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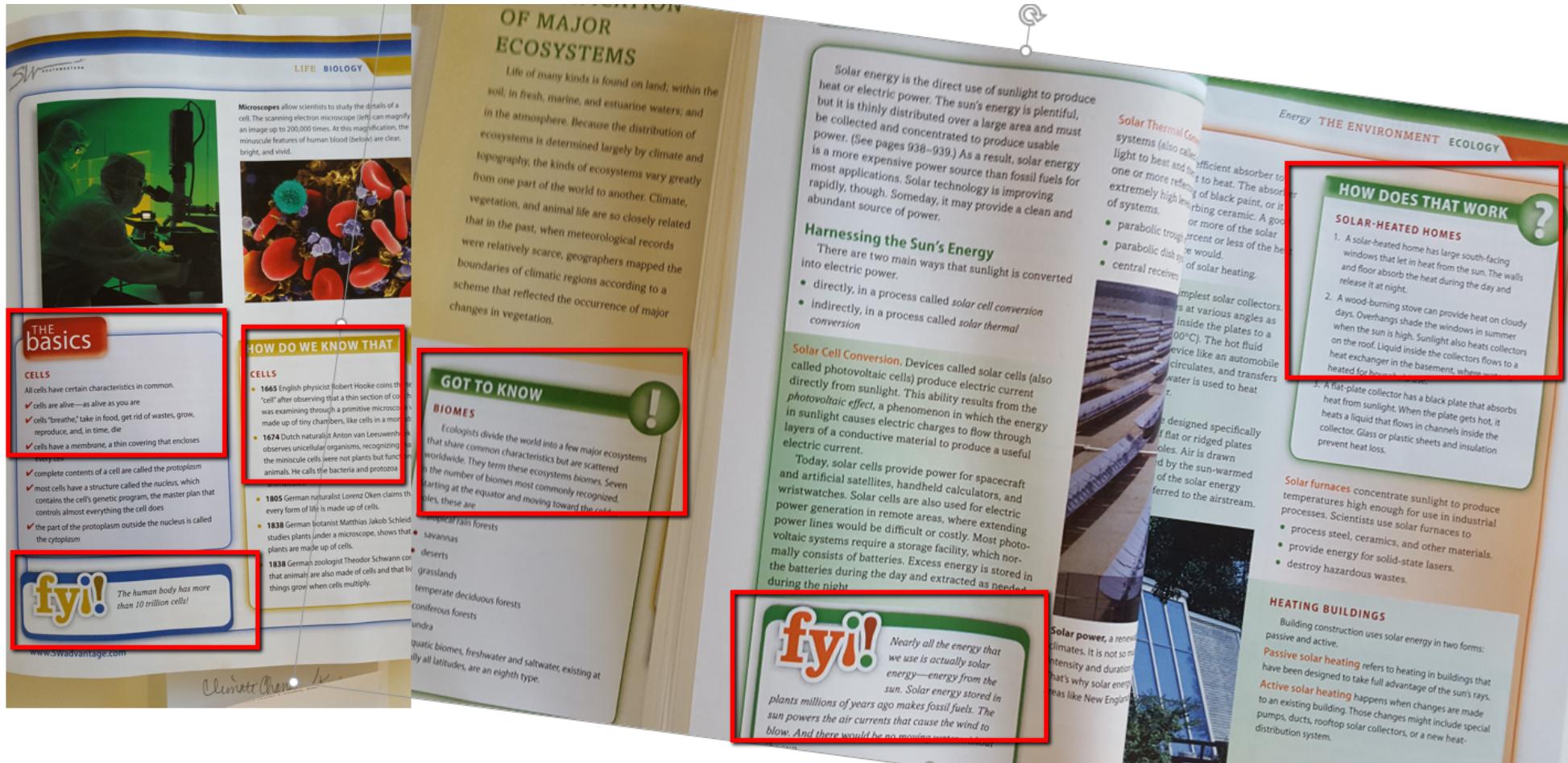
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Total Learning

