Appendix S2: Comparison of Pretest/Posttest Forms A and B

The following table summarizes the two forms of the pretest/posttest used in the study. The table includes only the item stems. Please refer to the complete versions of forms A and B for the scenarios used for the questions as well as the answer options.

- 18 of the 26 science content questions are the same on both forms. Fifteen of the 18 common items were used for common item equating of the forms. Items marked with an asterisk (*) in table below were used in the equating process.
- 5 of the 10 attitude questions are the same on both forms. (Two other questions on each form have very minor differences in context.)
- Items 1 and 2 on both forms are for teacher's name and student ID code,

Question	Form A	Form B
Science Content Questions		
If the same experiment was carried out in the dark, what would you expect the results to be?	3	4
What does the color change from red to yellow indicate?	--	3
What do you think would happen if Janel used a straw to blow into a test tube containing the red liquid for 30 seconds?	4	--
*Test tube 1 is a control for which other test tubes?	5	5
Where did the mass go that was lost in Dish 2 (water but no light)? The plant.	6	8
Which of the following best describes the substance produced during Janel's experiment?	--	6
What accounts for the increase in mass observed in Dish 3 (light and water)?	7	9
After two weeks, the seeds and seedlings were dried so that no water remained. Mark weighed the dried seeds and seedlings from each dish and compared them. Which of the following best describes the results that Mark saw?	--	7
Based on these results, what is the relationship between photosynthesis and mass?	8	--
You are interested in studying plants and need to come up with a project for your school's science fair. Which of the following is the best testable question suitable for a science project?	9	--
*Which of the following is the best reason to doubt her conclusion?	10	11
Which of the following is the best testable question relating to this letter to the editor?	--	10

*Which of the following do plants need for photosynthesis?	26	26
*A flowerpot sits in a sunny window with a green plant in it. The plant has plenty of water and light. What will happen to the mass of the plant as the month passes?	27	27
*In green plants, sunlight is necessary for which of the following?	28	28
Attitudes about Scientists Questions		
I don't have anything in common with a scientist.	29	--
I would like to have friends who are scientists.	--	29
*Scientists are eager to learn about the world in which they live	30	30
It would make me nervous to be around a scientist	31	--
Scientists do not have a sense of humor.	--	31
It would be difficult to talk to a scientist.	32	--
Scientists spend most of their time in a laboratory.	--	32
*Scientists want to find out why strange things happen in our world.	33	33
*Scientists do not have hobbies.	34	34
Scientists are about as likely as anyone to enjoy sports.	35	--
Scientists are about as likely as anyone to enjoy going to a concert.	--	35
I think a scientist might like the same movies that I like.	36	--
I think a scientist might like the same TV shows that I like.	--	36
*I think a scientist might like the same hobbies that I like.	37	37
*I think a scientist might enjoy the same kinds of music that I like.	38	38

Appendix S2

Student Knowledge and Attitudes Towards Scientists Survey_POST form a

Teacher Name and Student ID

*** 1. Please enter your teacher's name**

*** 2. What is your student ID?**

Items on this form (Form A) used for common item achievement test equating: 5, 10, 11, 12, 13, 14, 15, 16, 18, 23, 24, 25, 26, 27, 28

Appendix S2	**Student Knowledge and Attitudes Towards Scientists Survey_POST form a**
Janel's Experiment	

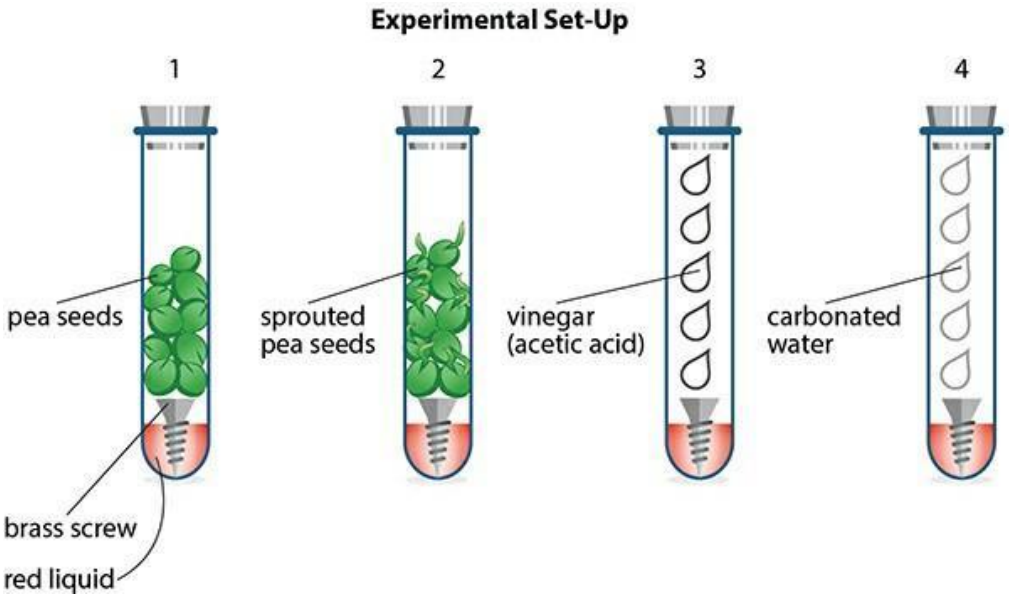
Questions 3 - 5 refer to the experiment described below.

PlantingScience: Digging Deeper Together

The diagram below shows an experiment Janel designed to learn about substances given off by living things. Each test tube has liquid in the bottom and a brass screw for plant material to rest upon. The brass screw does not participate in any of the reactions. At the start of the experiment, the liquid in the bottom of each test tube is red. The liquid will change color when the pH changes. Janel will add the following items to the test tubes:

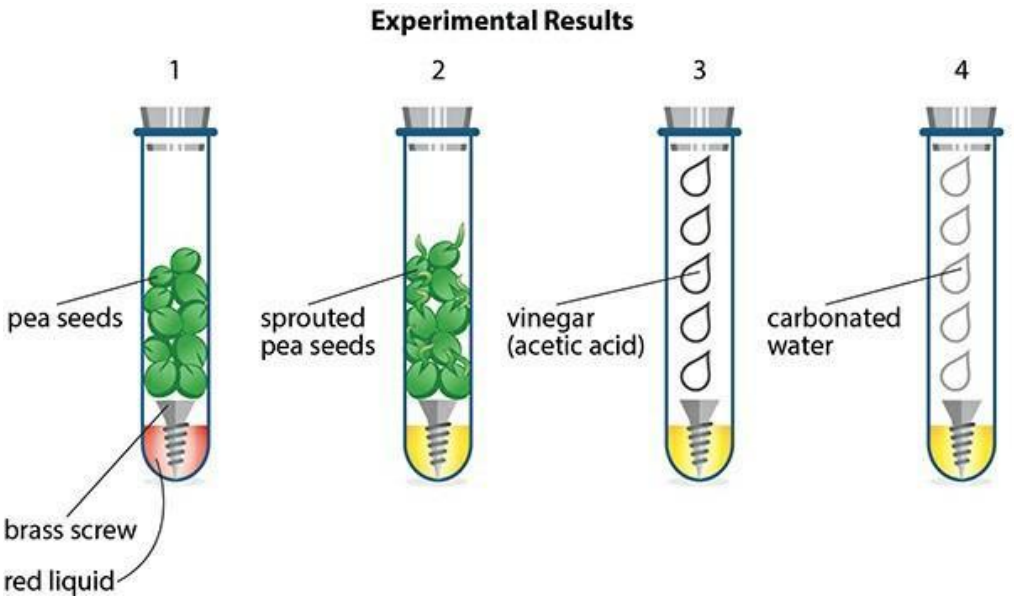
Experimental Set-up:

