Food, Energy and Body Weight

Your body uses a lot of energy to run, dance or play a sport. This chart shows how your muscles get the energy to move.

- Food is digested to smaller molecules which are carried by the blood to cells all over the body. For example, starch is digested to glucose.
- Inside cells, cellular respiration produces ATP. These chemical equations summarize cellular respiration of the simple sugar, glucose:
  \[
  \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2 \rightarrow 6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \\
  \checkmark
  \]
  \[
  \checkmark
  \]
  \[
  \sim29 \text{ ADP} + \sim29 \text{ P} \rightarrow \sim29 \text{ ATP} + \sim29 \text{ H}_2\text{O} \\
  \checkmark
  \]
- Hydrolysis of ATP provides the energy for muscle contraction.
  \[
  \text{many ATP} + \text{many H}_2\text{O} \rightarrow \text{many ADP} + \text{many P} \\
  \checkmark
  \]
  \[
  \checkmark
  \]
  \[
  \text{muscle cell relaxed} \rightarrow \text{muscle cell contracted} \\
  \]

1a. In the chart, draw an oval around the pair of chemical equations that show how chemical energy is transformed to mechanical energy.

1b. Where does the ATP inside the oval come from? What process produces ATP?

2. How do our cells get glucose for cellular respiration?

In your diet, you need:
- molecules that can be digested to smaller molecules that can be used for cellular respiration
- other nutrients (e.g. protein and minerals) that can be used to make organic molecules needed in your body.

3. The average American consumes almost 2000 pounds of food each year. Luckily, we do not gain 2000 pounds of weight each year! What happens to all the weight of the food we eat? Where do the atoms in the food molecules go?

4. If a person consumes food with more calories than needed to provide the energy for body activities, he or she will gain weight. Which explanation is correct?
   a. Excess energy (calories) is converted to matter (weight).
   b. Glucose and other food molecules that are not needed for cellular respiration are converted to fat molecules and stored in fat cells.
   c. Glucose and other food molecules that are not needed for cellular respiration are stored in the stomach.
Eating and Exercising

Two friends had lunch together as follows:

<table>
<thead>
<tr>
<th>Alicia</th>
<th>Maria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Item</td>
<td>Calories</td>
</tr>
<tr>
<td>Two slices of cheese pizza</td>
<td>280</td>
</tr>
<tr>
<td>Garden salad</td>
<td>38</td>
</tr>
<tr>
<td>Iced tea</td>
<td>88</td>
</tr>
<tr>
<td>Total calories</td>
<td>406</td>
</tr>
</tbody>
</table>

5a. Both friends are teenage girls who don’t play sports or do other vigorous physical activity. Therefore, each girl is likely to gain weight if she consumes more than ~1800 calories per day. If she divides the 1800 calories equally between breakfast, lunch, dinner and snacks, how many calories should she consume for lunch?  

___ 250    ___450    ___900    ___1200

5b. What advice would you give to Maria?

Both girls are going to a big dinner that evening. They want to avoid weight gain, so they hope that they can burn off the calories they consumed during lunch by walking a total of 40 minutes while they shop that afternoon. Each girl uses ~240 calories per hour as she walks (based on a walking speed of ~2 miles per hour and a body weight of ~150 pounds).

6a. How long would Alicia have to walk to use all the calories she consumed at lunch?  

___ 40 minutes    ___1 hour 40 minutes    ___3 hours 20 minutes    ___5 hours 30 minutes

6b. How long would Maria have to walk to use all the calories she consumed at lunch?  

___ 40 minutes    ___1 hour 40 minutes    ___3 hours 20 minutes    ___5 hours 30 minutes

7. State one or more questions you have concerning the effects of eating and physical activity on obesity or other aspects of health.

Here are some informative and reliable sources to research your question.

- “Weight-Loss and Nutrition Myths” (http://www.niddk.nih.gov/health-information/health-topics/weight-control/myths/Pages/weight-loss-and-nutrition-myths.aspx)
- “Small Changes to Prevent Weight Gain” (http://www.eufic.org/article/en/artid/Small-changes-to-prevent-weight-gain/)
- “Physical Activity and Health” (http://www.cdc.gov/nccdphp/sgr/)
- “Better Health and You: Tips for Adults” (http://www.niddk.nih.gov/health-information/health-topics/weight-control/better-health/Pages/better-health-and-you-tips-for-adults.aspx)
- “Obesity” (http://www.mayoclinic.org/diseases-conditions/obesity/basics/prevention/con-20014834)

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1 By Dr. Ingrid Waldron, University of Pennsylvania, © 2016. Teachers are encouraged to copy this Student Handout for classroom use. The Student Handout and Teacher Notes with background information and instructional suggestions are available at http://serendip.brynmawr.edu/exchange/bioactivities/foodenergy.