BIOA-CA · Biology A — Cells, Energy and Heredity (California)

Unit 1: Cells as Systems: Structure, Function and Homeostasis

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

Name _____ Period _____

Lesson 1.1 — Phenomenon: Surviving a Central Valley Heat Wave

FLUENCY

1. Convert 25 cm^3 to mL.

2. Convert 100 km to m.

3. Convert 105 °F, a Central Valley afternoon high, to degrees Celsius. Use °C = (°F − 32) × 5/9.

4. Heat stroke becomes a danger when core temperature passes about 40 °C. Convert 40 °C to °F.

5. Put these in order from smallest to largest level of organization: organ system, cell, organ, tissue, organism.

APPLICATION

6. Classify each as a cell, tissue, organ or organ system: (a) a sweat gland cell; (b) the skin; (c) smooth muscle in a blood-vessel wall; (d) the heart, blood vessels and blood together.

7. A worker doing moderate labor produces about 400 W of body heat (illustrative value; 1 W = 1 J/s). On a 105 °F day nearly all of it must leave by sweat evaporation, and each gram of sweat that evaporates removes about 2.4 kJ. How much sweat must evaporate each hour?

8. Rewrite this question so that it is testable in a school: “Is heat bad for athletes?” Name the variable you would change and the one you would measure.

CHALLENGE

9. In humid air only half of the sweat evaporates; the rest drips off. For the same 400 W worker, how much sweat must be produced each hour to remove the same heat, and why does this raise the risk of dehydration?

REVIEW

10. A 70 kg worker loses 1.4 kg of body mass as sweat during a shift. What percentage of body mass is that?

Lesson 1.2 — Cells Up Close: Onion, Elodea and Salt Water

FLUENCY

1. A microscope has a 10x eyepiece. Find the total magnification with the 4x, 10x and 40x objectives.

2. The field of view at 40x is 4.5 mm. What is it at 100x?

3. Convert 0.45 mm to micrometers.

4. Find the surface-area-to-volume ratio of a cube-shaped cell with side 4 μm.

APPLICATION

5. At 400x the field of view is 450 μm. Three onion cells fit end to end across it. Estimate the length of one cell.

6. Five Elodea cells fit across the same 450 μm field. Estimate one cell's length and compare it with the onion cell.

7. An Elodea leaf is placed in a salt solution much saltier than its cell sap. Predict what happens to the vacuole and the membrane, and explain in terms of water movement.

CHALLENGE

8. Compare a flat cell measuring 1 × 10 × 10 μm with a cube of the same volume. Find each surface-area-to-volume ratio and explain why many cells that exchange materials quickly are flat.

REVIEW

9. Convert 37 mL to L.

Lesson 1.3 — Feedback in Action: Heart Rate After Exercise

FLUENCY

1. For the data 4, 11, 17, 20, 21, 23, 26, 36, 37: find the mean, median, range and interquartile range. (Find the quartiles as the medians of the lower and upper halves, leaving out the overall median when the count is odd.)

2. For the data 2, 5, 10, 20, 33, 34, 39: find the mean, median, range and interquartile range. (Find the quartiles as the medians of the lower and upper halves, leaving out the overall median when the count is odd.)

3. A student counts 19 pulse beats in 15 seconds. What is the heart rate in beats per minute?

4. Classify as negative or positive feedback: (a) sweating when core temperature rises; (b) ethylene from ripening fruit causing more ripening; (c) insulin release after a meal.

APPLICATION

5. A student's resting pulse is 68 bpm, the pulse right after exercise is 128 bpm, and 2 minutes later it is 92 bpm. What percentage of the rise has been recovered after 2 minutes?

6. Name the sensor, control center and effectors in the loop that lowers blood glucose after a meal.

7. Pulse drops per minute after exercise were 20, 16, 12, 8 and 6 bpm. Explain how this pattern is evidence of negative feedback.

CHALLENGE

8. Student B rests at 70 bpm, peaks at 150 bpm, and is at 110 bpm after 3 minutes. Student A (from the lesson) recovered 73% of the rise in 3 minutes. Compare the two and suggest one variable, other than fitness, that could explain the difference.

REVIEW

9. A graph of pulse against time falls from 138 bpm at 0 min to 90 bpm at 3 min. What is the average rate of change?

Lesson 1.4 — Proteins at Work: Enzymes and Temperature

FLUENCY

1. For the data 8, 15, 19, 30, 33, 33, 40: find the mean, median, range and interquartile range. (Find the quartiles as the medians of the lower and upper halves, leaving out the overall median when the count is odd.)

2. Three trials of catalase at 37 °C gave foam heights of 36, 41 and 37 mm. Find the mean.

3. Name the substrate and the products of the reaction catalase speeds up.

APPLICATION

4. Illustrative data: mean foam 12 mm at 4 °C, 25 mm at 22 °C, 38 mm at 37 °C, 20 mm at 50 °C and 3 mm at 80 °C. Express the activity at 50 °C and at 80 °C as a percentage of the maximum.

5. Explain why activity is low at 4 °C and also low at 80 °C, but for different reasons.

6. For the catalase lab, name the independent variable, the dependent variable and two controlled variables.

CHALLENGE

7. A student cools the 80 °C tube back to 37 °C and adds fresh peroxide; almost no foam forms. Another cools the 4 °C tube to 37 °C and gets about 38 mm. Explain the difference and connect it to why a fever above 40 °C is dangerous.

REVIEW

8. Convert 100 km to m.

Unit 1 checkpoint

1. Which is an organ?
   A. A sweat gland cell
   B. Smooth muscle tissue
   C. The skin
   D. The circulatory system
2. In the body-temperature loop, which structure is the control center?
   A. Sweat glands
   B. The hypothalamus
   C. Skin blood vessels
   D. The heart
3. If the field of view is 4.5 mm at 40x, it is _____ mm at 400x.
4. True or false: As a cube-shaped cell gets larger, its surface-area-to-volume ratio increases.
5. Elodea cells in salt water shrink away from their walls. What moved, and which way?
   A. Salt moved into the cells
   B. Water moved out of the cells by osmosis
   C. Chloroplasts left the cells
   D. Water moved into the cells

6. Which is an example of positive feedback?
   A. Shivering when cold
   B. Insulin release after a meal
   C. Ripening fruit releasing ethylene that speeds more ripening
   D. Sweating when hot

7. Resting pulse 72 bpm, peak 138 bpm, 90 bpm at 3 minutes: the percentage of the rise recovered is about _____%.

8. True or false: An enzyme that has been denatured by heat regains full activity once it cools.

9. Why does a protein's function depend on its shape?
   A. Shape decides its color
   B. Its active site or binding region must fit specific molecules
   C. Shape decides how much DNA it contains
   D. It does not; function depends only on size

10. Why can humid air make heat illness more likely?
    A. Humid air is always hotter
    B. Sweat evaporates more slowly, so less heat is removed
    C. Humidity stops sweat glands working
    D. Humid air increases heart rate directly

11. At 400 W of body heat and 2.4 kJ removed per gram of evaporated sweat, about _____ g of sweat must evaporate per hour.

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