Test tube 1: pea seeds (not sprouted)
Test tube 2: sprouted pea seeds
Test tube 3: 5 drops of vinegar (acetic acid)
Test tube 4: 5 drops of carbonated water



Experimental Results:

Janel placed the test tubes in a sunny window at room temperature. After 30 minutes, she recorded the following information:
Test tube 1: pea seeds (not sprouted), no color change
Test tube 2: sprouted seeds, color changed to yellow
Test tube 3: 5 drops of vinegar (acetic acid), color changed to yellow
Test tube 4: 5 drops of carbonated water, color changed to yellow



*** 3. If the same experiment was carried out in the dark, what would you expect the results to be?**

- A. The results would be the same.
- B. The results would be the same but would take longer to observe.
- C. None of the test tubes would show a color change.
- D. The color change would only be seen in test tubes 3 and 4.

*** 4. What do you think would happen if Janel used a straw to blow into a test tube containing the red liquid for 30 seconds?**

- A. Nothing would happen.
- B. The red liquid would become more acidic.
- C. The red liquid would become more basic.

D. The red liquid would become oxygenated.

*** 5. Test tube 1 is a control for which other test tubes?**

- A. Test tube 2
- B. Test tube 3
- C. Test tube 4
- D. Test tubes 2-4

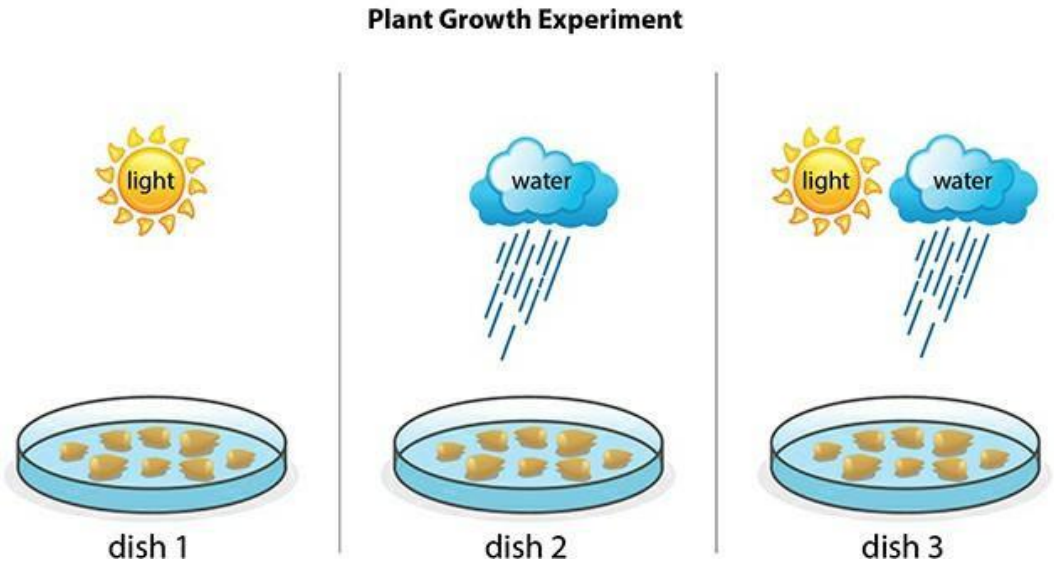
NOTE: Check your answers before clicking "Next." You won't be able to go back and change your answers.

Appendix S2	Student Knowledge and Attitudes Towards Scientists Survey_POST form a
Mark's Experiment	

Questions 6 - 9 refer to the experiment described below.

Mark performed an experiment to study what plants need to grow. He placed an equal number of radish seeds into three separate, identical dishes.

Dish 1 was dry, but in the light
Dish 2 was wet, but in the dark
Dish 3 was wet and in the light



Appendix S2 **Student Knowledge and Attitudes Towards Scientists Survey_POST form a**

Mark's Results

Refer to Mark's results in the table below when answering questions 6 and 7.

Treatment	Dish 1 Light but no water	Dish 2 Water but no light	Dish 3 Light and Water
Initial dry mass of seeds (g)	1.00	1.00	1.00
Final dry mass of seeds (g)	0.99	0.81	1.10
Change in dry mass (g)	-0.01	-0.19	+0.10

*** 6. Where did the mass go that was lost in Dish 2 (water but no light)? The plant...**

- A converted it to energy and used it up.
- B released it as carbon dioxide and water.
- C released it as glucose.
- D released it as oxygen.

*** 7. What accounts for the increase in mass observed in Dish 3 (light and water)?**

- A. Nutrients from the water.
- B. Carbon dioxide from the water.
- C. Carbon dioxide from the air.
- D. Oxygen from the air.

*** 8. Based on these results, what is the relationship between photosynthesis and mass?**

- A. Plants undergoing photosynthesis lose mass.
- B. Plants undergoing photosynthesis gain mass.
- C. Plants undergoing photosynthesis conserve mass.
- D. Plants undergoing photosynthesis first lose, then gain mass.

*** 9. You are interested in studying plants and need to come up with a project for your school's**

science fair. Which of the following is the best testable question suitable for a science project?

- A. Do all plants carry out photosynthesis?
- B. Why do plants only carry out photosynthesis in the light?
- C. Which is more important to plants: photosynthesis or cellular respiration?
- D. Does cellular respiration in plants happen faster in the day and more slowly at night?

NOTE: Check your answers before clicking "Next." You won't be able to go back and change your answers.

Appendix S2	Student Knowledge and Attitudes Towards Scientists Survey_POST form a
Testable Questions	

A scientist observed that large trees grow from small seeds. She wanted to carry out an experiment to answer the question. "Where does a growing tree get its mass?"

To investigate her question, she planted a tree seedling in a large container that contained soil. She periodically added water to the container but nothing else. After five years the tree had gained 75 kg (75,000 g) in weight but the soil had lost just 50 g. The scientist concluded that the tree had produced 75 kg of new growth from water alone.

