

Think – Pair - Share

Dr. Edward Prather

University of Arizona

Center for Astronomy Education (CAE)

<http://astronomy101.jpl.nasa.gov>



Center for Astronomy Education

» Dedicated to the professional development of introductory astronomy instructors

Think-Pair-Share (TPS) aka Peer Instruction:

A questioning in the classroom technique that makes use of a combination of conceptually challenging multiple choice questions, and classroom feedback designed to increase student-to-student discourse and provide insight into students' learning for you and them

Crouch, C. H. & Mazur, E. 2001, "Peer Instruction: Ten Years of Experience and Results," *American Journal of Physics*, 69(9), 970, 2001

Development and Application of a Situated Apprenticeship Approach to Professional Development of Astronomy Instructors, Prather, E. E., and Brissenden, G. *The Astronomy Education Review*, 7(2), 2008

Clickers as Data Gathering Tools and Students' Attitudes, Motivations, and Beliefs on Their Use in this Application, Prather, E. E., Brissenden, G., *The Astronomy Education Review*, 8 (1), 2009 .



Center for Astronomy Education

» Dedicated to the professional development of introductory astronomy instructors

Idealized (& shorthand) Implementation of Think-Pair-Share

- Create a cognitively engaging multiple-choice question that challenges students thinking and has the ability to foster deep discussion amongst your students.
- Present question to students.
- Ask students to "think" individually about the question (and find the best answer)
- Have students anonymously and simultaneously vote on their answer to the question.
- Decide if students should "share" their answers with each other. If so then...
- Ask students to "pair" with someone next to them and to "share" their answers with each other with the goal of trying to convince their partner that their own answer is the correct one.
 - *“Turn to your neighbor and convince them that you are right, just because you have the same answer that does NOT mean you are right, so be sure to explain your reasoning”*
- Again have students anonymously and simultaneously vote on their answer to the question.
- Debrief the results and correct answer to your students.

