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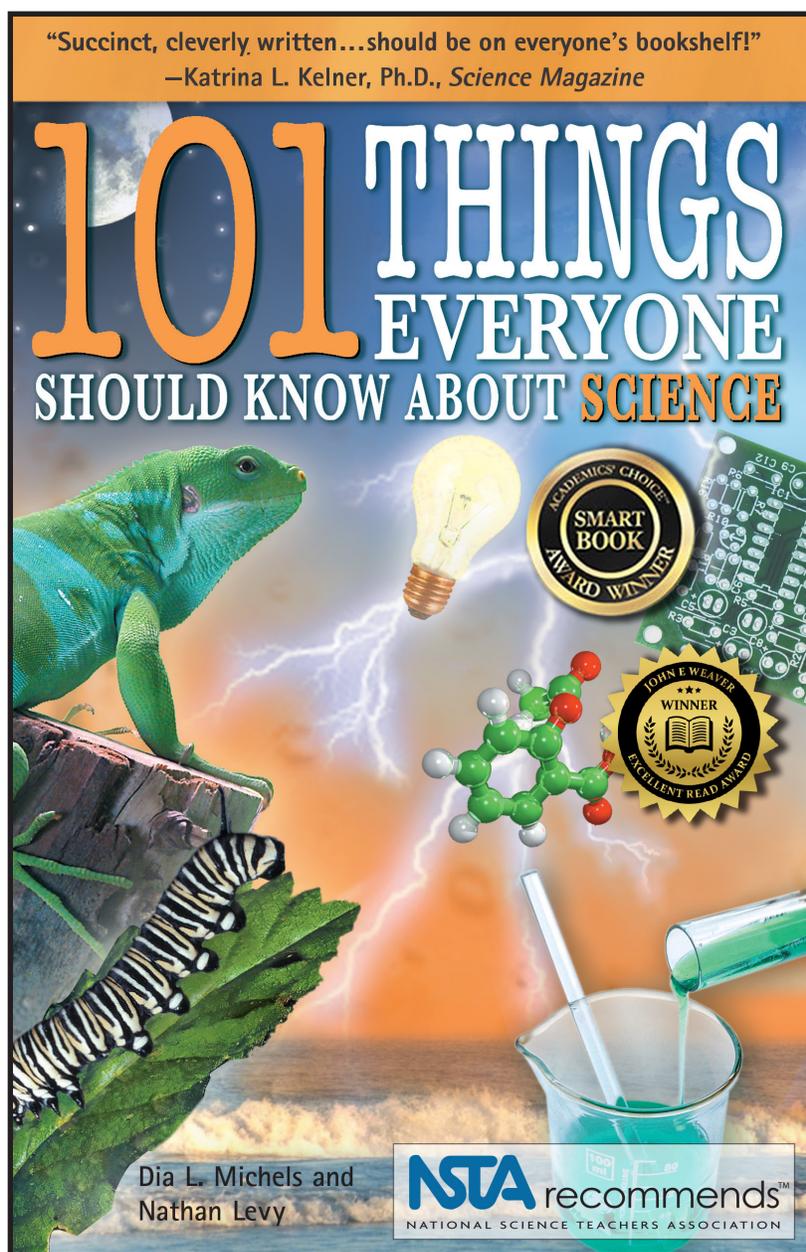
By Dia L. Michels and Nathan Levy

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Contents

Introduction	11
<u>Questions</u>	
Biology	17
Chemistry	21
Physics	25
Earth Science	29
General Science	33
Bonus	36
<u>Answers</u>	
Biology Answers	39
Chemistry Answers	63
Physics Answers	83
Earth Science Answers	103
General Science Answers	125
Bonus Answers	135
About the Author	143
Index	147
Glossary	153

Question Section



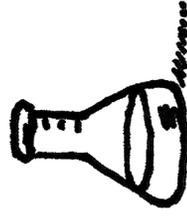
Chemistry Questions



(The answers to these questions start on page 63.)

23. What are the three phases of water?
24. What are the two elements that make up water?
25. Does it take longer to boil water at low altitudes or at high altitudes?
26. When you stir two cups of sugar into one cup of boiling water, you end up with fewer than three cups of syrup. Why?
27. What mineral is found in a saline solution?

Chemistry Answers



23. What are the three phases of water?

Liquid, solid, and gas.