Books = Instruction + Reference Help

- visual info boxes & ready-reference help
 - biology life cycles & systems
 - chemistry tables, laws, & properties
 - earth science maps & charts
 - ecology ecosystems, charts, history
 - physics diagrams, milestones, & formulas
 - history of science
 - glossaries

on Preface page in front of book



Biology – life cycles & systems

Brain and Skeletal System

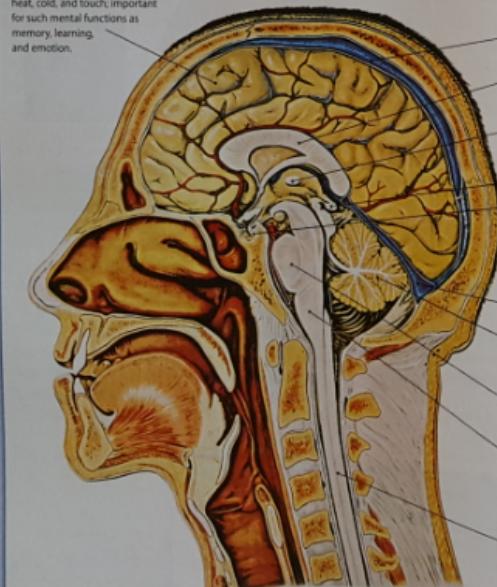
Human Anatomy

This section on human anatomy is designed to show the various structures of the body and their exact location in relation to each other.

Many of the labels in these illustrations not only identify a structure but give additional information about the structure and its function.

The Brain

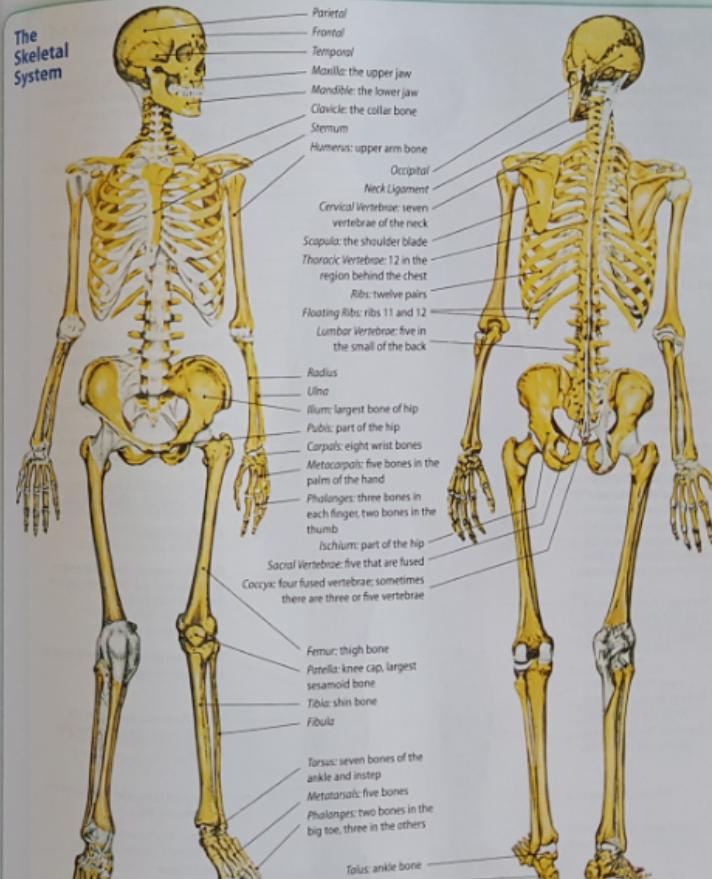
Cerebrum: divided into two halves called cerebral hemispheres; controls such sensations as pain, heat, cold, and touch; important for such mental functions as memory, learning, and emotion.



The illustrations are based on the famous wall charts by Professors Franz Frohse of the University of Berlin and Max Brödel of Johns Hopkins Medical School.