*** 10. Which of the following is the best reason to doubt her conclusion?**

- A. The tree contains many minerals that add mass and must come from the soil.
- B. She did not weigh the total amount of water added to the soil.
- C. She did not account for the energy supplied by sunlight.
- D. Much of the tree is made of carbon, and there is no carbon in water.

*** 11. A small tree can grow into a large tree that weighs hundreds of pounds. Where does the wood in a tree get its mass?**

- A. Mostly from the air.
- B. Mostly from the soil.
- C. Mostly from water.
- D. Equally from the soil and water.

Questions 12 - 13 refer to the experiment described below

A scientist needs to grow plants indoors. He wants to know what lighting conditions will help his plants grow the best. To find out, he placed individual seedlings under different light conditions. All of the seedlings were kept at the same temperature, were potted in identical soil, and received equal amounts of water.

Seedling 1: was placed in the dark Seedling 2: was placed in white light Seedling 3: was placed in green light Seedling 4: was placed in red light Seedling 5: was placed in blue light

*** 12. After the experiment is underway for a few days, which of the seedlings would you expect to be undergoing cellular respiration?**

- A. Only seedling 1
- B. Only seedling 2
- C. Only seedling 3
- D. All of the seedlings

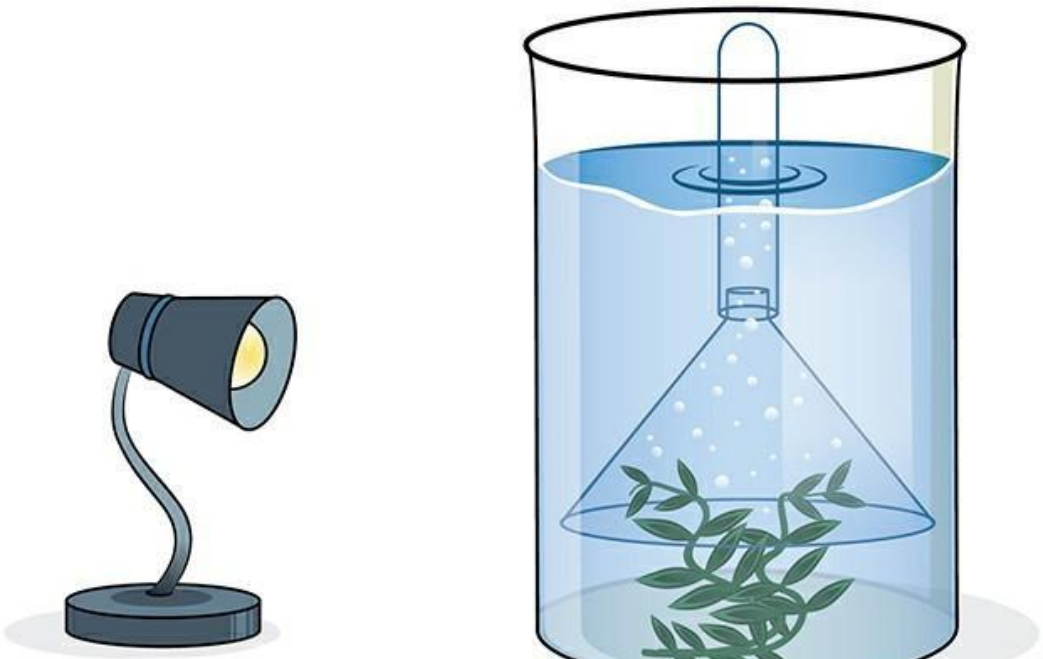
*** 13. In this experiment, which of the following is the dependent variable?**

- A. The amount of plant growth
- B. The color of light used
- C. The type of plant used
- D. The amount of water provided

Questions 14 - 15 refer to the experiment described below.

In the experiment illustrated below, when the lamp is turned on, bubbles are released from the plant. When the lamp is moved closer to the plant, bubbles are released at a greater frequency.

Plant Experiment



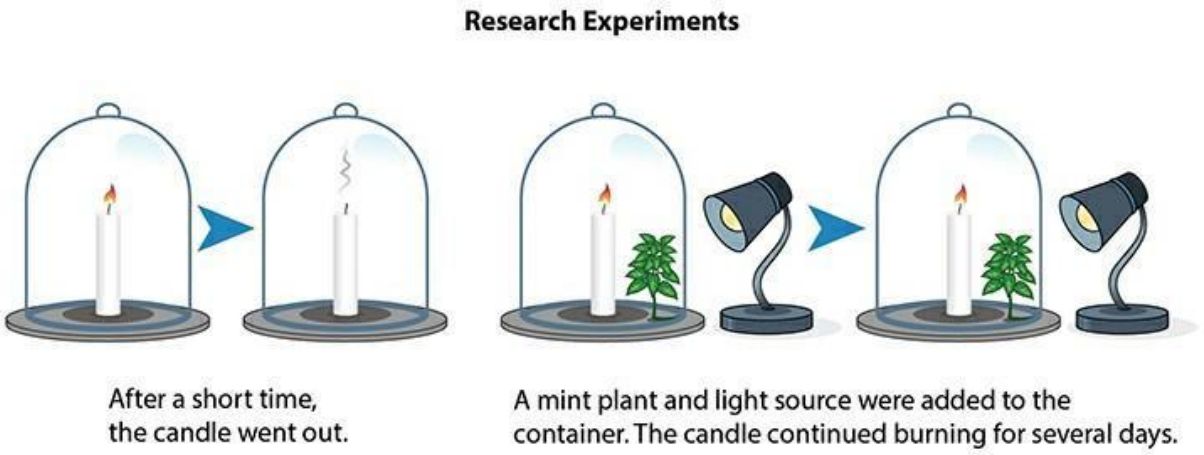
*** 14. What is the most likely identity of the gas in the bubbles?**

- A. Oxygen
- B. Carbon dioxide
- C. Nitrogen
- D. A mixture of oxygen, carbon dioxide, and nitrogen

*** 15. The frequency with which the bubbles are released is a measure of the rate of which process?**

- A. Cellular respiration
- B. Photosynthesis
- C. Transpiration
- D. Biosynthesis

Questions 16 - 19 refer to the experiment described below.



*** 16. Which one of the following research questions is best answered by the experiments illustrated above?**

- A. Can a plant grow in a vacuum?
- B. Is plant growth sensitive to temperature?
- C. What type of gas is released by a plant during photosynthesis?

D. Does glass stop light from supporting photosynthesis?

*** 17. What would happen if the experiment with the mint plant was repeated without a light source?**

- A. The candle flame would die out immediately.
- B. The candle flame would die out after several days, as it did before.
- C. The candle flame would burn for days, until the candle completely melted.
- D. The candle flame would die out after a short time as it did without the mint plant.