Water exists in three phases. We use the liquid phase most often in our daily activities, for drinking, washing things, and cooking. Liquids do not hold a shape, but they maintain a constant volume. In humans, liquid water makes up about 70 percent of our bodies. Ice, snow, and frost are frozen water. Water's freezing temperature—the highest temperature at which water will become solid—is 32°F (0°C).

Water vapor is water in its gaseous state. Until it reappears as a liquid or solid, it is invisible. Water evaporates into the air from bodies of water and from plant and animal respiration. Water vapor is an important regulator of the Earth's heat. Without it, and other so-called greenhouse gases, our planet would be very hot by day and very cold at night. A gas doesn't hold its shape or maintain its volume. For example, if you pour one liter of water from a watering can into a bucket, it's still one liter. If you take one liter of water vapor and release it into a two-liter bottle, it will spread out to fill the entire bottle. At sea level, water vaporizes at 212°F (100°C).

24. What are the two elements that make up water?

Hydrogen and oxygen.

A water molecule is made up of two hydrogen atoms and one oxygen atom. Its chemical formula is H₂O. Water in its liquid and solid states—including oceans, lakes, streams, and glaciers—covers 71 percent of the world's surface, making Earth unique among the planets. It is this abundance of water that makes

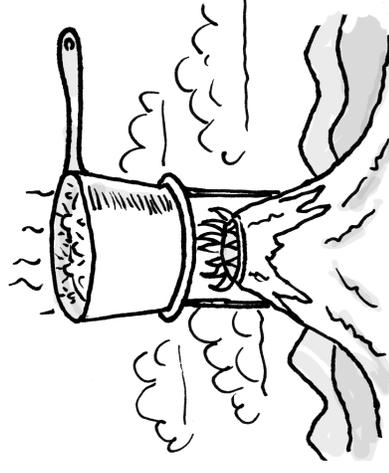
life on Earth possible, but there is a delicate balance to be maintained. If there is too much water, flooding occurs, and with too little, drought will make it difficult or impossible for many plants to survive.

Water makes up 50 to 90 percent of the weight of living organisms (from bacteria to human beings) and is essential for many of the processes that occur within these organisms' cells. As humans, for example, we can go without food for several weeks, but we will die without water in only a few days (see question 81 and the Earth science bonus question).

25. Does it take longer to boil water at low altitudes or at high altitudes?

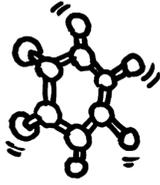
Low altitudes.

At higher elevations (such as in Denver, Colorado—the Mile High City), the boiling point of water decreases, so it boils faster. This is because as you increase elevation,



atmospheric pressure decreases (there is less atmosphere above you). To boil, the vapor pressure of a liquid must equal the vapor pressure of the air around it (the atmospheric pressure). Since atmospheric pressure is lower at higher elevations, water being heated reaches atmospheric pressure quicker (and at a lower temperature) and boils faster than it would at lower elevations. This means some foods will actually require longer cooking times at higher elevations. Check food labeling to see if there are special instructions for higher altitude cooking.

Physics Questions



(The answers to these questions start on page 83.)

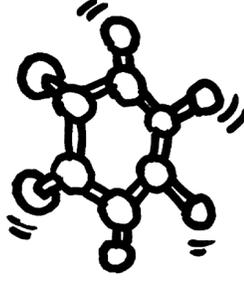
46. Sir Isaac Newton taught us that for every action (or force) there is an equal and opposite _____.

47. If an object is moving, it has energy. What do we call this type of energy?

48. Can a machine run forever? Explain.

49. At the same pressure, which is more dense—hot air or cold air?

Physics Answers



46. Sir Isaac Newton taught us that for every action (or force), there is an equal and opposite _____.

Reaction force.

Newton's third law of motion states, "For every action, there is an equal and opposite reaction." For any force (action) one object exerts upon a second object, there is a reaction force applied by the second object back onto the first object. This reaction force is always equal in magnitude and opposite in direction from the action force. For example, if you hit a ball with a baseball bat, the bat exerts a force on the ball as it hits it. At the same time, the ball exerts an equal but opposite force on the bat. The same concept applies in soccer (a player may lose his balance after a kick) and in car accidents (in which one car hits another or when a car hits another object). (For more about Sir Isaac Newton, see questions 2 and 50).

47. If an object is moving, it has energy. What do we call this type of energy?

Kinetic energy.

The energy of motion is called kinetic energy (k). Kinetic energy is measured by how much work is needed to either put an object from rest into its current state of motion, or to bring a moving object to rest. The more mass (m) an object has, and the greater its velocity (v), the greater the object's kinetic energy. To determine something's kinetic energy, we use the equation $k=1/2mv^2$. In other words, the kinetic energy of an object is one-half of its mass times its velocity squared.

