

## Online Activity Worksheet 7.5

**Cellular respiration converts energy in food to energy in ATP.**

Explore a pinball analogy for cellular respiration.

**PAGE 1 OBJECTIVE:** to compare the output of the three stages of respiration

Come play the respiration pinball game! See how the three stages of respiration—glycolysis, the Krebs cycle, and the electron transport chain—generate ATP.

Click the arrow **Glycolysis** in the cytoplasm of the cell to begin the activity.

**PAGE 2 OBJECTIVE:** to compare the output of the three stages of respiration

**How to Play:** Scroll down to reveal the entire pinball animation. Start the animation by dragging two ATP molecules into the “coin slot.”

Carefully follow the directions within the game.

Now answer the following questions in the spaces provided.

1. What is the final net gain of ATP molecules in the first stage, glycolysis?

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2. How many ATP molecules were made in the second stage, the Krebs cycle?

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3. How many ATP molecules were made in the third stage, the electron transport chain?

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### Closer Look: Respiration Stages

**PAGE 1 OBJECTIVE:** to analyze the steps involved in the process of glycolysis

How many ATP molecules are used to activate glycolysis? How many net ATP molecules are produced? What changes does glucose go through in the process?

- Click 1 to start the steps in glycolysis. Click 2 and 3 when you are ready. You may repeat any step by clicking on the appropriate number.
- When you have finished studying glycolysis, take a closer look at the Krebs cycle on page 2.

**PAGE 2 OBJECTIVE:** to analyze the steps involved in the Krebs cycle

Although some ATP molecules are produced in the Krebs cycle, its main job is to provide electrons for the third phase of cellular respiration, the electron transport chain. These electrons are transported by carrier molecules, NADH and  $FADH_2$ . Do the activity to watch how these molecules, as well as some ATP and  $CO_2$ , are formed.

- Click 1 to start the steps in the Krebs cycle. Click 2 and 3 when you are ready. You may repeat any step by clicking on the appropriate number.
- When you have finished studying the Krebs cycle, take a closer look at the electron transport chain on page 3.

**PAGE 3 OBJECTIVE:** to analyze the steps involved in the electron transport chain

Now you will explore how most of the ATP molecules are produced. The electron transport chain uses the flow of electrons from NADH and  $FADH_2$  to pump  $H^+$  out of the mitochondrial matrix to the intermembrane space. The flow of the  $H^+$  back into the matrix provides the energy that is used to combine ADP and P and produce ATP.

Click **start** to begin. Follow the directions within the animation as you study the electron transport chain process.

When you are finished exploring all three stages, draw a graphic of what is going on in cellular respiration.