Techniques for all classes

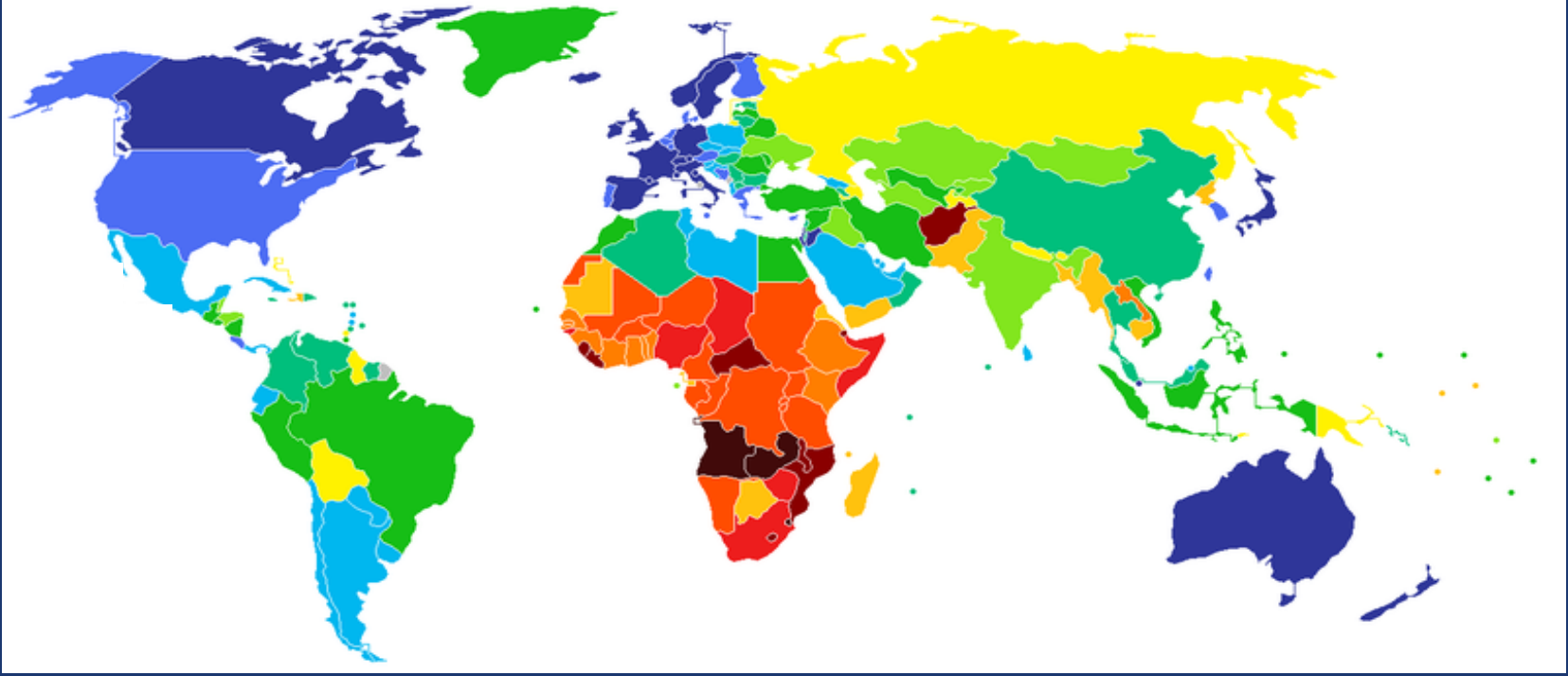






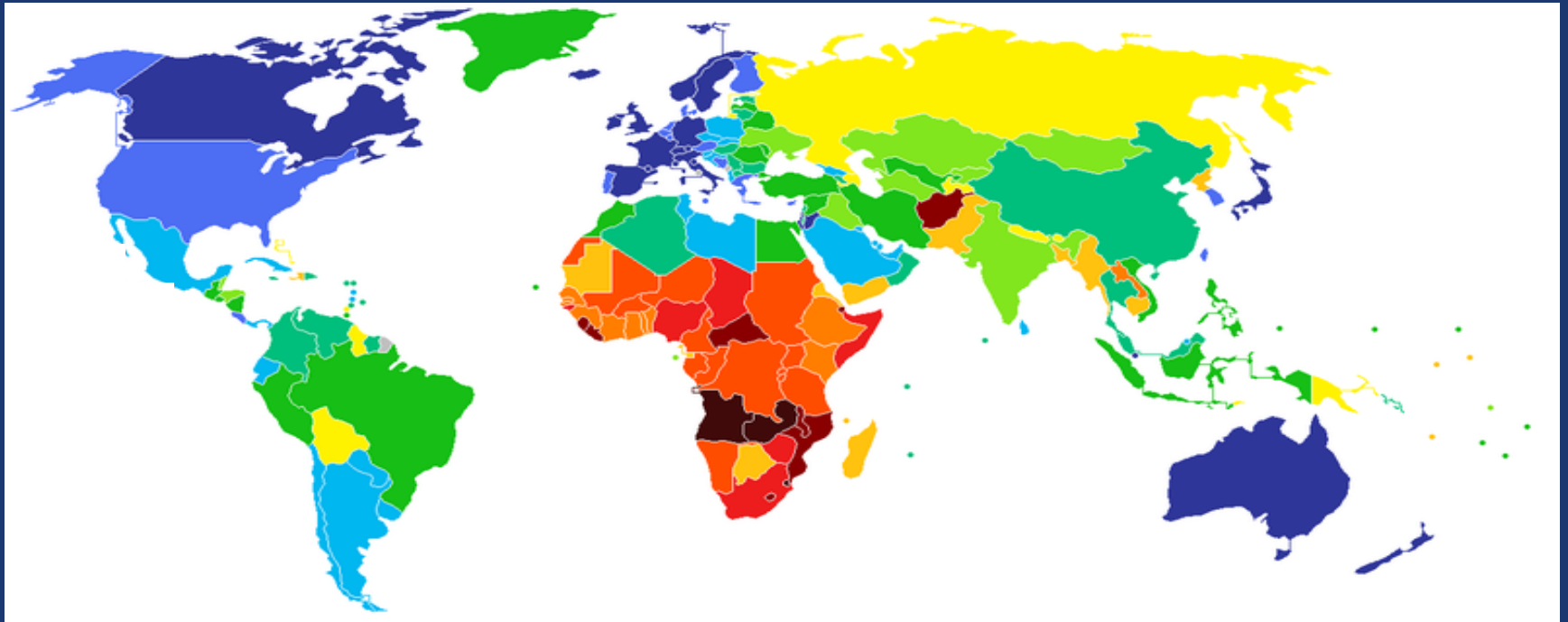


What does this chart represent?

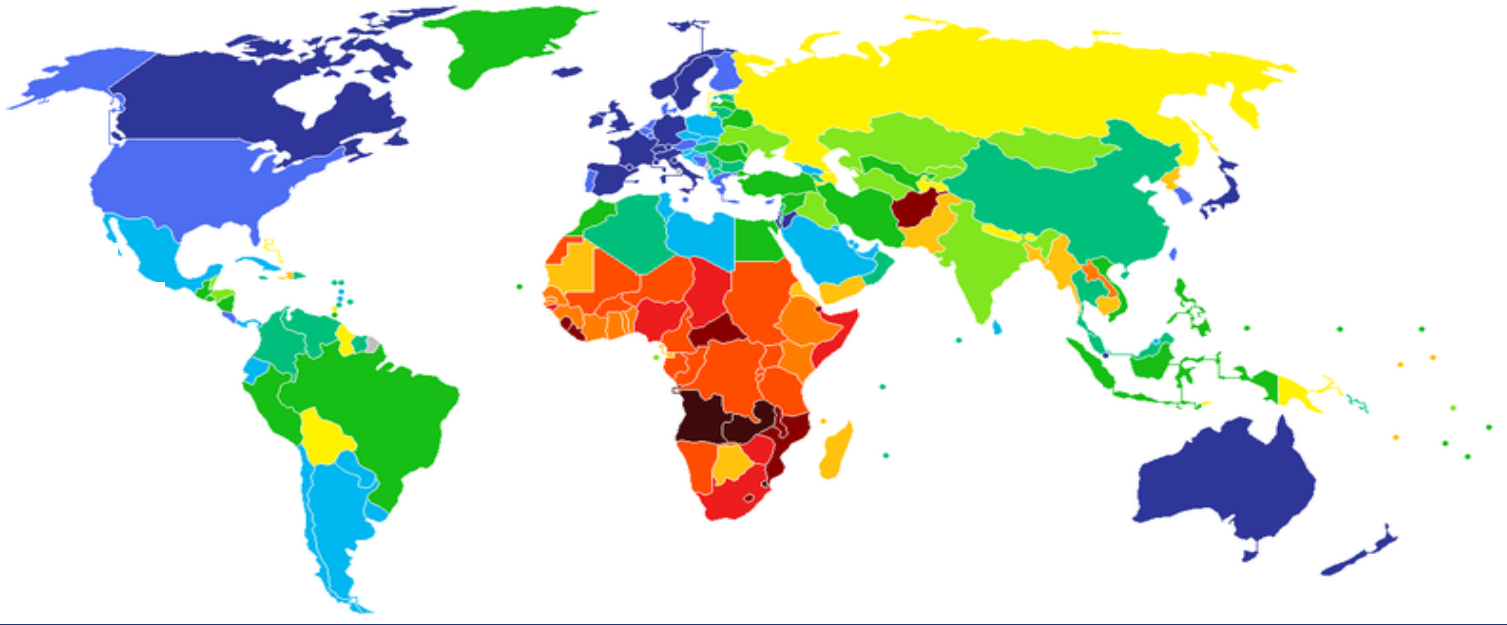


Work with your partner and write a multiple choice question that would provoke a thoughtful discussion amongst students about this false color map?

Could any of the items listed below be represented by this false color image?



- Average household income
- Infant mortality rate
- Emission of Greenhouse gasses
- Average life expectancy
- Percent of citizenry with a college degree



- Average household income
- Infant mortality rate
- Emission of Greenhouse gasses
- Average life expectancy
- Percent of citizenry with a college degree

How many of the listed items could be represented by this false color image?