Human Anatomy HUMANS BIOLOGY

The Skeletal System



Periodic Table

Chemistry – updated Table of Elements

1 alkali metals IA	1+ atomic number chemical symbol atomic mass name of element	6 C 12.01 Carbon	1+ ion					
Period 1 1 H 1.01 Hydrogen	2 alkaline earth metals IIA							
Period 2 3 Li 6.94 Lithium	4 Be 9.01 Beryllium	3 4 5 6 7 8 9	transition metals					
Period 3 11 Na 23.00 Sodium	12 Mg 24.31 Magnesium	III B IV B V B VI B VII B	VIII					
Period 4 19 K 39.10 Potassium	20 Ca 40.08 Calcium	21 Sc 44.96 Scandium	22 Ti 47.90 Titanium	23 V 58.94 Vanadium	24 Cr 52.00 Chromium	25 Mn 54.94 Manganese	26 Fe 55.85 Iron	27 Co 58.93 Cobalt
Period 5 37 Rb 85.47 Rubidium	38 Sr 87.62 Strontium	39 Y 88.91 Yttrium	40 Zr 91.22 Zirconium	41 Nb 92.91 Niobium	42 Mo 95.94 Molybdenum	43 Tc 98.91 Technetium	44 Ru 101.07 Ruthenium	45 Rh 102.91 Rhodium
Period 6 55 Cs 132.91 Cesium	56 Ba 137.34 Barium	72 Hf 178.49 Hafnium	73 Ta 180.95 Tantalum	74 W 183.85 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.08 Platinum
Period 7 87 Fr (223) Francium	88 Ra (226) Radium	104 Rf (261) Rutherfordium	105 Db (262) Dubnium	106 Sg (263) Seaborgium	107 Bh (262) Bohrium	108 Hs (265) Hassium	109 Mt (266) Meitnerium	110 Ts (267) Tsingonium

A figure in parentheses is the isotope of longest known half-life. No stable isotope is known.

Polyatomic ions—Theoretical summary					
1. Ions					
• acetate	CH_3COO^-				
benzene	$\text{C}_6\text{H}_5\text{COO}^-$				
chlorate*	ClO_3^-				
chlorite	ClO_4^-				
cyanide	CN^-				
dihydrogen phosphate	H_2PO_4^-				
glutamate	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COO}^-$				
• hydrogen carbonate		HCO_3^-			
hydrogen peroxide		H_2O_2			
hydrogen sulfate		HSO_4^-			
hydrogen sulfide (bisulfide)		HSO_3^-			
hydrogen sulfide (formaldehyde)		HS^-			
hydrogen sulfite (bisulfite)		HSO_3^-			
hydroxide		OH^-			
• hypochlorite			ClO^-	OCl	
nitrate			NO_3^-	NO_2	
nitrite			NO_2^-	NO_3^-	
perchlorate*			ClO_4^-	ClO_3^-	
permanganate			MnO_4^-	MnO_4^-	
stearate			$\text{C}_18\text{H}_{35}\text{COO}^-$	$\text{C}_18\text{H}_{35}\text{COO}^-$	
thiocyanate			SCN^-	SCN^-	

* There are also corresponding ions containing Br and I ions.

	13	14	15	16	17			
	nonmetals							
	III A	IV A	V A	VIA	VII A			
10	11	12						
I B	II B							
28 2+ Ni 58.71 Nickel	29 2+ Cu 63.55 Copper	30 2+ Zn 65.37 Zinc	31 3+ Ga 69.72 Gallium	32 4+ Ge 72.59 Germanium	33 3+ As 74.92 Arsenic	34 2+ Se 78.96 Selenium	35 1+ Br 79.90 Bromine	36 Kr 83.80 Krypton
46 2+ Pd 106.4 Palladium	47 1+ Ag 107.87 Silver	48 2+ Cd 112.40 Cadmium	49 3+ In 114.82 Indium	50 4+ Sn 118.89 Tin	51 5+ Sb 121.75 Antimony	52 2+ Te 127.60 Tellurium	53 1+ I 126.90 Iodine	54 Xe 131.30 Xenon
78 4+ Pt 195.09 Platinum	79 3+ Au 196.97 Gold	80 2+ Hg 200.59 Mercury	81 1+ Tl 204.37 Thallium	82 2+ Pb 207.2 Lead	83 3+ Bi 208.98 Bismuth	84 2+ Po (209) Polonium	85 1+ At (210) Astatine	86 Rn (222) Radon
110 Ds (269)	111 Rg (272)	112 Cn (277)	113 Nh (284)	114 Fl (285)	115 Mc (288)	116 Lv (289)	117 Ts (294)	118 Og (294)
Darmstadtium	Rosetgenium	Copernicium	Nihonium	Flerovium	Moscovium	Livermorium	Tennessee	Oganesson
other metals								
64 3+ Gd 157.25 Gadolinium	65 3+ Tb 158.93 Terbium	66 3+ Dy 162.50 Dysprosium	67 3+ Ho 164.93 Holmium	68 3+ Er 167.26 Erbium	69 3+ Tm 168.93 Thulium	70 3+ Yb 173.94 Ytterbium	71 2+ Lu 174.97 Lutetium	
96 3+ Cm (247)	97 4+ (247)	98 3+ Cf (251)	99 3+ Es (254)	100 3+ Fm (257)	101 2+ Md (258)	102 2+ No (259)	103 2+ Lr (260)	104 3+ Lawrencium

