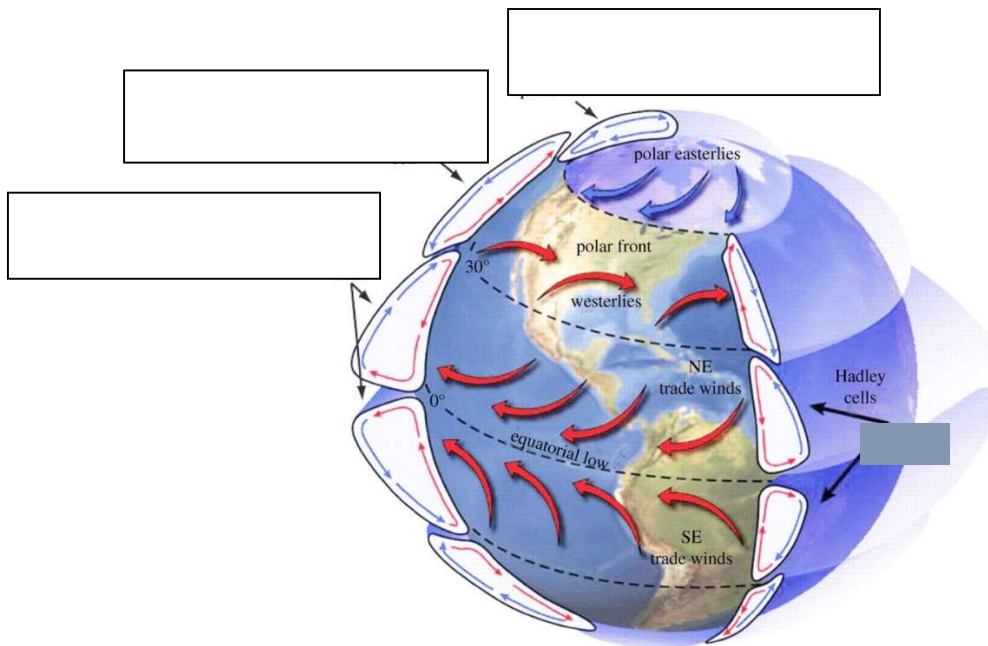


From the graph above of the annual radiation budget, your classmate makes a claim that the tropics are getting hotter and the poles are getting colder. Do you agree with your classmate? Provide an explanation. (3 points)



Provide an explanation for the above profile. What is the term used to describe this phenomenon? What factors cause this effect? (4 points) (Tiebreaker #3)

Using the three cell model, label the global circulation patterns below: (3 points)



Meteorology Test

Holt Invitational 2018

Write the answers to the multiple choice questions 1-45 on the Meteorology Answer Sheet. Answers circled and not on the answer sheet will not be graded.

1. Weather, like rain, sleet, or thunderstorms, occurs in which layer of the atmosphere?
 - A) Thermosphere
 - B) Exosphere
 - C) Stratosphere
 - D) Troposphere

2. The most abundant gases in the earth's atmosphere by volume are:
 - A) Carbon dioxide & water vapor
 - B) Oxygen & carbon dioxide
 - C) Nitrogen & oxygen
 - D) Oxygen & helium

3. In the atmosphere, tiny solid or liquid suspended particles of various compositions are called:
 - A) Aerosols
 - B) Greenhouse gases
 - C) Carcinogens
 - D) Sulfates

