

**Passage IV**

The chemical reactions associated with photosynthesis can be summarized with the following chemical equation:

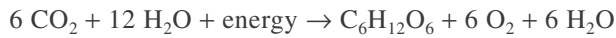


Table 1 lists wavelength ranges for visible light and the color frequently associated with each range.

Table 1	
Color	Wavelength (nm)
Violet	380–430
Blue	430–500
Green	500–565
Yellow	565–585
Orange	585–630
Red	630–750

Table 1 adapted from Neil A. Campbell, Jane B. Reece, and Lawrence G. Mitchell, *Biology*, 5th ed. ©1999 by Benjamin/Cummings.

Figure 1 shows the relative absorption of light by chlorophyll *a* and chlorophyll *b* versus the wavelength of light from 400 nm to 750 nm.

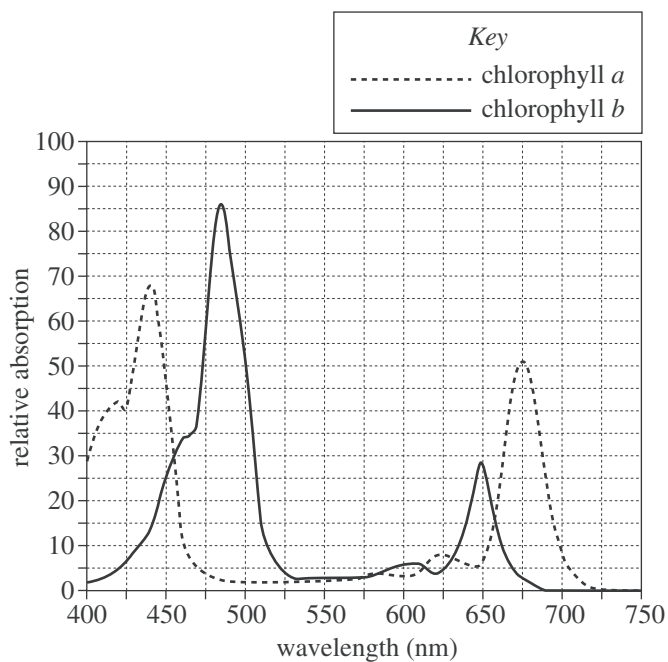


Figure 1

Figure 2 shows the average rate of photosynthesis at various wavelengths as a percent of the average rate of photosynthesis at 670 nm.

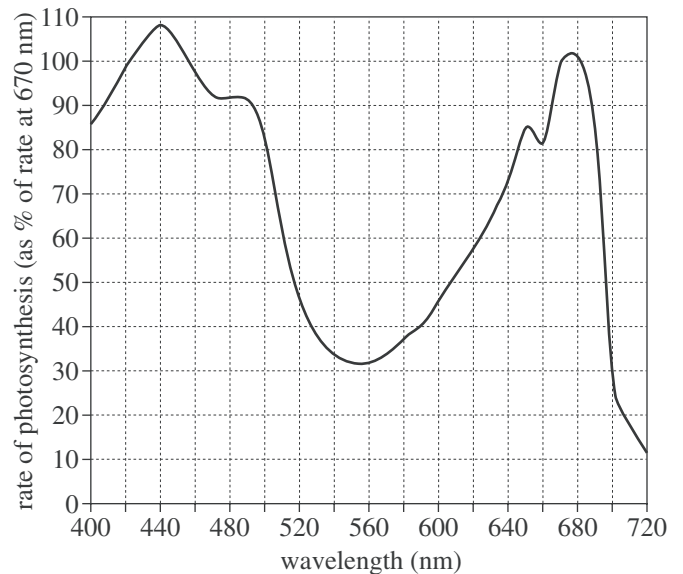


Figure 2

Figures 1 and 2 adapted from Peter H. Raven, Ray F. Evert, and Susan E. Eichhorn, *Biology of Plants*, 4th ed. ©1986 by Worth Publishers, Inc.