A. Only one

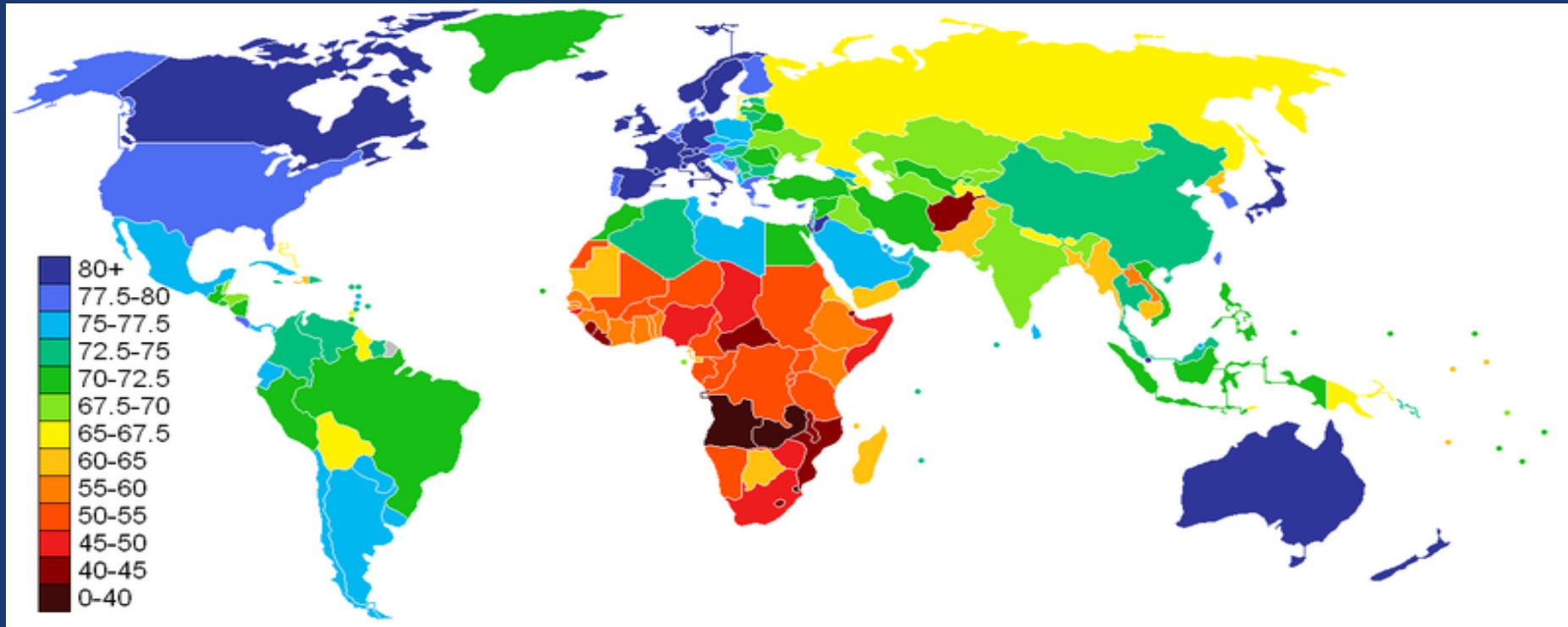
B. Two

C. Three

D. Four

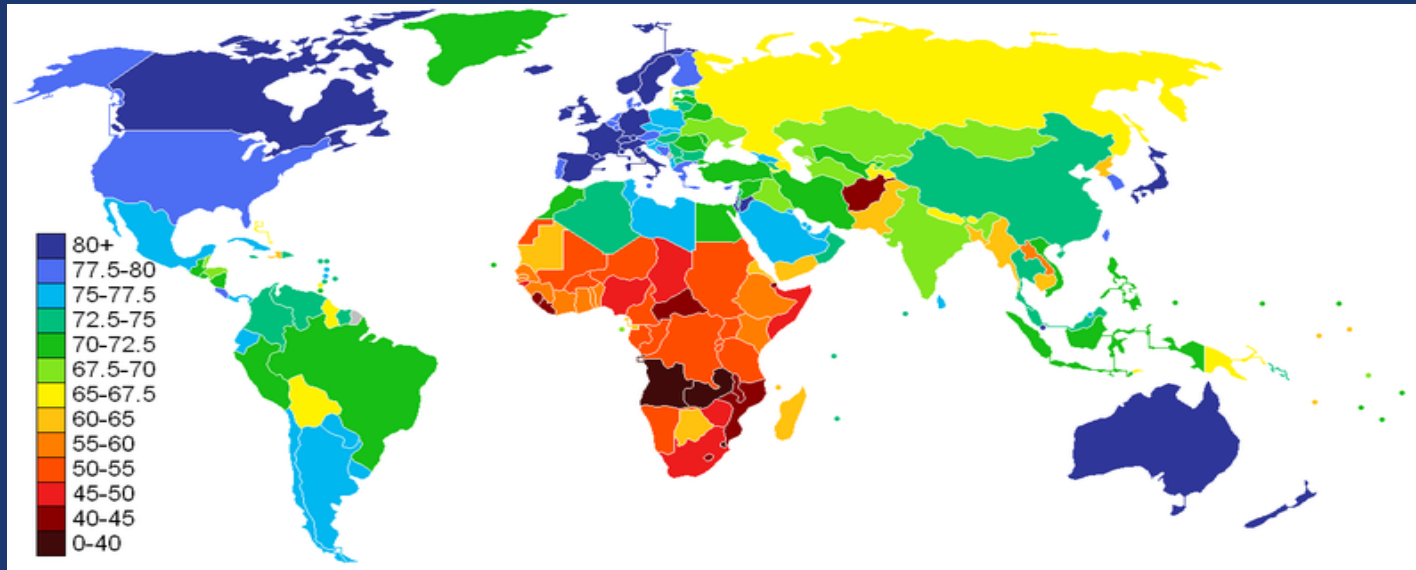
E. All are possible

CHART OF AVERAGE LIFE EXPECTANCY



Ranking the continents, from greatest to least “average” life expectancy.

CHART OF AVERAGE LIFE EXPECTANCY



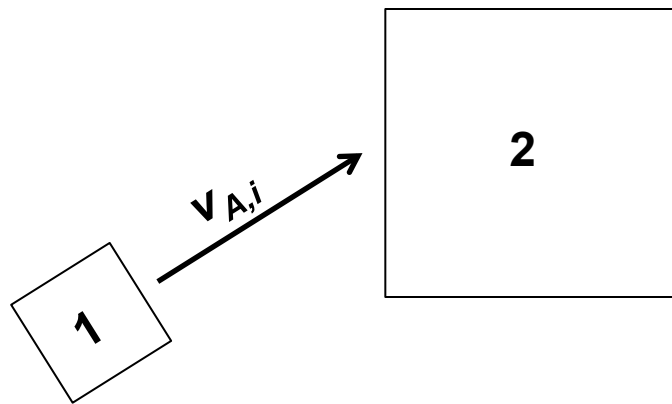
Which of the following is the correct ranking of the continents, from greatest to least “average” life expectancy.