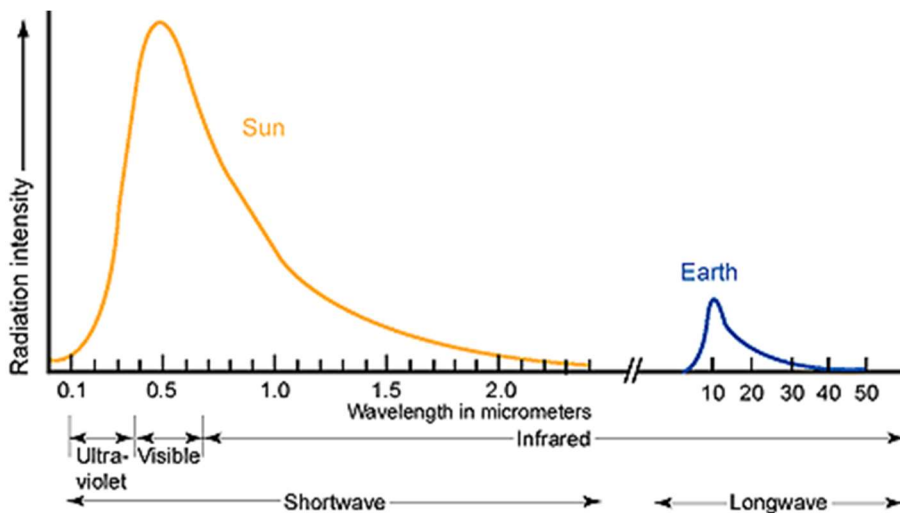
4. The ozone layer in the stratosphere absorbs
 - A) visible light
 - B) infrared rays
 - C) ultraviolet radiation
 - D) carbon dioxide

5. Which type of wave in the electromagnetic spectrum is radiated out from Earth to heat the atmosphere?
 - A) Visible light
 - B) Ultraviolet light
 - C) Microwaves
 - D) Infrared light

6. Which of the following processes act to remove carbon dioxide from the atmosphere?
 - A) Deforestation
 - B) Burning of fossil fuels
 - C) Respiration
 - D) Photosynthesis

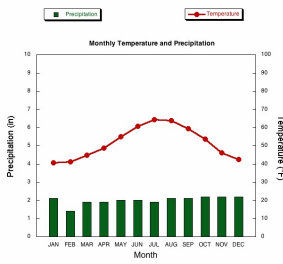
7. Scientist hypothesize the earth's earliest atmosphere was a result of:
 - A) Volcanic outgassing
 - B) Bacteria
 - C) Plants
 - D) Earthquakes
 - E) None of these

8. Which is responsible for the increase of oxygen in the early atmosphere?
- Volcanos
 - Solar winds
 - Bacteria
 - Photosynthesis
 - Both C and D
9. What effect do pure sulfates and nitrate aerosols have on the earth's atmosphere?
- Absorb radiation warming the atmosphere
 - Absorb radiation cooling the atmosphere
 - Reflect radiation warming the atmosphere
 - Reflect radiation cooling the atmosphere
 - They have little to no effect
10. Which of the following is used to detect climate change?
- Sea-floor sediments
 - Oxygen Isotope Analysis
 - Ice core samples
 - Fossils
 - All of the above

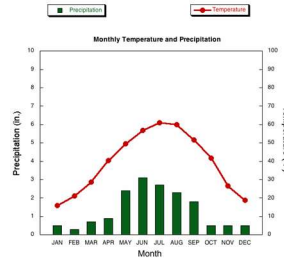


11. According the graph above the sun's radiation intensity is highest in the:
- Ultraviolet range
 - Visible range
 - Infrared range
 - Longwave range
 - Both C & D
12. Which does not affect the amount of incoming radiation?
- Clouds
 - Time of year
 - CO₂
 - Particulates in the atmosphere

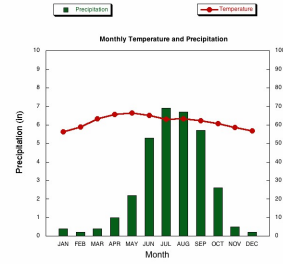
13. At night low clouds:
- A) Enhance the atmospheric greenhouse effect
 - B) Weaken the atmospheric greenhouse effect
 - C) Are caused by the atmospheric greenhouse effect
 - D) Have no effect on the atmosphere greenhouse effect
14. If the amount of energy lost by the earth to space each year were not approximately equal to that received:
- A) The atmosphere's average temperature would change
 - B) The length of year would change
 - C) The sun's output would change
 - D) The mass of the atmosphere would change
 - E) All of the above
15. Which of the following is not a reason why water warms and cools more slowly than land?
- A) Solar energy penetrates more deeply into water
 - B) Heat energy is mixed in a deeper layer of water
 - C) Water has a higher heat capacity
 - D) A portion of the solar energy that strikes water is used to evaporate it
 - E) It takes more energy to raise the temperature of a given amount of soil 1° C than it does to raise an equal amount of water 1° C.
16. During an equinox:
- A) The days and night are of equal length except at the poles
 - B) At noon the sun is overhead at the equator
 - C) The earth is not tilted toward nor away from the sun
 - D) All of the above
17. Which surface will have the largest albedo?
- A) Fresh snow
 - B) Sand
 - C) Forest
 - D) Grass
18. Which would most likely be the correct order of daytime surface temperatures from coldest to warmest:
- A) Snow, grass, sea ice, deciduous forest
 - B) Grass, deciduous forest, snow, sea ice
 - C) Deciduous forest, grass, snow, sea ice
 - D) Snow, sea ice, grass, deciduous forest