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Highlights in History of Science

Highlights in the History of Science

c. 400 BC	Hippocrates taught that diseases have natural causes.
c. 300 BC	Euclid organized geometry as a single system of mathematics.
200s BC	Archimedes proved the law of the lever and invented the compound pulley.
AD 100s	Ptolemy proposed that Earth is the center of the universe.
AD 100s	Galen developed the first medical theories based on experiments.
800s and 900s	Arab scientists mapped the heavenly bodies and made major advances in mathematics, medicine, and optics.
c. 1500	Leonardo da Vinci studied anatomy, astronomy, botany, and geology.
1543	Nicolaus Copernicus of Poland published <i>On the Revolutions of the Heavenly Spheres</i> . The book, which proposed a sun-centered theory of the universe, revolutionized astronomy.
1543	The first scientific text on human anatomy, <i>On the Structure of the Human Body</i> by Andreas Vesalius, appeared.
1609	Johannes Kepler established astronomy as an exact science.
1628	William Harvey published his theory of how the blood circulates.
Early 1600s	Human vision was explained in geometric terms by René Descartes. He held that mathematics was a model for all sciences.
Mid-1600s	Robert Hooke used the microscope to uncover the world of cells.
Mid-1600s	Robert Boyle helped establish the experimental method in chemistry.
Late 1600s	Experiments with prisms conducted by Sir Isaac Newton showed that sunlight is a mixture of all colors.

Ptolemy's Universe. Ptolemy's hypothesis that Earth was the center of the universe changed when Copernicus observed that the planets revolve around the sun.

Isaac Newton used a prism to demonstrate that sunlight is a mixture of all colors.

Radioactivity. In 1898, Marie and Pierre Curie discovered the radioactive element *radium*, as well as *transmutation*, a process through which atoms of one element can transform into atoms of another element.

Nuclear Energy. Scientists, including Enrico Fermi, first released nuclear energy on a large scale in 1942. This work led to the development of both the atomic bomb and the first controlled nuclear chain reaction.

Highlights in the History of Science

Mid-1800s	Gregor Mendel, an Austrian monk, demonstrated the laws of heredity. He studied the inheritance of traits in pea plants.
Mid-1800s	Louis Pasteur of France started modern microbiology. He demonstrated that certain kinds of microorganisms cause disease.
1859	Charles Darwin set forth his theory of evolution, <i>On the Origin of Species</i> .
1860s	James Clerk Maxwell developed his theory of electromagnetism.
1869	Dmitri Mendeleev published his periodic table of elements.
1879	Wilhelm Wundt founded one of the first psychology laboratories.
1898	Marie and Pierre Curie and Gustave Bémont isolated the element radium.
c. 1900	Sigmund Freud established the field of psychotherapy.
c. 1900	Paul Ehrlich originated the treatment of syphilis with the drug Salvarsan.
1900	Max Planck, a German physicist, proposed the quantum theory, which states that energy is given off in discrete amounts called quanta.
1905	Albert Einstein, a German-born physicist, proposed the theory of relativity, which revolutionized our understanding about space and time.
1911	Ernest Rutherford put forth his theory of the atomic nucleus.
1928	Alexander Fleming discovered penicillin, the first antibiotic.
1942	Enrico Fermi and others at the University of Chicago created the first controlled nuclear chain reaction.
1953	Jonas Salk produced the first effective vaccine against polio.

Glossaries at the back of each science topic

Biology Glossary

- fossil** the hardened remains or plant of a former age.
- fruit** the part of a flowering plant that contains seeds.
- fungi** organisms, such as molds, mildews, rusts, and smuts, that obtain their养分 from other living organisms or from dead, once-living things.
- gamete** a reproductive cell capable of fusing with another gamete to form a fertilized egg.
- gene** a functional hereditary unit located in a chromosome, which influences phenotype, and is capable of producing various alleles.
- genome** a set of all the genes a cell contains.
- genotype** the underlying genetic make-up of an organism.
- geotropism** response by plant to gravity.
- germination** the sprouting of a seed during growth or development.
- glucose** an important carbohydrate, formed during digestion and absorption of carbohydrates in the intestines into the blood.
- Golgi complex** a stacked arrangement of membrane-bound sacs.