- A. Australia, North America, Europe, South America, Asia, Africa
- B. North America, Australia, Europe, South America, Asia, Africa
- C. Africa, Asia, South America, Europe, North America, Australia
- D. Europe, Australia, North America, South America, Asia, Africa
- E. None of the above is correct

Idealized (& shorthand) Implementation of Think-Pair-Share

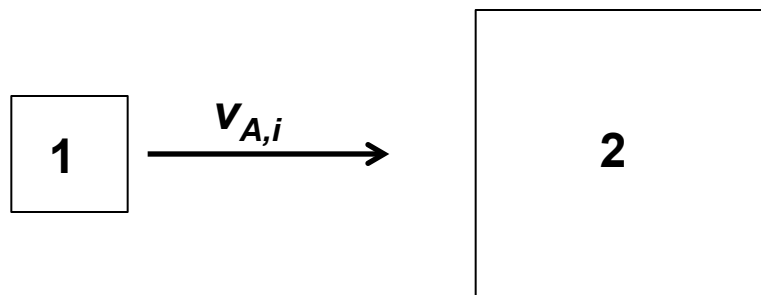
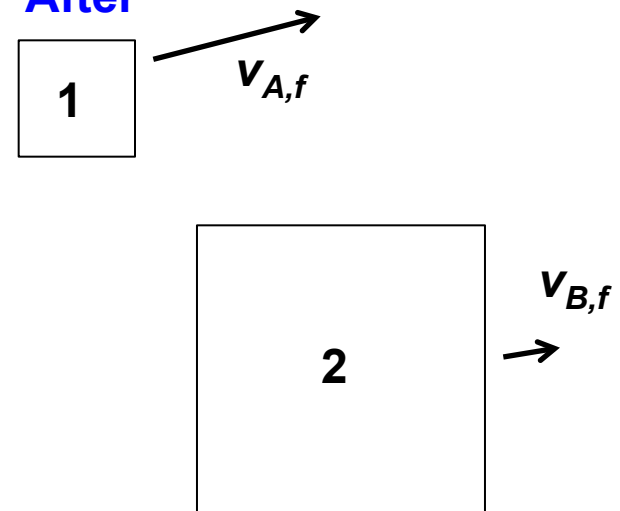
- Create a cognitively engaging multiple-choice question that challenges students thinking and has the ability to foster deep discussion amongst your students.
- Present question to students.
- Ask students to "think" individually about the question (and find the best answer)
- Have students anonymously and simultaneously vote on their answer to the question.
- Decide if students should "share" their answers with each other. If so then...
- Ask students to "pair" with someone next to them and to "share" their answers with each other with the goal of trying to convince their partner that their own answer is the correct one.
 - *“Turn to your neighbor and convince them that you are right, just because you have the same answer that does NOT mean you are right, so be sure to explain your reasoning”*
- Again have students anonymously and simultaneously vote on their answer to the question.
- Debrief the results and correct answer to your students.

Before

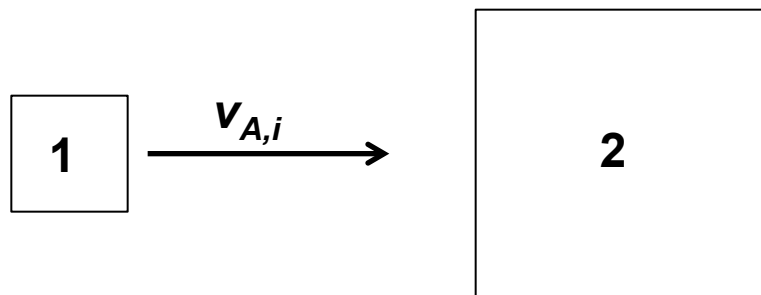
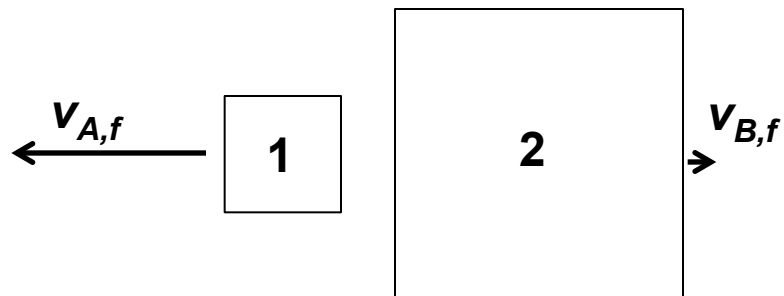


A

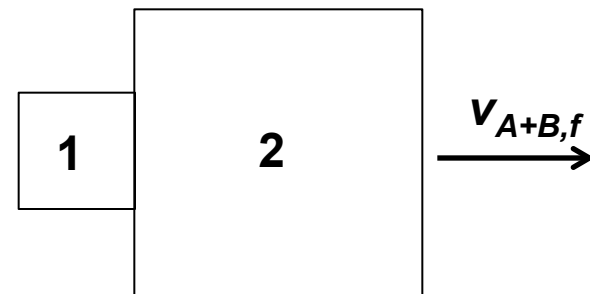
After



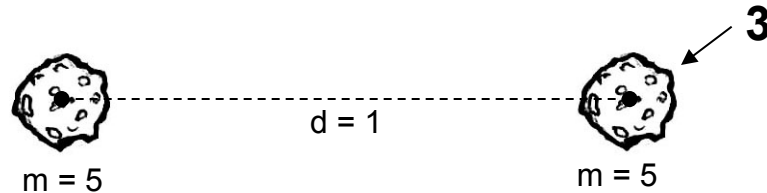
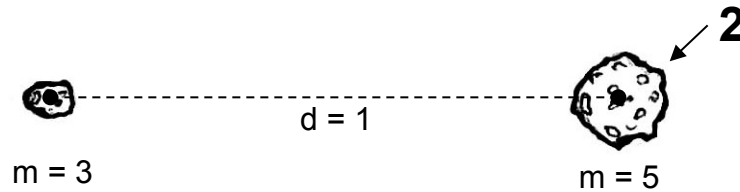
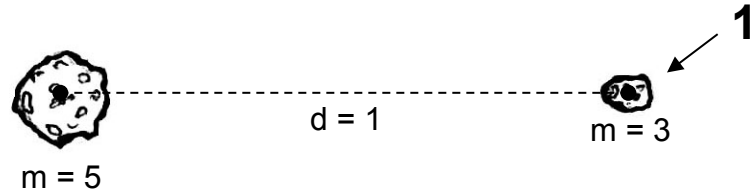
B



C



Which of the following is the best ranking (from greatest to least), for the gravitational force exerted on asteroids 1, 2 and 3 by their partner asteroids?