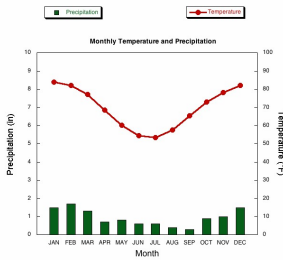
City A



City B

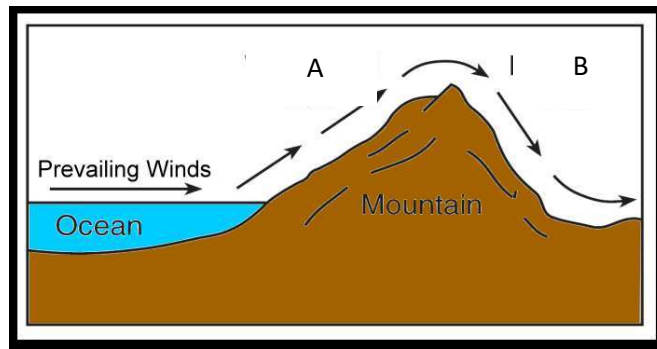


City C



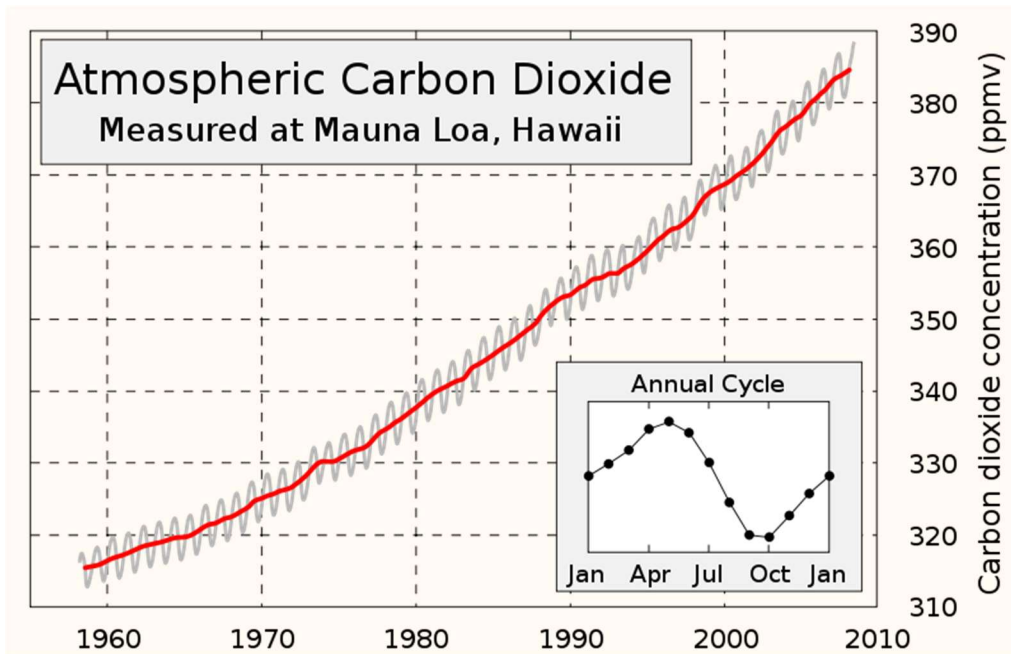
City D

19. Using the climate graphs of the cities above, which city would be located near the equator?
- A) City A
 - B) City B
 - C) City C
 - D) City D
20. Using the climate graphs from the above cities, which city would most likely be located in the southern hemisphere?
- A) City A
 - B) City B
 - C) City C
 - D) City D
21. Scientists studying climate collect data that is slightly different from the data collected by those interested in weather. What is different about the data collected about climate? Climate data –
- A) does not include information about air temperature
 - B) requires more specialized equipment than weather data
 - C) focuses on conditions only in the upper atmosphere
 - D) refers to longer times and wider areas than weather data
22. What climate data is needed to classify a climate using the Köppen's system?
- A) Temperature & Cloud coverage
 - B) Latitude & Precipitation
 - C) Prevailing wind & Temperature
 - D) Temperature & Precipitation
 - E) None of the above
23. What caused the "Year without a Summer" throughout Europe and New England in 1816?
- A) the 6-month eruption of Mt Pinatubo