*** 18. A house plant is sitting on a window sill absorbing sunlight. The plant is moved to a dark room, but is watered as needed. After a few days will the plant weigh more or less than it did when it was sitting on the window sill?**

- A. It will weigh less because it is still carrying out cellular respiration.
- B. It will weigh less because it is not carrying out photosynthesis.
- C. It will weigh more because it still has access to water and soil nutrients.
- D. It will weigh the same because no biomass is being produced.

*** 19. A seedling is planted outdoors where it receives adequate sunlight and water with which to grow. After two weeks, the seedling has tripled in height. Based on this observation, what can you say about the seedling gaining mass?**

- A. The mass gained from photosynthesis is more than the mass lost from cellular respiration.
- B. The mass gained from cellular respiration is greater than the mass lost from photosynthesis.
- C. The mass gained during the day from photosynthesis is greater than the mass lost at night from cellular respiration.
- D. The mass gained during the day from photosynthesis is greater than the mass lost during the day from cellular respiration.

PLANT GROWTH EXPERIMENT

Day	Average Height (in centimeters)	
	Container A: Water Only	Container B: Water plus Fertilizer
1	2.0	2.0
2	2.2	2.3
3	2.3	2.8
4	2.5	3.2
5	2.6	3.8

*** 20. What do you think is the research question being investigated?**

- A. Can bean plants grow in the presence of water alone?
- B. What is the effect of fertilizer on the growth of bean plants?
- C. What is the maximum height bean plants can reach in five days?
- D. What is the rate of growth of bean plants?

NOTE: Check your answers before clicking "Next." You won't be able to go back and change your answers.

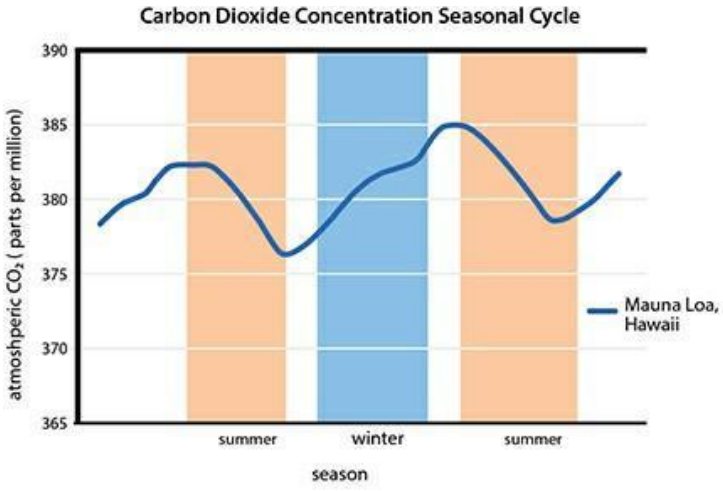
Appendix S2	**Student Knowledge and Attitudes Towards Scientists Survey_POST form a**
Photosynthesis and Cellular Respiration	

*** 21. Which of the following statements is true about cellular respiration?**

- A. Cellular respiration is carried out by all living organisms.
- B. Cellular respiration is carried out by animals but not by plants.
- C. Cellular respiration is carried out by animals both day and night while plants carry it out during the day.
- D. Cellular respiration is carried out by plants and animals both night and day.

Question 22 refers to the following graph.

The graph below shows measurements of the carbon dioxide concentration in the atmosphere. The data were collected from atop the Mauna Loa Astronomical Observatory in Hawaii. Plants growing in the northern hemisphere affect the amount of carbon dioxide in the atmosphere.



*** 22. Why does CO_2 concentration fall during the summer?**

- A. During the summer, the effect of cellular respiration outweighs that of photosynthesis.
- B. During the summer, the effect of photosynthesis outweighs that of cellular respiration.
- C. During the summer, the rate of cellular respiration rises.
- D. During the summer, the rate of cellular respiration decreases.

Appendix S2 **Student Knowledge and Attitudes Towards Scientists Survey_POST form a**

Photosynthesis and Cellular Respiration continued....

*** 23. Which of the following statements about cellular respiration and breathing is true?**

- A. Cellular respiration and breathing are the same thing.
- B. Plants carry out cellular respiration while animals breathe instead.
- C. Plants carry out cellular respiration but do not breathe.
- D. Plants carry out cellular respiration and breathe.

*** 24. Which of the following statements best describes how gases are exchanged by plants in the dark?**

- A. Oxygen is taken in and carbon dioxide is released.
- B. Carbon dioxide is taken in and oxygen is released.
- C. Neither gas is taken in or released.
- D. Oxygen and carbon dioxide are taken in and nothing is released.

*** 25. Which of the following list of factors is most important for determining the rate of photosynthesis?**

- A. Carbon dioxide concentration, oxygen, and light intensity.
- B. Carbon dioxide concentration, glucose, and light intensity.
- C. Carbon dioxide concentration, nitrogen availability, and light intensity.
- D. Carbon dioxide concentration, water availability, and light intensity.

*** 26. Which of the following do plants need for photosynthesis?**

- A. Sunlight
- B. Water

C. Carbon dioxide

D. All of the above

*** 27. A flower pot sits in a sunny window with a green plant in it. The plant has plenty of water and light. What will happen to the mass of the plant as the month passes?**

- A. Nothing
- B. The mass will get bigger
- C. The mass will get smaller
- D. There is not enough information to answer the question.

*** 28. In green plants, sunlight is necessary for which of the following?**

- A. Photosynthesis
- B. Cellular respiration
- C. Carbon dioxide production
- D. Water production

Appendix S2	**Student Knowledge and Attitudes Towards Scientists Survey_POST form a**
Science Attitude Questions	**[Items on this form (Form A) used for common item attitude survey equating: 30, 33, 34, 37, 38]**

Please respond to each statement based on your experience in science and science class**over the past two weeks.** Select the button that corresponds to your opinion, from "strongly disagree" to "strongly agree."

*** 29. I don't have anything in common with a scientist.**

- Strongly
- Disagree
- Disagree
- Unsure
- Agree
- Strongly Agree

*** 30. Scientists are eager to learn about the world in which they live.**

- Strongly
- Disagree
- Disagree
- Unsure
- Agree
- Strongly Agree

*** 31. It would make me nervous to be around a scientist.**

- Strongly
- Disagree
- Disagree
- Unsure
- Agree

Strongly Agree

*** 32. It would be difficult to talk to a scientist.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

*** 33. Scientists want to find out why strange things happen in our world.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

*** 34. Scientists do not have hobbies.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

*** 35. Scientists are about as likely as anyone to enjoy sports.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

*** 36. I think a scientist might like the same movies that I like.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

*** 37. I think a scientist might like the same hobbies that I like.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

*** 38. I think a scientist might enjoy the same kinds of music that I like.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

Appendix S2	**Student Knowledge and Attitudes Towards Scientists Survey_POST form a**
Optional Demographic Questions	

The following demographic questions are OPTIONAL. You are not required to answer them if you don't want to. The funder of this project, the National Science Foundation, asks that we document this information to the extent possible to assure inclusion of all groups in the study.