A. $3 > 2 > 1$

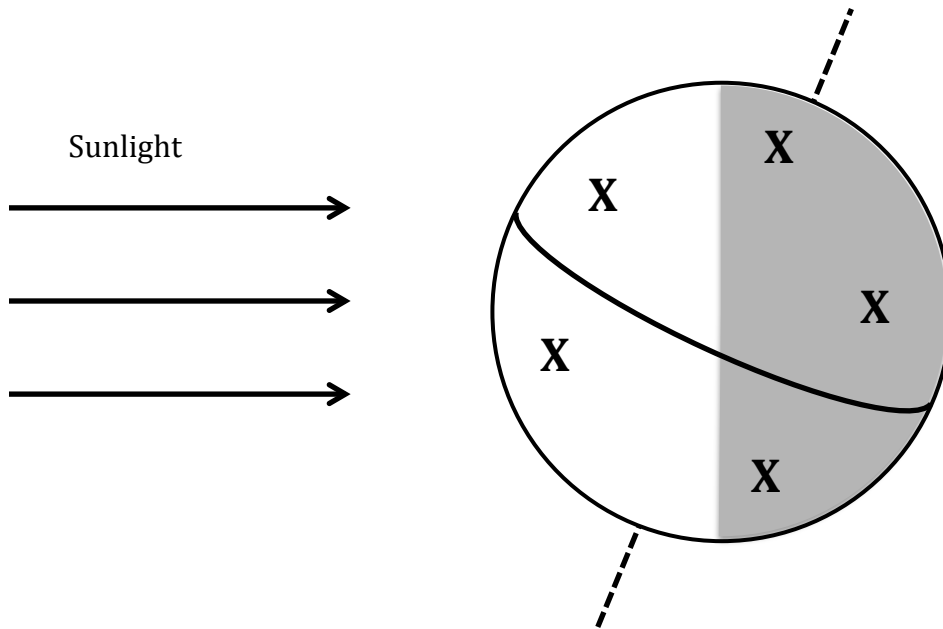
B. $3 = 2 > 1$

C. $3 > 2 = 1$

D. $1 = 2 > 3$

E. $3 = 1 > 2$

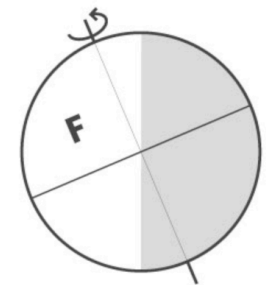
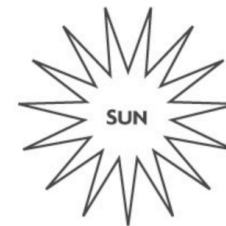
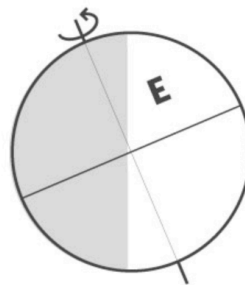
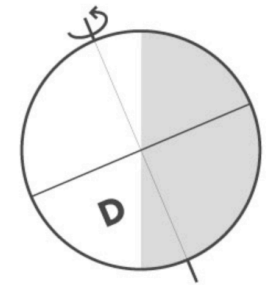
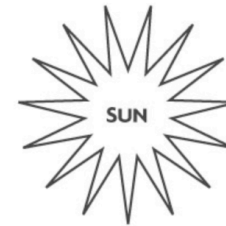
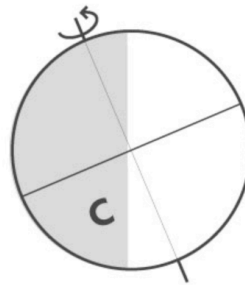
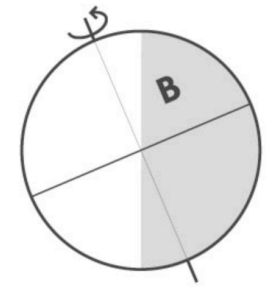
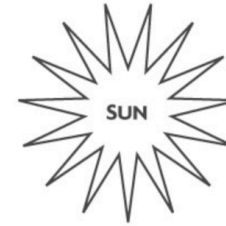
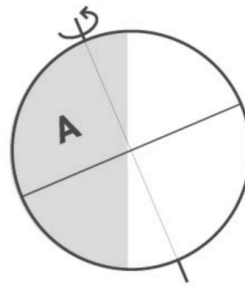
How many of the Earth locations marked with an “X” would be experiencing Winter?