 - B) the estimated 30 Km³ of debris emitted during the eruption of Mt Tambora
 - C) the increase of carbon dioxide in the atmosphere due to industrialization
 - D) Orbital variation



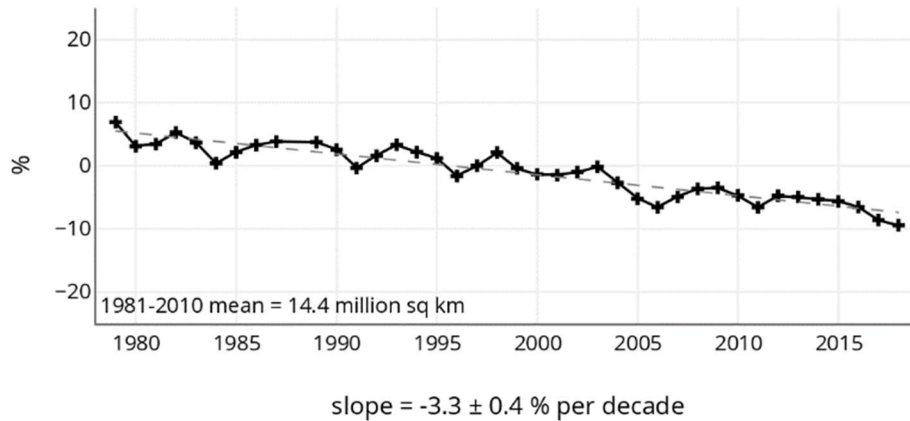
Use the diagram to answer the following questions. Label as either “A” or “B”:

24. _____ Windward side
 25. _____ Leeward side
 26. _____ Cool, moist climate
 27. _____ Cloud formation
 28. _____ Warm, arid climate
29. Which of the following is not a greenhouse gas?
 - A) Methane
 - B) Nitrogen
 - C) Water vapor
 - D) Carbon dioxide
 30. Which of the following is not true about the Greenhouse Effect?
 - A) Gasses in the atmosphere trap incoming solar radiation
 - B) light from the sun is converted into heat and radiated back to space, but getting trapped by gasses in the atmosphere
 - C) it keeps the Earth at a temperature that can support life
 - D) water is the most effective Greenhouse Gas.
 31. Which of the following is not considered a “natural” mechanism of climate change?
 - A) Plate tectonics
 - B) Volcanic activity
 - C) Solar variability
 - D) Desertification
 32. The last glacial maximum occurred:
 - A) during the Little Ice Age
 - B) about 15-20,000 years ago
 - C) during the 1810-1819 decade, the coldest decade in Europe since the seventeenth century
 - D) during the Holocene Epoch.