17. Based on Table 1 and Figure 1, which color of light is associated with the wavelength of light that results in the greatest absorption by chlorophyll *b* ?

- A. Blue
- B. Green
- C. Yellow
- D. Red

GO ON TO THE NEXT PAGE.



18. In eukaryotic organisms, the chemical reactions associated with the chemical equation shown in the passage typically occur within which of the following structures?
- F. Chloroplasts
 - G. Mitochondria
 - H. Lysosomes
 - J. Nuclei
19. In Figure 2, at which of the following wavelengths does the rate of photosynthesis exceed the rate of photosynthesis at 670 nm ?
- A. 400 nm
 - B. 430 nm
 - C. 630 nm
 - D. 700 nm
20. In the chemical equation shown in the passage, the carbon in CO_2 becomes part of which of the following types of molecules?
- F. Fat
 - G. Sugar
 - H. Protein
 - J. Nucleic acid
21. Which of the following conclusions is best supported by Figures 1 and 2 ? The wavelength that results in the highest rate of photosynthesis also results in the:
- A. lowest relative absorption by chlorophyll *a*.
 - B. lowest relative absorption by chlorophyll *b*.
 - C. highest relative absorption by chlorophyll *a*.
 - D. highest relative absorption by chlorophyll *b*.

**Passage V**

Students performed the following experiments to determine the density of common plastics.

Experiment 1

A dry 100 mL graduated cylinder was placed on an electronic balance and *tared* (the balance was reset to 0.000 g). H₂O was added to the graduated cylinder until a certain mass was obtained. Ethanol was added to the graduated cylinder until the volume of liquid was 50.0 mL. The density of the liquid was then calculated. The procedure was repeated with different amounts of ethanol and H₂O (see Table 1).

Liquid	Mass of H ₂ O (g)	Mass of ethanol (g)	Total mass (g)	Density (g/mL)
1	0	39.67	39.67	0.793
2	10.24	32.43	42.67	0.853
3	19.79	25.23	45.02	0.900
4	35.42	12.47	47.89	0.958
5	49.96	0	49.96	0.999

Experiment 2

A known mass of potassium iodide (KI) was dissolved in a known mass of H₂O. A dry 100 mL graduated cylinder was placed on the balance and tared. The solution was added to the graduated cylinder until the volume was 50.0 mL. The density of the liquid was then calculated. The procedure was repeated with different amounts of KI and H₂O (see Table 2).

Liquid	Mass of H ₂ O in solution (g)	Mass of KI in solution (g)	Mass of solution in graduated cylinder (g)	Density (g/mL)
6	97.66	7.36	52.51	1.05
7	95.41	15.52	55.70	1.11
8	94.38	20.68	57.53	1.15
9	92.18	29.08	60.63	1.21
10	87.77	41.31	64.64	1.29

Experiment 3

A solid plastic bead was placed at the bottom of a sample of each of Liquids 1–10 from Experiments 1 and 2. If the bead stayed at the bottom, “S” was recorded in Table 3. If the bead rose, “R” was recorded in Table 3. The procedure was repeated for various plastics.

Plastic	Liquid									
	1	2	3	4	5	6	7	8	9	10
Polybutylene	R	R	R	R	R	R	R	R	R	R
VLDPE	S	R	R	R	R	R	R	R	R	R
LDPE	S	S	S	R	R	R	R	R	R	R
HDPE	S	S	S	S	R	R	R	R	R	R
PA-11	S	S	S	S	S	R	R	R	R	R
PA-6	S	S	S	S	S	S	S	R	R	R
Polycarbonate	S	S	S	S	S	S	S	S	R	R
PVC	S	S	S	S	S	S	S	S	S	S

22. In Experiment 1, the density of ethanol was found to be:

- F. less than 0.793 g/mL.
- G. 0.793 g/mL.
- H. 0.999 g/mL.
- J. greater than 0.999 g/mL.

23. Based on the results of Experiments 1–3, the density of PA-11 is most likely:

- A. less than 0.793 g/mL.
- B. between 0.853 g/mL and 0.958 g/mL.
- C. between 0.999 g/mL and 1.05 g/mL.
- D. greater than 1.11 g/mL.