48. Can a machine run forever? Explain.

No.

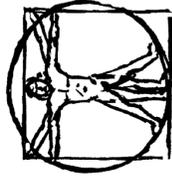
There is no machine that operates without any external power source. Such a machine, commonly referred to as a perpetual motion machine, has been attempted by many over the years, but no one has succeeded. Even Leonardo da Vinci failed to invent one. People's attempts have included all sorts of components, such as a wheel of revolving balls, magnets, pulleys, and ramps. Such a machine would defy the law of conservation of energy, one of the most fundamental of all natural laws. No system can produce more energy than is supplied to it.

49. At the same pressure, which is more dense—hot air or cold air?

Cold air.

Cold air is denser than hot air. Air is composed of nitrogen, oxygen, and other molecules of gases. These molecules move at incredible speeds, colliding with each other and all other objects. The higher the temperature, the faster the molecules move. As the air is heated, the molecules speed up and push harder against their surroundings and each other. If the volume of the area is not fixed, this increases the space between the molecules, making the air less dense. For example, when the air in a hot-air balloon is heated, it expands (molecules speed up and spread apart). Now less dense than the surrounding air, the balloon rises. When the heater is turned off, the air in the balloon cools, the molecules slow down and move closer together, and the balloon descends (see question 36).

General Science Questions



(The answers to these questions start on page 125.)

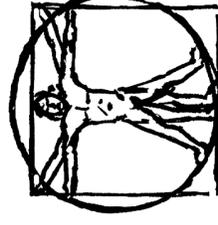
91. What does the suffix “-ology” mean?

92. What is a hypothesis?

93. What are the two most common measurements of temperature?

94. How many pounds does one cup of water weigh?

General Science Answers



91. What does the suffix “-ology” mean?

“-ology” means a field of study or branch of science.

From its Greek root, “-ology” means “the study of.” We get a specific branch of study when we add a prefix to this suffix, or word ending. For example, the prefix “bio” means life, or living organism. Biology, then, means the study of living things. “Geo” means Earth; geology is the study of the Earth. Volcanology is the study of volcanoes. The suffix “-onomy” is nearly the same as “-ology” and means “the science of.” Astronomy is the science of the universe; taxonomy is the science of classifying living organisms.

92. What is a hypothesis?

A proposed explanation for why something happens.

In common usage today, a hypothesis (which is Greek for assumption) is a provisional idea whose merit must be evaluated. Science happens in many ways. In some instances, a scientist observes a phenomenon—such as, food left at room temperature spoils more rapidly than food kept cool—and then develops a hypothesis for why. Other times, scientists set out to answer a question—such as, will mice be healthier if they eat vegetables or chocolate? Whether the hypothesis comes from an intellectual pursuit or an observation, the job of scientists is to perform tests in order to validate or negate their ideas. Through rigorous testing, scientists can help us learn what is speculation and what is real.

93. What are the two most common measurements of temperature?

Fahrenheit and Celsius.

Temperature is the measure of the warmth or coolness of an object. It is measured with a thermometer or another instrument that has a scale calibrated in degrees. The size of a degree depends on the particular temperature scale being used. A temperature scale is determined by choosing two reference temperatures and dividing the temperature difference between these two points into a certain number of degrees. The two reference temperatures used for most common scales are the melting point of ice and the boiling point of water. On the Celsius temperature scale, also referred to as the Centigrade scale, the melting point of ice is set at 0°C, the boiling point of pure water (at sea level) is set at 100°C, and the difference between them is divided into 100 degrees. On the Fahrenheit temperature scale, the melting point is set at 32°F, the boiling point at 212°F, and the difference between them is equal to 180 degrees.

Temperatures on the Fahrenheit scale can be converted to equivalent temperatures on the Celsius scale by first subtracting 32 from the Fahrenheit temperature, then multiplying the result by 5/9, according to the formula $(F-32) \times 5/9 = C$. So, 59°F is the same as 15°C.

Although the Fahrenheit scale was formerly used widely in English-speaking countries, many of these countries began changing to the more convenient Celsius temperature scale in the late 1960s and early 1970s; a notable exception is the United States, where the Fahrenheit scale is still in common use, along with other English units of measurement.