IF YOU DO NOT ANSWER THE QUESTIONS, PLEASE GO TO THE END OF THE SURVEY AND CLICK "DONE" TO SUBMIT YOUR SURVEY.

39. What is your gender?

- ○ Female
- ○ Male

40. What is your grade level at school?

- ○ 9th grade
- ○ 10th grade
- ○ 11th grade
- ○ 12th grade

Appendix S2 **Student Knowledge and Attitudes Towards Scientists Survey_POST form a**

Demographic Questions continued...

The following questions ask about your race/ethnicity. These are the same categories used by the U.S. Census Bureau. Choose 'yes' for all race/ethnicity groups that apply to you.

41. Are you Asian?

- ○ Yes
- ○ No

42. Are you African American?

- ○ Yes
- ○ No

43. Are you American Indian or Alaska Native?

- ○ Yes
- ○ No

44. Are you Native Hawaiian or Other Pacific Islaner?

- ○ Yes
- ○ No

45. Are you Hispanic or Latino/Latina?

- ○ Yes
- ○ No

46. Are you White?

- ○ Yes
- ○ No

47. Are you some other race/ethnicity?

- ○ Yes
- ○ No
- ○ If yes, please provide more information:

48. Is English your first language? If not, how comfortable do you feel with reading, writing, and speaking in English?

- English is not my first language, and I have difficulty reading, writing, or speaking in English.
- English is not my first language, and I feel somewhat comfortable reading, writing, and speaking in English.
- English is not my first language, but I feel very comfortable reading, writing, and speaking in English.
- English is my first language.

49. Do you receive a free or reduced-price lunch at school?

- Yes
- No

Bravo - you're done! Please submit your survey by clicking "Done" and have a wonderful rest of your day. The survey will close completely once submitted.

AppendixS2

POST_form b_Student Knowledge and Attitudes Towards Scientists Survey

Teacher Name

*** 1. Please enter your teacher's name**

*** 2. Please enter your student ID**

Items on this form (Form B) used for common item achievement test equating: 5, 11, 12, 13, 14, 15, 16, 17, 18, 23, 24, 25, 26, 27, 28

Appendix S2	POST_form b_Student Knowledge and Attitudes Towards Scientists Survey
Janel's Experiment	

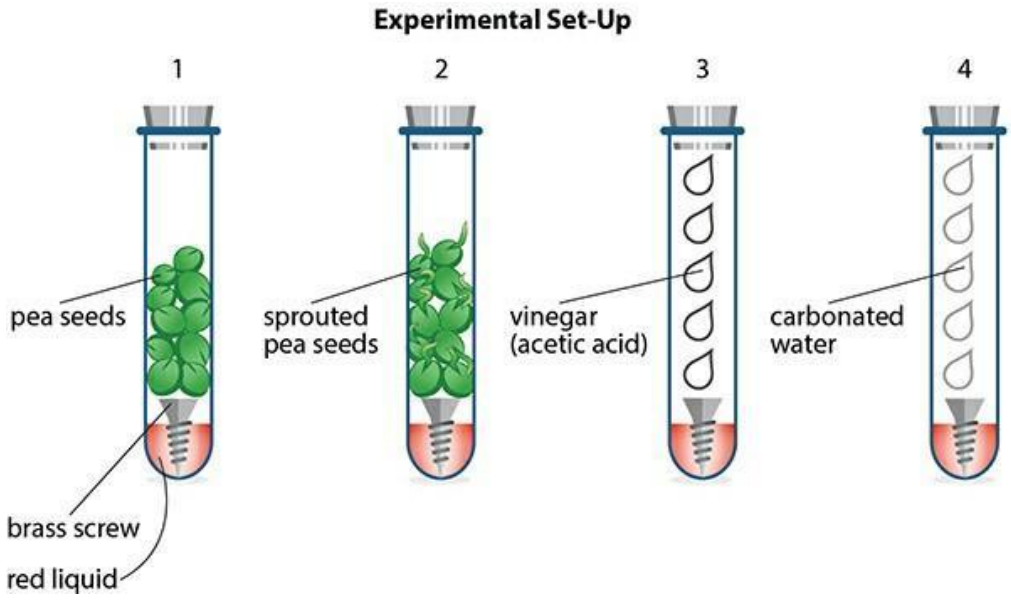
Questions 3 - 6 refer to the experiment described below.

PlantingScience: Digging Deeper Together

The diagram below shows an experiment Janel designed to learn about substances given off by living things. Each test tube has liquid in the bottom and a brass screw for plant material to rest upon. The brass screw does not participate in any of the reactions. At the start of the experiment, the liquid in the bottom of each test tube is red. The liquid will change color when the pH changes. Janel will add the following items to the test tubes:

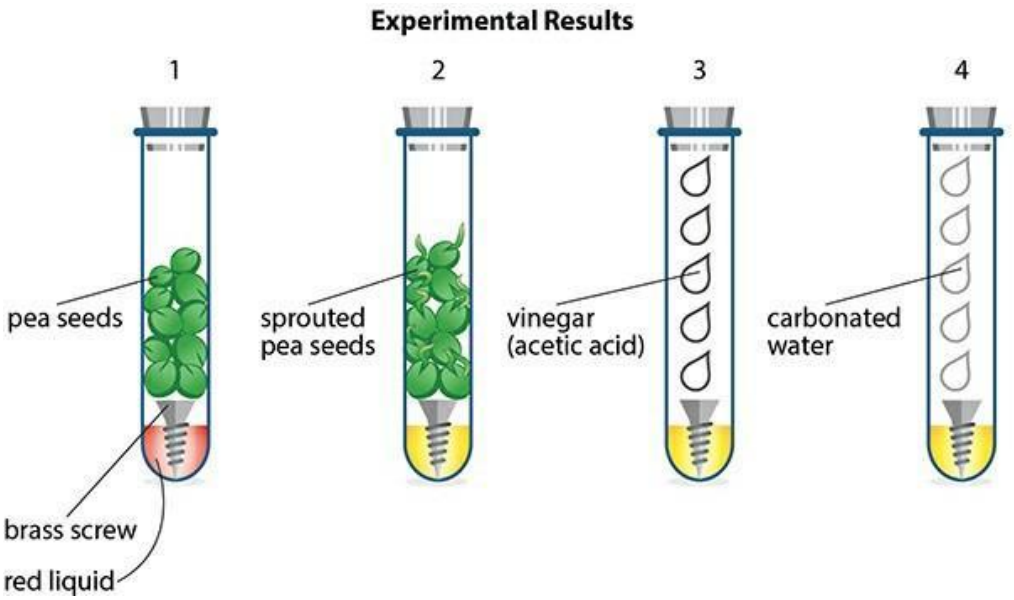
Experimental Set-up:

Test tube 1: pea seeds (not sprouted)
Test tube 2: sprouted pea seeds
Test tube 3: 5 drops of vinegar (acetic acid)
Test tube 4: 5 drops of carbonated water



Experimental Results:

Janel placed the test tubes in a sunny window at room temperature. After 30 minutes, she recorded the following information:
Test tube 1: pea seeds (not sprouted), no color change
Test tube 2: sprouted seeds, color changed to yellow
Test tube 3: 5 drops of vinegar (acetic acid), color changed to yellow
Test tube 4: 5 drops of carbonated water, color changed to yellow



*** 3. What does the color change from red to yellow indicate?**

- A. The liquid has become more acidic.
- B. The liquid has become more basic.
- C. The liquid contains sugar.
- D. The liquid was exposed to light.