24. Suppose that a sixth KI/H₂O solution had been measured in Experiment 2 and the mass of the solution in the graduated cylinder was 67.54 g. The density of this solution would most likely have been closest to which of the following?

- F. 1.25 g/mL
- G. 1.30 g/mL
- H. 1.35 g/mL
- J. 1.40 g/mL

25. A plastic bead was tested as in Experiment 3 using Liquids 1–4. Which of the following is NOT a plausible set of results for the plastic?

Liquid			
1	2	3	4

- A. R R R R
- B. R R S S
- C. S S R R
- D. S S S S

26. In Experiments 1 and 2, the students tared the graduated cylinder in each trial so they could more easily determine:

- F. the mass of the substances added to the graduated cylinder.
- G. the density of the graduated cylinder.
- H. when the total volume of the added substances was equal to 50.0 mL.
- J. when all of the KI was dissolved in the H₂O.

27. A student claimed that polycarbonate is more dense than PA-6. Do the results of Experiments 1–3 support his claim?

- A. No, because in Liquid 8, polycarbonate stayed at the bottom and PA-6 rose.
- B. Yes, because in Liquid 8, polycarbonate stayed at the bottom and PA-6 rose.
- C. No, because in Liquid 8, polycarbonate rose and PA-6 stayed at the bottom.
- D. Yes, because in Liquid 8, polycarbonate rose and PA-6 stayed at the bottom.

**Passage VI**

Bacteria break down sugars by *fermentation*. To study 2 fermentation pathways, researchers performed 2 experiments using broth that contained either the sugar *sucrose* or the sugar *lactose*. One of the fermentation pathways produces CO_2 gas and increases the acidity (lowers the pH) of the solution. The other pathway produces acid but not CO_2 .

Experiment 1

Sucrose broth was added to 5 large test tubes. Next, *phenol red* (a pH indicator that is yellow if $\text{pH} < 7$, red if $\text{pH} \geq 7$) was added to each large test tube. A *Durham tube* (a small test tube) was placed, inverted, in each large test tube to collect CO_2 (see Figure 1).

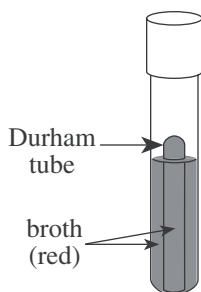


Figure 1

The large test tubes were capped, heated until the solutions were sterile, then cooled. One of 4 bacterial species (Species A–D) was added to each of 4 of the large test tubes. The procedure was repeated using lactose broth instead of sucrose broth. The 10 large test tubes (all containing solutions at a pH of 7) were then incubated at 37°C for 48 hr.

The large test tubes and Durham tubes were examined. If acid was produced, the solution was yellow. If no acid was produced, the solution remained red. If CO_2 was produced, a gas bubble was observed at the top of the Durham tube (see Table 1).

Species added	Sucrose broth		Lactose broth	
	acid	CO_2	acid	CO_2
A	–	–	–	–
B	–	–	+	+
C	+	+	–	–
D	+	–	+	–
None	–	–	–	–

Experiment 2

Synergism occurs when 2 bacterial species act together to ferment a sugar by using a pathway that neither species can use alone. To investigate synergism, Experiment 1 was repeated, except that different pairs of bacterial species were added to each large test tube (see Table 2).

Species added	Sucrose broth		Lactose broth	
	acid	CO_2	acid	CO_2
A and B	–	–	+	+
A and C	+	+	–	–
B and D	+	+	+	+
C and D	+	+	+	+

28. In Experiment 1, which of the bacterial species fermented lactose?

F. Species B only
 G. Species C only
 H. Species B and Species D only
 J. Species C and Species D only

29. Suppose that in Experiment 2 both Species B and Species C had been added to a large test tube containing sucrose broth and to a large test tube containing lactose broth. Which of the following would most likely depict the results?