Chemistry Glossary

- acid** compound that produces hydrogen ions in water and that is able to donate hydrogen ions to other compounds.
- addition reaction** in organic chemistry, a reaction in which one substance is added onto the structure of another, producing a single compound.
- alcohol** class of organic compounds in which the hydroxyl group ($-OH$) is added on to a hydrocarbon group.
- acyclics** hydrocarbons that have their carbon atoms arranged in a ring.
- aliphatics** hydrocarbon consisting of compound with their carbon atoms arranged in an open-chain structure.
- alkali metal** metallic element that belongs to Group IA of the periodic table and that forms a strong base when combined with the hydroxide group.
- alkane** hydrocarbon in which there are only single bonds between carbon atoms.
- alkene** hydrocarbon in which there is one double bond between two carbon atoms, and the rest of the carbon bonds are single.
- alkyne** hydrocarbon in which there is one triple bond between two carbon atoms, and the rest of the carbon-carbon bonds are single.
- alpha particle** particle consisting of two protons and two neutrons.

Earth Science Glossary

- aa** flowing lava that is cool enough to have partially solidified; and moves as a slow, pasty mass.
- air mass** a large body of air with uniform temperature and humidity.
- alluvial fan** fan-shaped accumulation of sediment that forms where a stream emerges from a narrow mountain canyon onto a flat plain.
- anticline** a fold or folds of rock layers that slope upward to form a crest.
- aquifer** a body of saturated rock or sediment through which water can move easily.
- asthenosphere** the thick layer of Earth's mantle that lies under the lithosphere, thought to consist of a thick slush of partially melted rocks and minerals.
- atmosphere** the envelope of gases that surrounds Earth; three gases essential to life on Earth—oxygen, nitrogen, and carbon dioxide—make up 99 percent of the atmosphere.
- avalanche** a powerful, rapid rock slide.
- bar** a visible ridge of sand or gravel deposited in the middle or along the banks of a stream.
- bed load** the heavy sediment that travels on or near the bottom of a stream.

Ecology Glossary

- abiotic factors** the nonliving components of an ecosystem, such as water, soil mineral content, and energy radiated from the sun.
- acid rain** rain and other precipitation that is made acidic by acids, particularly sulfuric acid.
- aquifers** underground formations that store groundwater.
- biome** a major type of ecosystem that shares common characteristics and moves between them by dispersing seeds and propagating wells and streams.
- biotic factors** the living components of an ecosystem, such as producer organisms, consumers, decomposers, and decomposer organisms.
- biotic potential** the inherent rate at which a population can increase under best of conditions.
- carbon dioxide** a colorless gas that is denser than air. It is found in the atmospheres of many planets and stars. On Earth, all green plants take in carbon dioxide from the atmosphere and release oxygen. Carbon dioxide is also created by burning fossil fuels and by decomposition of organic matter.
- carbon monoxide** a toxic gas that is produced by incomplete combustion of fossil fuels.

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Biology - 12 edition

ISBN13: 978-0547586663

by Stephen Nowicki



ISBN13: 978-0547586663

ISBN10: 0547586663

Cover type: Hardback

Edition: 12

Copyright: 2012

Publisher: McDougal Littell

Published: 2012

List price: \$104.75

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Part 1 of the question.

[◀ Cells](#)

Cells Quiz

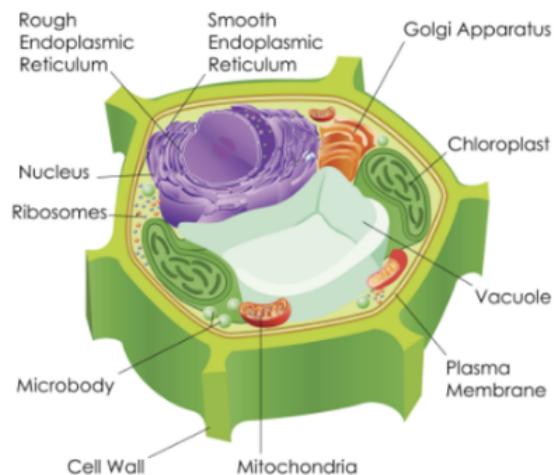
Progress: 8 of 21 answered

Rate: 25%



Score 2 correct 6 Incorrect

Vacuoles are membrane-bound cavities in the cytoplasm that vary greatly in size. Many plant cells contain one or more large vacuoles; in some, a single large vacuole takes up almost the entire interior space. Plant vacuoles may contain water, stored food, pigments, salts, gases, sugars, and other materials. Substances toxic to the cell may also be safely stored there. Vacuoles in animal cells are generally much smaller than those found in plants. Materials may enter and leave the cell by way of vacuoles.