*** 4. If the same experiment was carried out in the dark, what would you expect the results to be?**

- A. The results would be the same.
- B. The results would be the same but would take longer to observe.
- C. None of the test tubes would show a color change.
- D. The color change would only be seen in test tubes 3 and 4.

*** 5. Test tube 1 is a control for which other test tubes?**

- A. Test tube 2
- B. Test tube 3
- C. Test tube 4
- D. Test tubes 2-4

*** 6. Which of the following best describes the substance produced during Janel's experiment?**

- A. The substance is an input for cellular respiration and an output for photosynthesis.
- B. The substance is an input for photosynthesis and an output for cellular respiration.
- C. The substance is an input for both photosynthesis and cellular respiration.
- D. The substance is an output for both photosynthesis and cellular respiration.

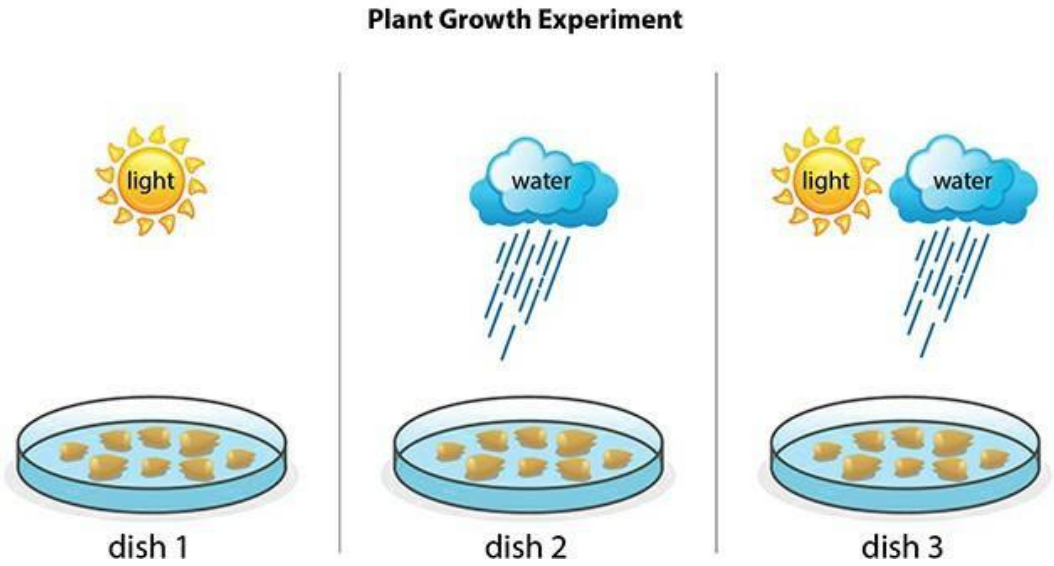
NOTE: Check your answers before clicking "Next." You won't be able to go back and change your answers.

Appendix S2	POST_form b_Student Knowledge and Attitudes Towards Scientists Survey
Mark's Experiment	

Questions 7 - 9 refer to the experiment described below.

Mark performed an experiment to study what plants need to grow. He placed an equal number of radish seeds into three separate, identical dishes.

Dish 1 was dry, but in the light
Dish 2 was wet, but in the dark
Dish 3 was wet and in the light



*** 7. After two weeks, the seeds and seedlings were dried so that no water remained. Mark weighed the dried seeds and seedlings from each dish and compared them. Which of the following best describes the results that Mark saw?**

- A. Weight Dish 1 = Weight Dish 2 = Weight Dish 3.
- B. Weight Dish 1 = Weight Dish 2 < Weight Dish 3.
- C. Weight Dish 2 < Weight Dish 1 < Weight Dish 3.
- D. Weight Dish 3 < Weight Dish 2 < Weight Dish 1.

NOTE: Check your answers before clicking "Next." You won't be able to go back and change your answers.

Appendix S2 **POST_form b_Student Knowledge and Attitudes Towards Scientists Survey**

Mark's Results

The table below lists Mark's results

Treatment	Light but no water	Water but no light	Light and Water
Initial dry mass of seeds (g)	1.00	1.00	1.00
Final dry mass of seeds (g)	0.99	0.81	1.10
Change in dry mass (g)	-0.01	-0.19	+0.10

*** 8. Why has the weight from Dish 2 (water but no light) decreased over the two-week period?**

- A. The difference in weight is small and likely due to measurement error.
- B. Some of the mass in the seeds was dissolved by water and disappeared when the seeds were dried.
- C. Some of the mass in the seeds was used by cellular respiration needed for germination.
- D. Some of the mass of the seeds was lost through evaporation.

*** 9. What accounts for the increase in mass observed in Dish 3?**

- A. Nutrients from the water.
- B. Carbon dioxide from the water.
- C. Carbon dioxide from the air.
- D. Oxygen from the air.

Appendix S2 **POST_form b_Student Knowledge and Attitudes Towards Scientists Survey**

Testable Questions

The following letter to the editor appeared in a local newspaper in response to the opening of the Quick and Tasty restaurant:

Fast Food and Cancer
"When are Americans going to wake up to the dangers of restaurants like Quick and Tasty? The food they serve contains many chemicals known to cause cancer. It is no coincidence that as more people eat at these restaurants, more cases of cancer are being reported. Americans need to learn that organic foods are better than processed foods."

*** 10. Which of the following is the best testable question relating to this letter to the editor?**

- A. Is organic food better than processed food?
- B. How many cancer causing chemicals are in the food at Quick and Tasty?
- C. Does Quick and Tasty food have more cancer causing chemicals than the same type of organic food?
- D. Why has the rate of cancer increased lately?

A scientist observed that large trees grow from small seeds. She wanted to carry out an experiment to answer the question. "Where does a growing tree get its mass?"

To investigate her question, she planted a tree seedling in a large container that contained soil. She periodically added water to the container but nothing else. After five years the tree had gained 75 kg (75,000 g) in weight but the soil had lost just 50 g. The scientist concluded that the tree had produced 75 kg of new growth from water alone.

*** 11. Which of the following is the best reason to doubt her conclusion?**

- A. The tree contains many minerals that add mass and must come from the soil.
- B. She did not weigh the total amount of water added to the soil.
- C. She did not account for the energy supplied by sunlight.
- D. Much of the tree is made of carbon, and there is no carbon in water.