	Sucrose broth		Lactose broth	
	acid	CO_2	acid	CO_2

A. – – + +
 B. + + – –
 C. + + + +
 D. – – – –



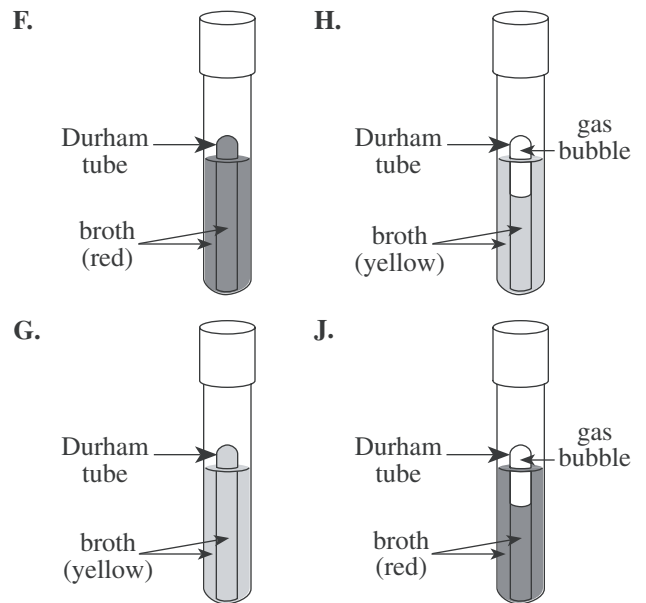
30. Suppose a scientist isolates a bacterial species that is 1 of the 4 species used in Experiment 1. She adds the species to sucrose broth and observes that neither acid nor CO_2 is produced. She then adds the species to lactose broth and observes that both acid and CO_2 are produced. Based on the results of Experiment 1, the species is most likely:

- F. Species A.
- G. Species B.
- H. Species C.
- J. Species D.

31. What is the evidence from Experiments 1 and 2 that Species C and Species D acted synergistically in Experiment 2?

- A. No acid was produced when each species was alone in the sucrose broth, but acid was produced when the 2 species were together in the sucrose broth.
- B. No acid was produced when each species was alone in the lactose broth, but acid was produced when the 2 species were together in the sucrose broth.
- C. No CO_2 was produced when each species was alone in the sucrose broth, but CO_2 was produced when the 2 species were together in the sucrose broth.
- D. No CO_2 was produced when each species was alone in the lactose broth, but CO_2 was produced when the 2 species were together in the lactose broth.

32. Which of the following figures best illustrates the results of Experiment 1 for Species D in the sucrose broth?

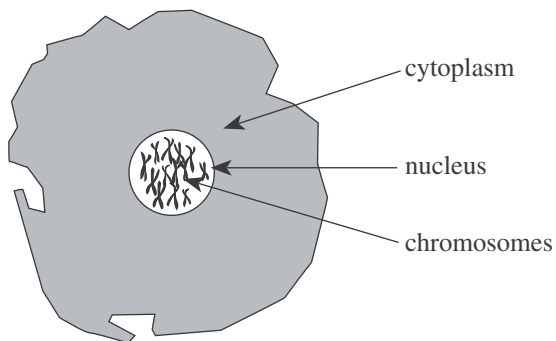


33. Is the hypothesis that Species A and Species C acted synergistically supported by the results of Experiment 2?

- A. Yes, because both acid and CO_2 were produced from sucrose.
- B. Yes, because both acid and CO_2 were produced from lactose.
- C. No, because only acid, not CO_2 , was produced from both sucrose and lactose.
- D. No, because neither acid nor CO_2 was produced from lactose.

**Passage VII**

In the 1940s, scientists thought all genetic material was contained in structures called *chromosomes* and that chromosomes had been found only in the nucleus of a cell (not in the cytoplasm):



Chromosomes are composed of 2 types of molecules, proteins and deoxyribonucleic acid (DNA). Proteins are composed of subunits called *amino acids*. DNA consists of chains of subunits called *nucleotides*. The parts of chromosomes that are responsible for the transmission of genetic information are called *genes*.