Vacuoles are used by the cell both to transport and to store materials that are not part of the cell.

Your Answer

- This is not true.
- This is true of plant cells only.
- This is true of all cells.
- This is true of animal cells only.

[Submit Answer](#)[Skip Question](#)

If you get Part 1 correct, you automatically advance to Part 2.
If you get Part 1 wrong, you automatically advance to the next question.

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Cells Quiz Progress: 8 of 21 answered Rate: 25%

Score 2 correct 6 Incorrect

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Rough Endoplasmic Reticulum Smooth Endoplasmic Reticulum Golgi Apparatus
Nucleus Chloroplast
Ribosomes Vacuole Plasma Membrane
Microbody Cell Wall Mitochondria

Vacuoles are used by the cell both to transport and to store materials that are not part of the cell.

Your Answer
 This is not true.
 This is true of plant cells only. ✓
 This is true of all cells.
 This is true of animal cells only.

Next Question

Ebsr questions eliminate guessing—you must prove that you understand.

Progress: 8 of 21 answered Rate: 25%

Score: 2 correct 6 Incorrect

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Which letter indicates the vacuole?

D
 C
 B
 A

Submit Answer
Skip Question

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Science in the US

Science Requirements for...

- high school diploma
 - > depends on the state <http://ecs.force.com/mbdata/mbprofall?Rep=HS01>
 - > typically 2 sciences (physical science + biology)
- college entrance
 - > 4 years of science (3 laboratory) ...honors/AP preferred
- any career in STEM
 - > 4 years of science, including physics & calculus...honors/AP preferred

Science in the US

Science Standardized Testing

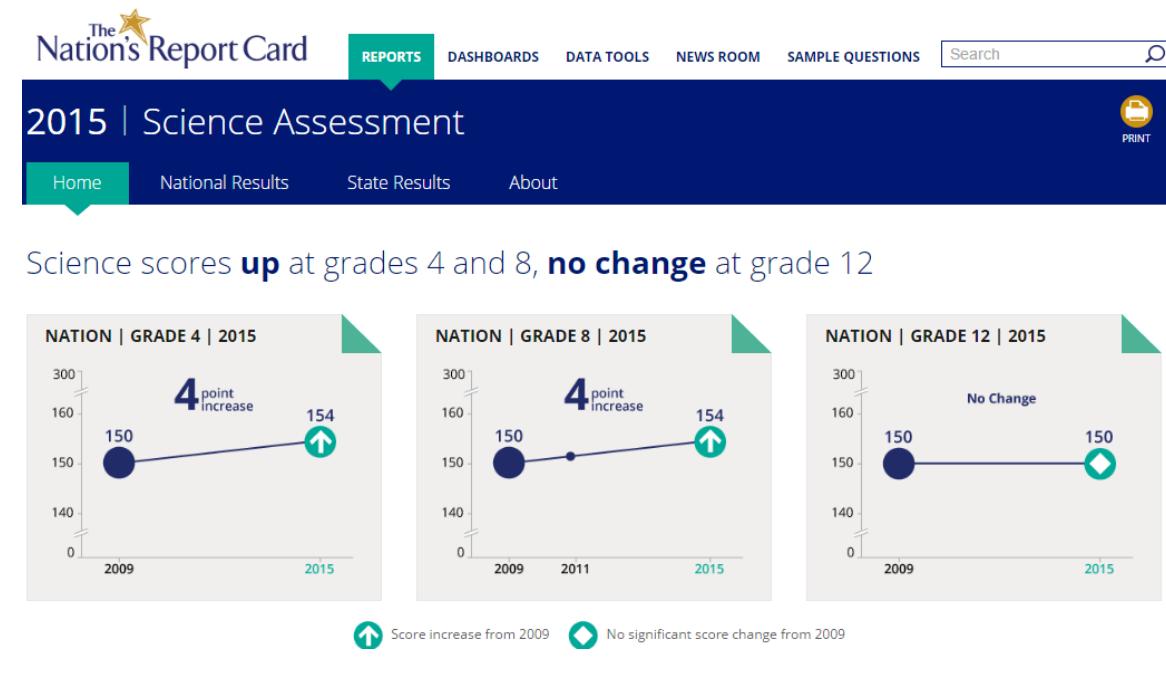
- voluntary by state in grades 4, 8, and 12
- ebsr—**evidence-based selected response**
- Physical science – Life science – Earth & Space science

Science in the US

NAEP National Assessment of
Educational Progress

US Student Rankings in Math

- NAEP: Slight gains in gr 4 & 8 since 2009.