*** 12. A small tree can grow into a large tree that weighs hundreds of pounds. Where does the wood in the tree get its mass?**

- A. Mostly from the air.
- B. Mostly from the soil.
- C. Mostly from water.
- D. Equally from the soil and water.

Questions 13 - 14 refer to the experiment described below

A scientist needs to grow plants indoors. He wants to know what lighting conditions will help his plants grow the best. To find out, he placed individual seedlings under different light conditions. All of the seedlings were kept at the same temperature, were potted in identical soil, and received equal amounts of water.

Seedling 1: was placed in the dark Seedling 2: was placed in white light Seedling 3: was placed in green light Seedling 4: was placed in red light Seedling 5: was placed in blue light

*** 13. After the experiment is underway for a few days, which of the seedlings would you expect to be undergoing cellular respiration?**

- A. Only seedling 1
- B. Only seedling 2
- C. Only seedling 3
- D. All of the seedlings

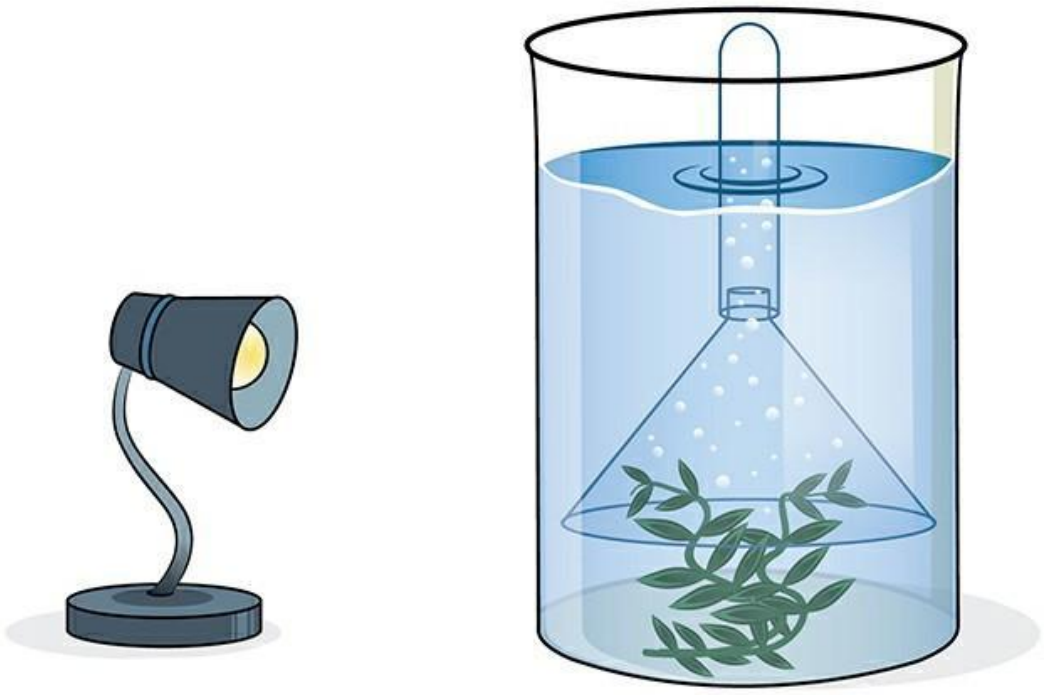
*** 14. In this experiment, which of the following is the dependent variable?**

- A. The amount of plant growth
- B. The color of light used
- C. The type of plant used
- D. The amount of water provided

Questions 15 - 16 refer to the experiment described below.

In the experiment illustrated below, when the lamp is turned on, bubbles are released from the plant. When the lamp is moved closer to the plant, bubbles are released at a greater frequency.

Plant Experiment



*** 15. What is the most likely identity of the gas in the bubbles?**

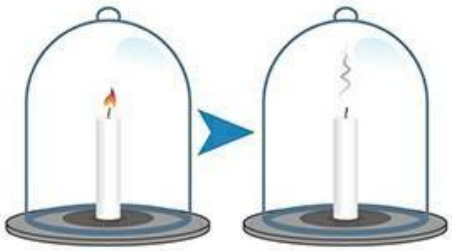
- A. Oxygen
- B. Carbon dioxide
- C. Nitrogen
- D. A mixture of oxygen, carbon dioxide, and nitrogen

*** 16. The frequency with which the bubbles are released is a measure of the rate of which process?**

- A. Cellular respiration
- B. Photosynthesis
- C. Transpiration
- D. Biosynthesis

Questions 17 - 18 refer to the experiment described below.

Research Experiments



After a short time, the candle went out.

A mint plant and light source were added to the container. The candle continued burning for several days.

*** 17. Which one of the following research questions is best answered by the experiments illustrated above?**

- A. Can a plant grow in a vacuum?
- B. Is plant growth sensitive to temperature?
- C. What type of gas is released by a plant during photosynthesis?
- D. Does glass stop light from supporting photosynthesis?

*** 18. A house plant is sitting on a window sill absorbing sunlight. The plant is moved to a dark room, but is watered as needed. After a few days will the plant weigh more or less than it did when it was sitting on the window sill?**

- A. It will weigh less because it is still carrying out cellular respiration.
- B. It will weigh less because it is not carrying out photosynthesis.
- C. It will weigh more because it still has access to water and soil nutrients.
- D. It will weigh the same because no biomass is being produced.

NOTE: Check your answers before clicking "Next." You won't be able to go back and change your answers.

Appendix S2	POST_form b_Student Knowledge and Attitudes Towards Scientists Survey
Photosynthesis and Cellular Respiration	