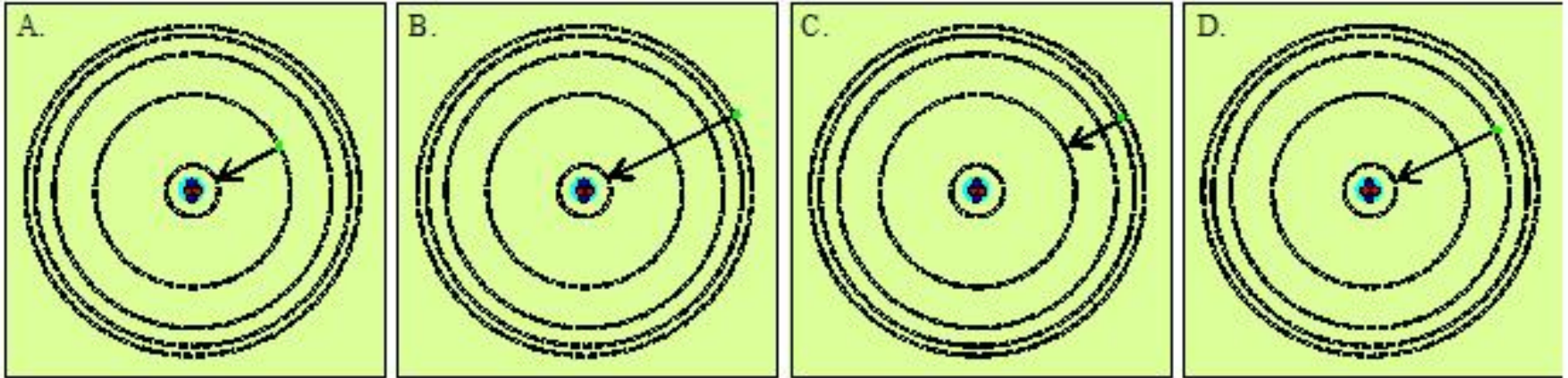
- A. Only one
- B. Two
- C. Three
- D. Four
- E. All Five

How many of the locations (A-F) would be experiencing Winter?

- A. only one**
- B. two**
- C. three**
- D. four**
- E. all the positions are experiencing Summer.**

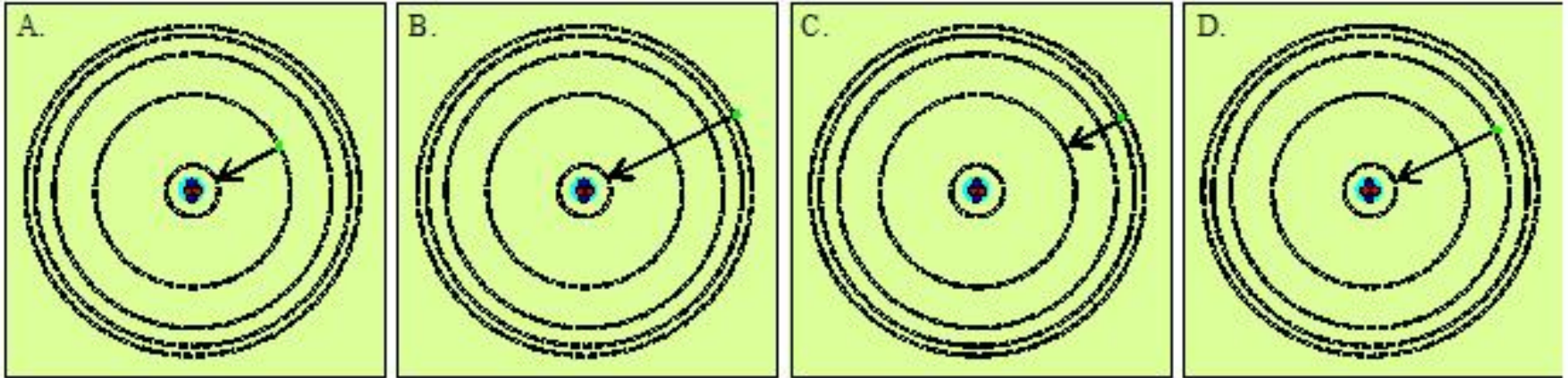


Which atom has absorbed light with the shortest wavelength?