2015 Results By State □ https://www.nationsreportcard.gov/science_2015/#?grade=4

Science Changes in the US

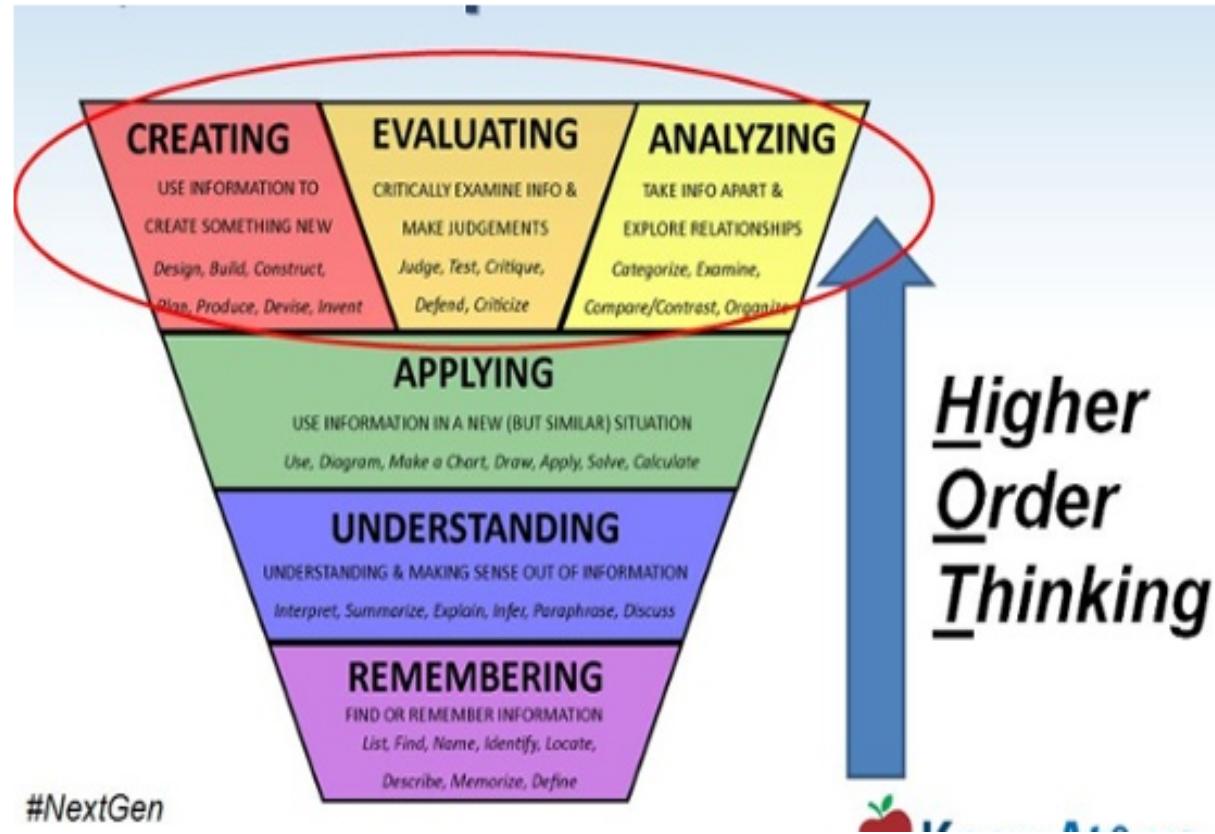
Next Generation Science Standards (NGSS)

- 2014
- increased rigor
- draw conclusions from evidence & data

Science Changes in the US

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Greater Focus on Scientific Thinking



**Higher
Order
Thinking**

Science Changes in the US

Greater Focus on Scientific Thinking

Not just consume technology.
Understand it.
Master it.
Participate in it.

Science Changes in the US

Greater Focus on Scientific Thinking

2014 STEM □ 2016 STEAM

Science

Technology

Engineering

Math

Science

Technology

Engineering

Art

Math

Science Riddle

What do you do with dead elements?

Science Riddle

Barium!