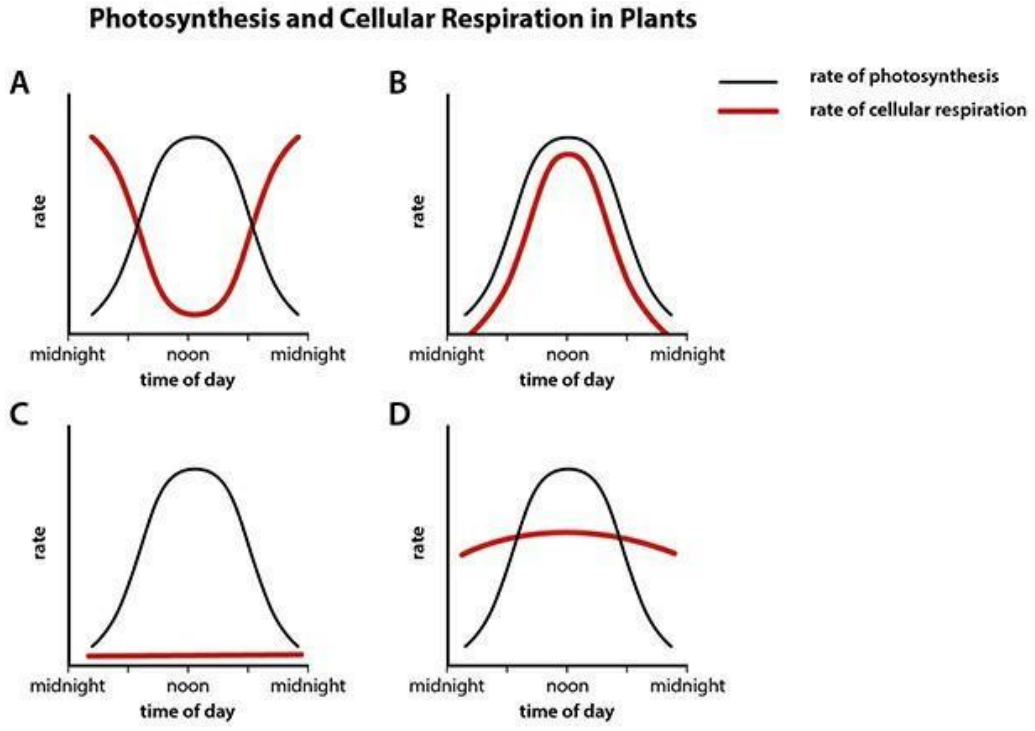
*** 19. Which of the following statements best describes the relationship between cellular respiration and energy?**

- A. Energy is created by cellular respiration.
- B. Energy is destroyed by cellular respiration.
- C. Energy is an output of cellular respiration.
- D. Energy is an input to cellular respiration.

Photosynthesis and Cellular Respiration continued....

*** 20. Jermel performed an experiment to investigate the rates of photosynthesis and cellular respiration over a 24-hour period beginning at midnight (hour 0). Which of the graphs below illustrates the results you would expect to see?**

- A.
- B.
- C.
- D.



*** 21. Which of the following is the best way to monitor the rate of photosynthesis in a plant?**

- A. Oxygen production

B. Water production

C. Hydrogen production

D. Carbon dioxide production

*** 22. Why do plants require oxygen?**

- A. Plants need oxygen to carry out photosynthesis.
- B. Plants need oxygen to carry out cellular respiration.
- C. Plants need oxygen to produce water.
- D. Plants need oxygen to trap sunlight.

*** 23. Which of the following statements about cellular respiration and breathing is true?**

- A. Cellular respiration and breathing are the same thing.
- B. Plants carry out cellular respiration while animals breathe instead.
- C. Plants carry out cellular respiration but do not breathe.
- D. Plants carry out cellular respiration and breathe.

*** 24. Which of the following statements best describes how gases are exchanged by plants in the dark?**

- A. Oxygen is taken in and carbon dioxide is released.
- B. Carbon dioxide is taken in and oxygen is released.
- C. Neither gas is taken in or released.
- D. Oxygen and carbon dioxide are taken in and nothing is released.

*** 25. Which of the following list of factors is most important for determining the rate of photosynthesis?**

- A. Carbon dioxide concentration, oxygen, and light intensity.
- B. Carbon dioxide concentration, glucose, and light intensity.
- C. Carbon dioxide concentration, nitrogen availability, and light intensity.
- D. Carbon dioxide concentration, water availability, and light intensity.

*** 26. Which of the following do plants need for photosynthesis?**

- A. Sunlight
- B. Water
- C. Carbon Dioxide
- D. All of the above

*** 27. A flower pot sits in a sunny window with a green plant in it. The plant has plenty of water and light. What will happen to the mass of the plant as a month passes?**

- A. Nothing
- B. The mass will get bigger
- C. The mass will get smaller
- D. There is not enough information to answer the question

*** 28. In green plants, sunlight is necessary for which of the following?**

- A. Photosynthesis
- B. Cellular respiration
- C. Carbon dioxide production
- D. Water production

Appendix S2	**POST_form b_Student Knowledge and Attitudes Towards Scientists Survey**
Science Attitude Questionnaire_form b **[Items on this form (Form B) used for common item attitude survey equating: 30, 33, 34, 37, 38]**	

*** 29. I would like to have friends who are scientists.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

*** 30. Scientists are eager to learn about the world in which they live.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

*** 31. Scientists do not have a sense of humor.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

*** 32. Scientists spend most of their time in a laboratory.**

- Strongly Disagree
- Disagree
- Unsure
- Agree
- Strongly Agree

*** 33. Scientists want to find out why strange things happen in our world.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

*** 34. Scientists do not have hobbies.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

*** 35. Scientists are about as likely as anyone to enjoy going to a concert.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

*** 36. I think a scientist might like the same TV shows that I like.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

*** 37. I think a scientist might like the same hobbies that I like.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

*** 38. I think a scientist might enjoy the same kinds of music that I like.**

Strongly

Disagree

Disagree

Unsure

Agree

Strongly Agree

Appendix S2	POST_form b_Student Knowledge and Attitudes Towards Scientists Survey
Optional Demographic Questions	

The following demographic questions are OPTIONAL. You are not required to answer them if you don't want to. The funder of this project, the National Science Foundation, asks that we document this information to the extent possible to assure inclusion of all groups in the study.

*IF YOU DO NOT ANSWER THE QUESTIONS, PLEASE GO TO THE END OF THE SURVEY AND CLICK "**DONE**" TO SUBMIT YOUR SURVEY.*

39. What is your gender?

- ○ Female
- ○ Male

40. What is your grade level in school?

- ○ 9th grade
- ○ 10th grade
- ○ 11th grade
- 12th grade

Appendix S2 **POST_form b_Student Knowledge and Attitudes Towards Scientists Survey**

Demographic Questions continued....

The following questions ask about your race/ethnicity. These are the same categories used by the U.S. Census Bureau. Choose **'yes'** for all race/ethnicity groups that apply to you.

41. Are you Asian?

- ○ Yes
- ○ No

42. Are you African American?

- ○ Yes
- ○ No

43. Are you American Indian or Alaska Native?

- ○ Yes
- ○ No

44. Are you Native Hawaiian or Other Pacific Islander?

- ○ Yes
- ○ No

45. Are you Hispanic or Latino/Latina?

- ○ Yes
- ○ No

46. Are you White?

- ○ Yes
- ○ No

47. Are you some other race/ethnicity?

- ○ Yes
- ○ No
- ○ If yes, please provide more information:

48. Is English your first language? If not, how comfortable do you feel with reading, writing, and speaking in English?

- English is not my first language, and I have difficulty reading, writing, or speaking in English.
- English is not my first language, and I feel somewhat comfortable reading, writing, and speaking in English.
- English is not my first language, but I feel very comfortable reading, writing, and speaking in English.
- English is my first language.

49. Do you receive a free or reduced-price lunch at school?

- Yes
- No

*Bravo - you're done! Please submit your survey by clicking**"Done"** and have a wonderful rest of your day.*

The survey will close completely once submitted.