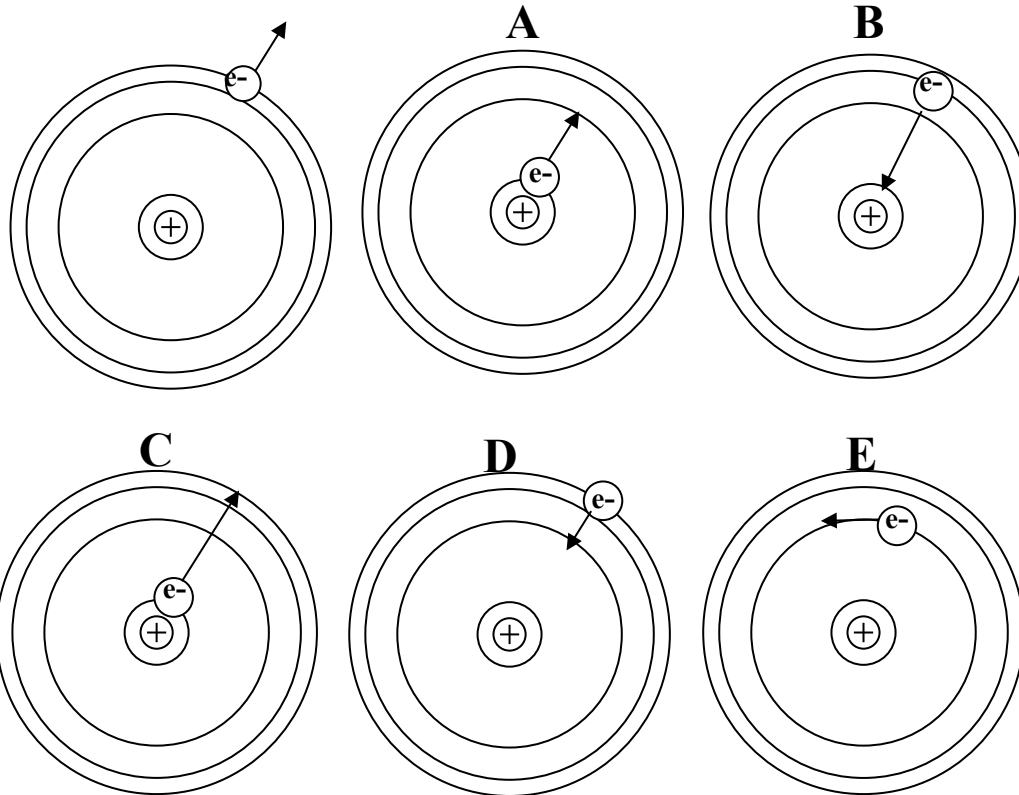
E. None of the above

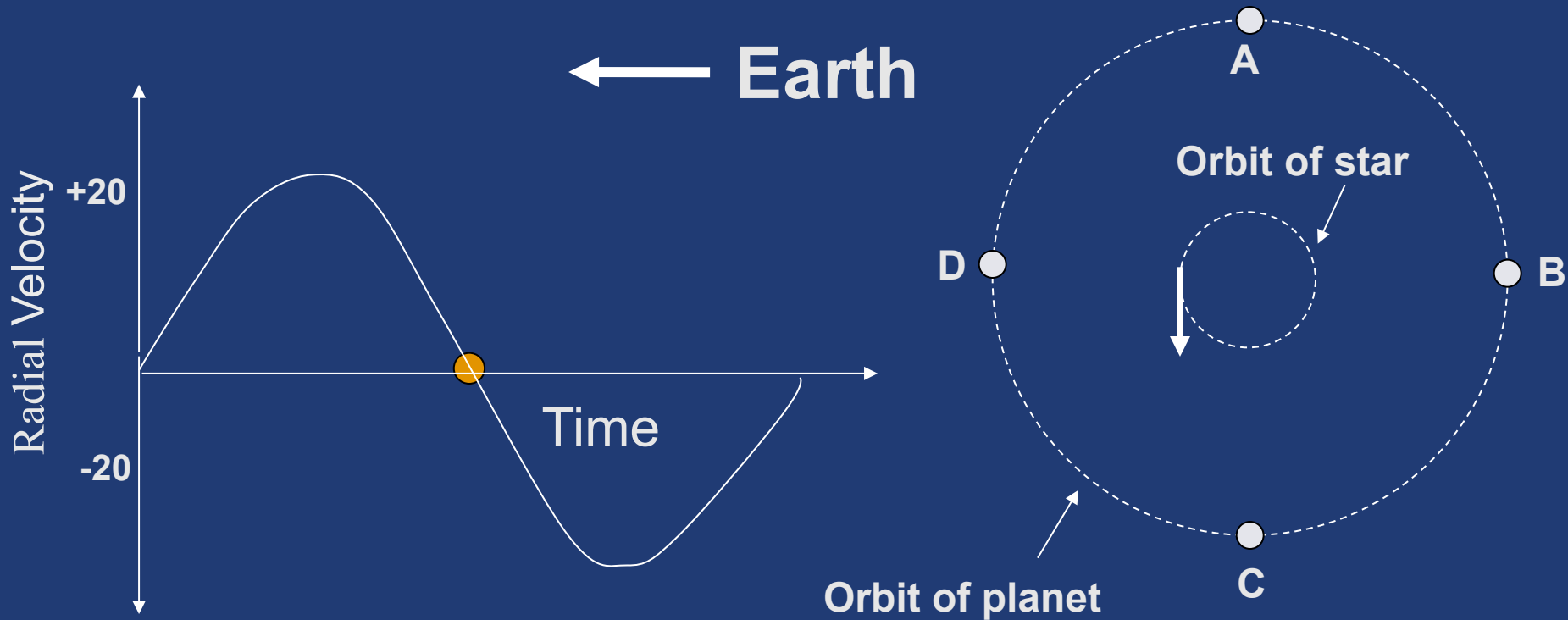
Which atom will emit light with the longest wavelength?



E. None of the above

Which of these atoms:

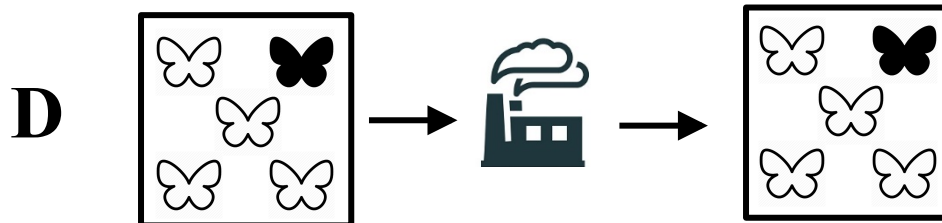
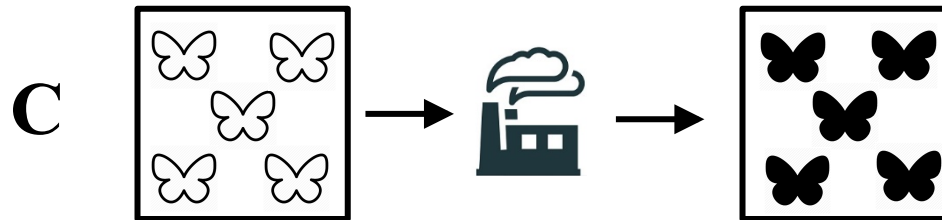
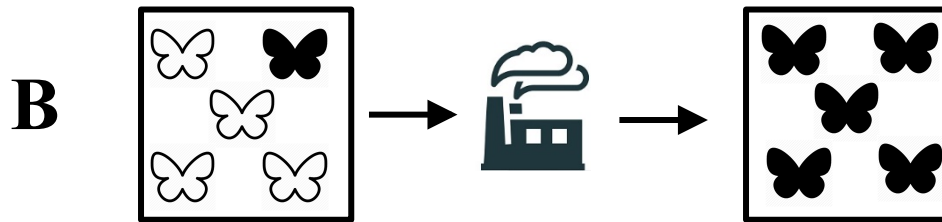
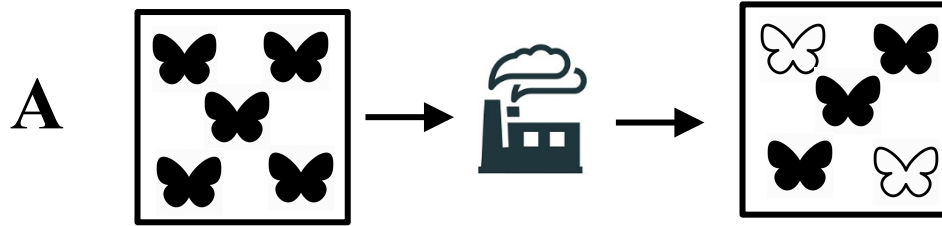




Given the location marked with the orange dot on the star's radial velocity curve, at what location (A-D) would you expect to find the planet?