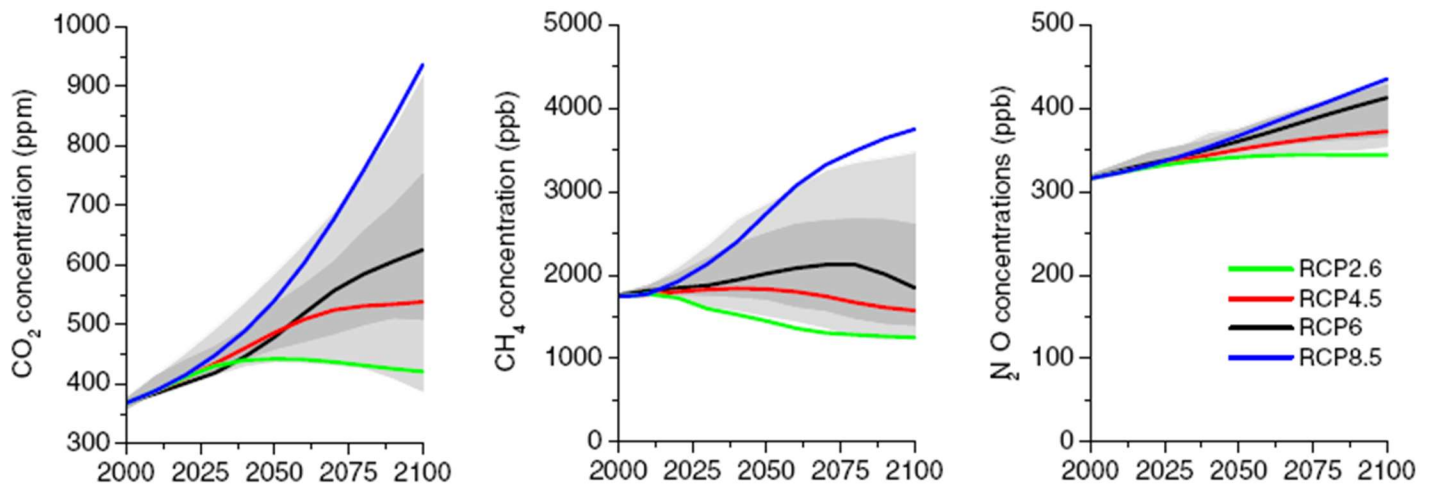
33. The figure above shows the changes in atmospheric CO₂ in the north hemisphere due to?
- increased emissions from human combustion of fossil fuels
 - increased deforestation
 - seasonal changes in primary productivity
 - all of the above
 - none of the above
34. More than 2 billion years ago, a much fainter sun should have left the Earth as an orbiting ice ball, unfit to develop life as we know it today. This is known as the:
- Thornthwaite projection
 - Faint young sun paradox
 - El Nino
 - Milankovitch cycle
35. Why is the Paleo-Eocene thermal maximum thought of as a great analog for modern climate change?
- Because the ocean was so warm is caused a mass extinction
 - Because the event is associated with a large input of a large amount of carbon in the atmosphere
 - Because the event is associated with the extinction of dinosaurs
 - Because all of the ice on earth melted during the event
 - All of the above

Northern Hemisphere Extent Anomalies Jan 1979 - 2018



National Snow and Ice Data Center, University of Colorado, Boulder

36. The graph above is Arctic sea ice extent for the Northern Hemisphere from National Snow and Ice Data Center. Which of the following best explains the natural climate feedback trend on the graph?
- A) Exposing more open ocean allows a great deal of solar energy to be absorbed by the earth's surface causing temperatures to increase and leading to more melting and the cycle to continue.
 - B) Exposing more dark soil on land will allow for more solar energy to be absorbed by the earth's surface causing temperatures to increase and the cycle to continue.
 - C) Exposing less open ocean allows more solar energy to be absorbed by the earth's surface causing temperatures to decrease and the cycle to continue.
 - D) Sea ice extent is not a variable when considering earth's rise in global temperature.
37. The direct measure of the amount that the Earth's energy budget is out of balance is known as:
- A) Radiative forcing
 - B) Greenhouse effect
 - C) Solar accountability
 - D) Albedo
 - E) None of the above



38. According to the graph above, which pathway would be consistent with a future with no policy change to reduce emissions and a heavy reliance of fossil fuels.
- RCP2.6
 - RCP4.5
 - RCP6
 - RCP8.5
39. According to the latest Intergovernmental Panel on Climate Change (IPCC) report, how much will the average global surface temperature will increase if there is a doubling of greenhouse gases (expressed as carbon dioxide equivalents) in the air, once the planet has had a chance to settle into a new equilibrium after the increase occurs.
- 1°C
 - 3°C
 - 5°C
 - 7°C
 - No change in temperature

