

Background: a plant is placed inside of a sealed bell jar (right). The jar and plant are placed in a sunny location. Assume that the soil is moist and there are enough nutrients in the soil. Use this information to answer the questions below.

1. Can this plant survive for extended periods in this jar? YES NO
Explain your answer.

2. Explain why each of the following is necessary to this plant in the jar above and how it will be acquired/produced:

Oxygen – Why is it necessary to a plant?

How it will be produced/acquired in this jar?

Water – Why is it necessary to a plant?

How it will be produced/acquired in this jar?

CO₂ – Why is it necessary to a plant?

How it will be produced/acquired in this jar?



Background: a group of scientists have developed a genetically engineered plant that can create a new type of simple carbohydrate called “*synthase*”. This carbohydrate is similar to glucose except that it has the molecular formula $C_7H_{15}O_6$.

When scientists test the effects of this sugar on cellular respiration using yeast, they find that while there is a slight increase to the amount of CO_2 that is released during respiration, the ATP that is produced increases even more. While respiration of one glucose molecule yields 6 molecules of CO_2 and 36 molecules of ATP, respiration of one *synthase* molecule yields 7 molecules of CO_2 and 45 ATP molecules.

Use this information to answer the questions below.

1. Why would more CO_2 per molecule be produced from *synthase* than from glucose? *Hint: look at how many carbon atoms are on each molecule.*
2. Why would more ATP per molecule be produced from *synthase* than from glucose? *Hint: look at how many hydrogen atoms are on each molecule.*
3. These scientists are claiming that they have developed this plant to fight climate change. If this plant were grown throughout the world on a large-scale basis, would this increase or decrease atmospheric levels of carbon dioxide over time? In the blank below, write “increase” or “decrease” and then explain.

I hypothesize that widespread use of the plants that produce synthase sugars would _____ atmospheric levels of CO_2 because ____

4. Scientists find that in order for this plant to survive, they also had to genetically modify it to produce more chlorophyll and more Rubisco. Explain what each does and why more is needed to make synthase.
 - a. Chlorophyll – What does it do? Why more is needed?
 - b. Rubisco – What does it do? Why more is needed?

Abstract - Ever since the discovery of C4 photosynthesis in the mid-1960s, plant biologists have envisioned the introduction of C4 photosynthesis into C3 crops such as rice and soybeans. Recent advances in genomics capabilities, and new evolutionary and developmental studies indicate that C4 engineering will be feasible in the next few decades. -Taken from Exploiting the engine of C4 photosynthesis by Rowan F. Sage, and Xin-Guang Zhu, published in the peer-reviewed *Journal of Experimental Botany*, Vol. 62, No. 9, pp. 2989–3000, 2011.

1. How does a C4 plant differ from a C3 plant?
2. What would be the advantage of converting a C3 plant into a C4 plant?
3. What is a legume?
4. What would be the advantage of creating a C4 legume?
5. Would this be considered a credible source if you were writing a paper? How do you know?