Two scientists in the 1940s debate whether genes are made of proteins or DNA.

Protein Hypothesis

Genes are made only of proteins. Proteins make up 50% or more of a cell's dry weight. Cells contain 20 different amino acids that can be arranged in a virtually infinite number of ways to make different proteins. The number and arrangement of different amino acids within a protein form the codes that contain hereditary information.

In contrast, only 4 different nucleotides make up the DNA found in cells, and they are believed to form chains only in certain ratios. As a result, the number of different combinations that DNA can carry is much smaller than the number that proteins can carry.

DNA Hypothesis

Genes are made only of DNA. DNA is found exclusively in the cell's nucleus, whereas proteins are found throughout the nucleus and cytoplasm. Additionally, the amount of protein in a cell varies from cell type to cell type, even within the same animal.

Though DNA is less abundant than proteins, the amount is consistent from cell type to cell type within the same animal, except for the *gametes* (the reproductive cells). Gametes have half the amount of DNA as other cells in the body. Gametes also have half the typical number of chromosomes. Thus, the amount of DNA in a cell is correlated with the number of chromosomes in the cell. No such correlation is found for proteins.

34. Which of the following statements is most consistent with the DNA Hypothesis? The amount of DNA will generally increase from cell type to cell type as the number of:

- F. amino acids in the nucleus increases from cell type to cell type.
- G. amino acids in the cytoplasm increases from cell type to cell type.
- H. chromosomes in the nucleus increases from cell type to cell type.
- J. chromosomes in the cytoplasm increases from cell type to cell type.

35. By referring to the observation that DNA is found exclusively in the nucleus while proteins are found throughout the cell, the scientist supporting the DNA Hypothesis implies that genes are made only of DNA because which of the following are also found only in the nucleus?

- A. Amino acids
- B. Proteins
- C. Gametes
- D. Chromosomes

36. According to the passage, a similarity between DNA and proteins is that both types of molecules:

- F. are found only in gametes.
- G. are abundant in the cytoplasm.
- H. contain 20 different amino acids.
- J. are composed of smaller subunits.

37. According to the Protein Hypothesis, which of the following observations provides the strongest evidence that genes are NOT composed of DNA ?

- A. DNA is composed of only 4 types of nucleotides.
- B. DNA is composed of smaller subunits than are proteins.
- C. DNA is abundant in both the nucleus and the cytoplasm.
- D. The concentration of DNA is generally consistent from cell to cell.

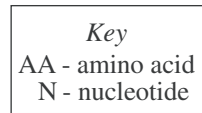
38. *Mitochondria* are organelles located in the cytoplasm that are responsible for energy transformation in a cell. After the 1940s, it was observed that mitochondria contain their own genes. This observation contradicts evidence stated in which hypothesis?

- F. The DNA Hypothesis, because if genes are made of DNA, the observation would show that DNA is present outside the nucleus.
- G. The DNA Hypothesis, because if genes are made of DNA, the observation would show that DNA is present inside the nucleus.
- H. The Protein Hypothesis, because if genes are made of proteins, the observation would show that proteins are present outside the nucleus.
- J. The Protein Hypothesis, because if genes are made of proteins, the observation would show that proteins are present inside the nucleus.



39. The scientist who describes the DNA Hypothesis implies that the Protein Hypothesis is *weakened* by which of the following observations?
- For a given organism, the amount of protein in the gametes is half that found in other types of cells.
 - For a given organism, the amount of protein in different types of cells is not the same.
 - Protein molecules are composed of many subunits.
 - Proteins are found only in the nucleus.

40. Which of the following illustrations of a portion of a DNA molecule is consistent with the description in the passage?



- F. } (AA) — (N) — (AA) — (N) }
- G. } (N) — (AA) — (AA) — (N) }
- H. } (AA) — (AA) — (AA) — (AA) }
- J. } (N) — (N) — (N) — (N) }

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

[See Note on page 56.]