

5.1: Grading the Tracing Atoms and Energy in Animals

*This worksheet has “grading” in the title because if they discuss these questions in class, students can be held accountable for correct answers. Level 4 (correct) responses to the questions are in **blue bold italics** below. There are also comments about common Level 2 and Level 3 responses to help you with grading and making decisions about what to emphasize in future lessons.*

Red italics suggest ways to grade student responses by giving them points for correct or partially correct answers. There are 20 points total on this worksheet.

Some things you may already know. One thing you already know is that *atoms last forever* in living systems. So all the atoms in an animal must have come from somewhere. Animals need *water, air, and food* to live and grow. So those are the sources that the atoms and the energy in animals must come from.

You may not know what kinds of atoms animals are made of. Chemists can take an animal and analyze what kinds of atoms (what elements) it is made of. The first column of the table below shows what they find. Where does each kind of atom in an animal come from?

<i>Kinds of atoms in animals</i>	<i>Where atoms come from</i>	<i>Your reasons for your ideas</i>
Carbon atoms make up about 19% of the mass of animals.	Animals’ bodies get some carbon atoms from water . True <i>False</i>	<i>Level 4 responses should trace carbon atoms back to large organic molecules in food.</i> <i>There are also carbon atoms in air (in CO₂), but they are not incorporated into organic molecules in cells.</i>
	Animals’ bodies get some carbon atoms from air . True <i>False</i>	
	Animals’ bodies get some carbon atoms from food . <i>True</i> False	
Oxygen atoms make up about 65% of the mass of animals.	Animals’ bodies get some oxygen atoms from water . <i>True</i> False	<i>Level 4 responses should trace oxygen atoms back to water and large organic molecules in food.</i> <i>See footnote below about oxygen in the air.</i>
	Animals’ bodies get some oxygen atoms from air . <i>True False¹</i>	
	Animals’ bodies get some oxygen atoms from food . <i>True</i> False	
Hydrogen atoms make up about 10% of the mass of animals.	Animals’ bodies get some hydrogen atoms from water . <i>True</i> False	<i>Level 4 responses should trace hydrogen atoms back to water and large organic molecules in food.</i>
	Animals’ bodies get some hydrogen atoms from air . True <i>False</i>	
	Animals’ bodies get some hydrogen atoms from food . <i>True</i> False	

¹ The oxygen that animals breathe is used exclusively for cellular respiration (not biosynthesis). Some of those oxygen atoms end up in water molecules that stay in their bodies, so a tiny percentage of oxygen atoms in animal bodies comes from air.

All other elements (mostly nitrogen, potassium, calcium, magnesium, and phosphorous) make up about 6% of the mass of animals.	Animals' bodies get some other atoms from water .	True False	Level 4 responses should trace other atoms back to minerals and large organic molecules in food.
	Animals' bodies get some other atoms from air .	True False	
	Animals' bodies get some other atoms from food .	True False	

1 point for each correct answer (16 points total)

You already know is that *energy lasts forever* in living systems. The energy in animals must come from somewhere. Use the table below to show where the chemical energy comes from.

Kinds of energy in animals	Where energy comes from	Your reasons for your ideas
Where does the <i>chemical energy</i> in an animal come from?	Animals' bodies get some energy from water .	True False
	Animals' bodies get some energy from air .	True False
	Animals' bodies get some energy from food .	True False
		Level 4 responses should explain that only food has organic molecules with high-energy bonds. Some Level 2 or Level 3 students may suggest that water and air have energy because they are essential for life.

1 point for each correct answer (4 points total)