Index

- A**
acid, measuring of, 22, 69-70
acid, mixing with base, 80
adenosine triphosphate (ATP), 49
air density, 25, 85-86
alkaline, measuring of, 22, 69-70
Allen, Paul, 132
altitude, in determining location, 111
amphibians, 43
AMU (atomic mass unit), 77
Anaximander, 134
angle of incidence, 138
angle of reflection, 138
Animalia, 41
Antarctica, 52, 113-114, 116
antibiotics, 59, 61
anti-inflammatory components, in
 breastmilk, 41
arachnids, 43
Archaea, 40
Archimedes, 99
Archimedes's principle, 99
arteries, 54-55
atmosphere, 30, 50, 91, 93, 104, 106-108
atomic mass, 24, 77
atomic mass unit (AMU), 77
atomic number, 71, 74, 76
atoms, and radioactive decay, 77
ATP (adenosine triphosphate), 49
atria, 55
auricle, 55
axis, Earth, 104-105, 109, 113
- B**
bacteria, 20, 40, 57, 58, 65, 86, 94
Balaenoptera musculus. *see* blue whale
Banneker, Benjamin, 17, 41-42
base (alkaline), 67, 70
 mixing with acid, 80
bats, 46, 48, 50
batteries, creation of, 96
bed bugs, 52
Beethoven, Ludwig van, 28, 102
Bell, Alexander Graham, 133
birds, 43, 50, 55
blood, 19, 48, 52-55, 90
blue whale, 47
bodily fluids, 19, 53
bones, importance of calcium in, 69
breastmilk, 45-46, 53
bridges, arch-shaped, 98-99
- C**
calcium, 69, 72
calcium oxalate, 72
calendars, religious, 105-106
calories, 22, 70
carbon, 23, 66, 72, 76-78, 93-94
carbon cycle, 18, 49-50
carbon dating, 77-78
carbon dioxide, 18, 49-50, 55, 78, 80
carbon monoxide, 78
carnivore, 36, 136
cast iron, 75
CAT scans (computerized axial
 tomography), 90
celestial motion, 104-105
Celsius, 127 body temperature, 19, 20,
 55-56, boiling point of water, 65, 127
Centigrade scale, 127
centrifugal force, 113
centripetal force, 88
cephalothorax, 43
chemical change, examples of, 80-81
Chinese, discovery of cast iron, 75
Christian calendar, 105-106
circulatory system, 54-55
circumference, 77, 112-113
Clarke, Sir Arthur C., 115
classes, 17, 40-44
classifications, of animals, 17, 40-44
classification system, 17, 40-42
coal, 93, 141
color, from sunlight, 104, 122
colors, primary additive, 89
 subtractive, 89
color spectrum, 89, 104, 122
compass points, 111-112
computerized axial tomography
 (CAT) scan, 90
cones. *see* eye receptors

Glossary

- A**
Abdomen [Noun] The part of a vertebrate's body that contains digestive organs.
Acidity [Noun] How acidic a solution is.
AIDS [Noun] A disease caused by HIV (human immunodeficiency virus). The body's immunity severely decreases, which lowers the resistance of the body to infection.
Alkalinity [Noun] How basic a solution is.
Altitude [Noun] The height of an object in relation to sea or ground level.
Amphibians [Noun] Cold-blooded animals that lay eggs and have smooth skin without scales, hair, or feathers. They require a moist environment to survive.
Aorta [Noun] The main artery in a body that supplies oxygenated blood for the circulatory system.
Arachnids [Noun] Animals with eight walking legs, a body divided into two parts (the cephalothorax and the abdomen), and no antennae.
Archaea [Noun] One-celled organisms that live in places where no other organism can survive, such as hot, salty, or acidic waters. However, not all archaeans lives in extreme conditions.
Arteries [Noun] The muscular-walled tubes that carry oxygenated blood from the heart to the rest of the body.
Atom [Noun] The smallest unit an element can be broken down into, made up of subatomic particles known as protons, electrons, and neutrons.
Atomic Mass [Noun] Roughly equal to the number of protons plus the number of neutrons of the element.
Atomic Number [Noun] The number of protons in the nucleus of an atom.
ATP [Noun] The abbreviation for Adenosine Triphosphate, which is the high-energy molecule found in all cells. The life of every organism depends on it.
Atrium [Noun] A chamber of the heart that receives blood from the veins and forces it into a ventricle.
- B**
Bacteria [Noun] Very simple one-celled organisms.
Binomial Nomenclature [Noun] An organism's two-word scientific name.
Birds [Noun] Warm-blooded, back-boned animals that lay eggs, have skin covered with feathers, and have wings.

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