RLP-BIOA · RLP Biology A — Cells, Energy and Heredity

Unit 2: Matter and Energy in Living Things

Practice Workbook. The same problems, in the same order, as the Practice sections of the online lessons.

Name _____ Period _____

Lesson 2.1 — Phenomenon: Where Does a Giant Bur Oak's Mass Come From?

FLUENCY

1. Find the molar mass of Al_2O_3.

2. Find the molar mass of $CaCO_3$.

3. Count the carbon, hydrogen and oxygen atoms on each side of $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$.

4. Which reactant supplies the carbon in glucose: carbon dioxide, water or soil minerals?

APPLICATION

5. Van Helmont's willow gained about 164 pounds 3 ounces while the soil lost about 2 ounces. What percentage of the tree's gain could have come from the soil? (1 pound = 16 ounces)

6. Van Helmont concluded that the willow's mass came from water. Which part of his conclusion was right, and what did he miss?

7. The McBaine bur oak's trunk is 295 inches around (Missouri Department of Conservation). Convert the circumference to meters (1 in = 0.0254 m) and find the trunk's diameter.

CHALLENGE

8. Model the lower trunk of the McBaine bur oak as a cylinder 7.493 m around and 4.5 m tall (an assumed height). Bur oak has a specific gravity of 0.58 on a green-volume basis (USDA Wood Handbook), so each cubic meter of living wood holds about 580 kg of dry wood. Assume dry wood is half carbon. Estimate the mass of carbon dioxide the tree removed from the air to build this part of its trunk.

REVIEW

9. Name the level of organization of a leaf and explain your answer.

Lesson 2.2 — Floating Leaf Disks: Measuring Photosynthesis

FLUENCY

1. Find the rate $1/ET_{50}$ for ET_{50} = 8.0 minutes.

2. Find the rate $1/ET_{50}$ for ET_{50} = 12.5 minutes.

3. Find the rate $1/ET_{50}$ for ET_{50} = 20 minutes.

4. In the leaf-disk lab, what gas makes the disks float, and which molecule is it released from?

APPLICATION

5. Illustrative data: ET_{50} = 8.0 min at 10 cm, 11.5 min at 20 cm, 16.0 min at 30 cm and 22.0 min at 40 cm. Calculate each rate to three decimals.

6. Light from a small lamp spreads out so that intensity is proportional to $1/\text{distance}^2$. Compared with 10 cm, what fraction of the light reaches cups at 20, 30 and 40 cm?

7. Disks in water with no baking soda barely float, even in bright light. Explain.

CHALLENGE

8. Using the two previous problems, light at 10 cm is 16 times as intense as at 40 cm, but the rate is only about 2.75 times as fast. Give a biological explanation.

REVIEW

9. In the catalase lab (Unit 1), mean foam was 38 mm at 37 °C and 25 mm at 22 °C. By what percentage did activity increase from 22 to 37 °C?

Lesson 2.3 — Respiration With and Without Oxygen: The Yeast Balloon Argument

FLUENCY

1. Write the overall equation for aerobic cellular respiration.

2. Write the overall equation for alcoholic fermentation in yeast.

3. About how many times more ATP per glucose does aerobic respiration release than fermentation, using about 30 ATP and 2 ATP?

APPLICATION

4. Yeast ferments 18 g of glucose completely. Find the mass of CO_2 produced (glucose 180.16 g/mol, CO_2 44.01 g/mol).

5. At room temperature one mole of gas occupies about 24.5 L. What volume of CO_2 could the 18 g of glucose in the previous problem produce by fermentation?

6. A balloon on a flask of yeast and sugar water inflates; a flask of yeast and plain water barely changes. A student concludes: “Yeast only respire when they are given sugar.” Evaluate the claim.

CHALLENGE

7. Show that mass is conserved when 18 g of glucose is fermented: find the mass of ethanol (46.07 g/mol) formed and add it to the CO_2 mass.

REVIEW

8. Explain why yeast in a warm (35 °C) flask produce gas faster than yeast in a cold (5 °C) flask, using what you learned about enzymes in Unit 1.

Lesson 2.4 — Following Carbon: Atoms From Air to Tree and Back

FLUENCY

1. Find the molar mass of $CaCO_3$.

2. Find the molar mass of Al_2O_3.

3. What fraction of the mass of glucose ($C_6H_{12}O_6$, 180.16 g/mol) is carbon? (C = 12.011)

APPLICATION

4. A young oak adds 250 kg of dry wood in a decade. Assuming wood is half carbon, how much CO_2 did it remove from the air?

5. Atmospheric CO_2 at Mauna Loa was about 315 ppm in 1958 and about 425 ppm in 2024 (NOAA). Find the increase in ppm, the percentage increase, and the average rise per year.

6. To make amino acids from sugar, a plant needs one element that is not in CO_2 or water. Which is it, and where does the plant get it?

CHALLENGE

7. The Mauna Loa record rises and falls by about 6 ppm each year, peaking around May. Explain the timing, and predict whether a station in the Southern Hemisphere would show a larger or smaller yearly swing.

REVIEW

8. A cube-shaped cell of side 3 μm grows to side 6 μm. By what factor does its surface-area-to-volume ratio change?

Unit 2 checkpoint

1. Most of the dry mass of a giant bur oak came from:
   A. Minerals in the soil
   B. Carbon dioxide from the air
   C. Water alone
   D. Sunlight
2. In 6CO₂ + 6H₂O → C₆H₁₂O₆ + 6O₂, each side has _____ oxygen atoms.
3. The oxygen gas released in photosynthesis comes from:
   A. Carbon dioxide
   B. Water
   C. Glucose
   D. The soil
4. If ET₅₀ = 16 minutes, the rate 1/ET₅₀ is _____ per minute.
5. True or false: Plants carry out photosynthesis instead of cellular respiration.

6. Which is produced by alcoholic fermentation but not by aerobic respiration?
   A. Carbon dioxide
   B. ATP
   C. Ethanol
   D. Heat

7. In cellular respiration, energy is released because:
   A. Atoms are destroyed
   B. Bonds in glucose and oxygen are broken and new, more stable bonds form in CO₂ and water
   C. Oxygen is turned into energy
   D. Glucose is turned into light

8. Each kilogram of carbon in wood came from about _____ kg of carbon dioxide.

9. True or false: Energy cycles through an ecosystem in the same way carbon does.

10. Which element must a plant take from the soil to turn sugar into amino acids?
    A. Carbon
    B. Oxygen
    C. Nitrogen
    D. Hydrogen

11. Why does the Mauna Loa CO₂ record fall each Northern Hemisphere summer?
    A. Fewer cars are driven
    B. Land plants photosynthesize faster than all organisms respire
    C. The ocean stops absorbing CO₂
    D. Volcanoes are quieter

Sejal Learning Systems · Royal Legacy Preparatory School · Generated from the course's practice files; generated problems are checked by computer, authored problems by their author.