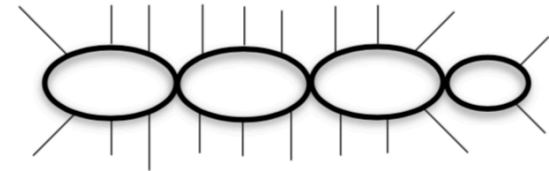
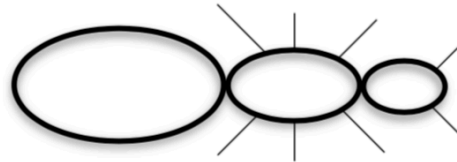
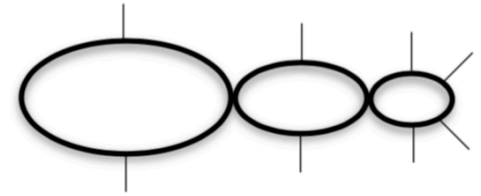
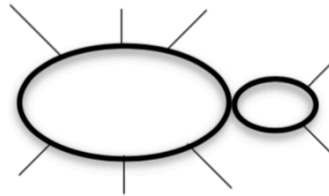
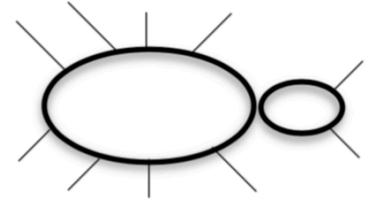
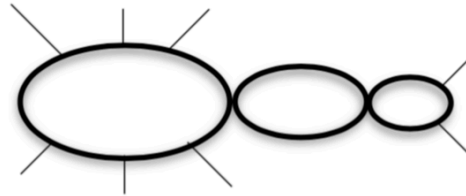
The following represent samples from a population of moths before and after the industrial revolution.

Which scenario is most likely?



How many of the illustrations below have the basic distinguishing characteristics of insects, but would not be classified as insects because those characteristics aren't in the right place?

- a. 1
- b. 3
- c. 4
- d. 6
- e. None of the above



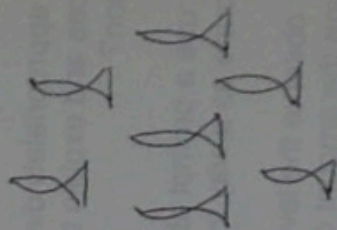
In which population will a new, selectively neutral mutation spread to fixation faster?

A. Big population

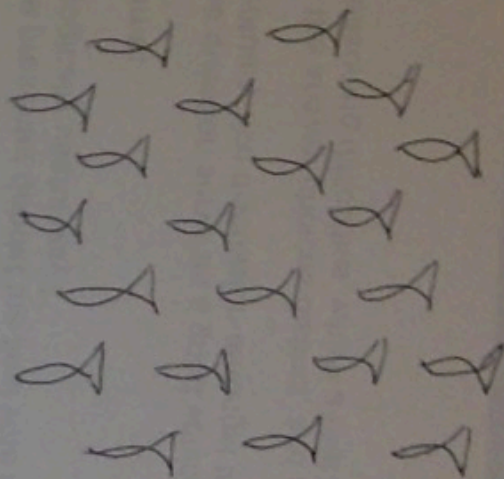
B. Small population

C. Same in both populations

D. Can't tell from the information provided



Small population

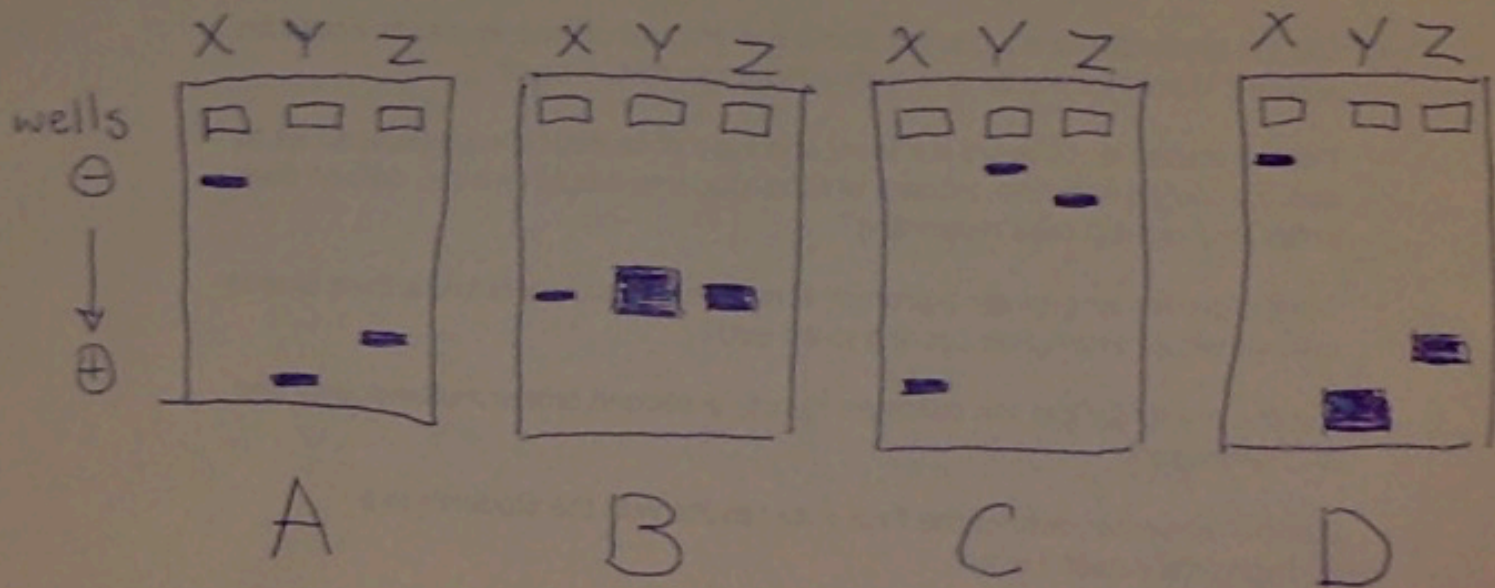


Big population

You're studying 3 genes that have lengths shown below. How would you expect them to appear on a gel electrophoresis.

Genes:

X = 400 bp Y = 1000 bp Z = 800 bp



Your friend is interested in whether gluten causes weight gain in rats. He measured gluten metabolites in 3 randomly selected rats and their weights. The heaviest rats had the most metabolites, so he concludes gluten caused weight gain.

How many of the topics below could you use to convince him he needs more evidence?

1. Sample size
2. Correlation vs. causation
3. Temporality
4. Sampling bias

- A. 0
- B. 1
- C. 2
- D. 3
- E. 4

