ACT Science Outside Knowledge Cheat Sheet

While the ACT Science Test primarily tests your ability to evaluate and interpret various scientific experiments and their corresponding data, there are a few questions on each test that require some outside scientific knowledge to answer correctly. This may seem like a very small portion of the test and therefore not worth the effort for you to study, so here are some key points to convince you otherwise!

Outside Knowledge Helps with Timing!

Outside knowledge is primarily used in very simple data interpretation questions in order to make them a bit more difficult. You can usually use outside knowledge to eliminate wrong answer choices (usually two of them) **without** consulting passages, tables or figures. If you don't know the outside knowledge, you might be tempted to consult the passage in an attempt to find that information (Spoiler Alert: it's not there!), which is an absolute KILLER for timing. If you know the outside knowledge, these questions should take you mere seconds and help you finish all 40 questions in time!

One Extra Correct Answer Can Make A Huge Difference!

Because the ACT Science Scale is so steep, one extra question correct almost always equates to one extra point on your scale score. In some instances, it can even add two points to your scale score!

Effort-Based Points are Hard to Come By!

Questions that test outside knowledge are the only types of questions on the ACT Science Test that you can prepare for fully in advance, and these questions are usually pretty easy if you know the outside knowledge. They are essentially free points if you study this document!

The ESM Curriculum Team has pored over every released ACT Science Test from the past 15 years to develop a comprehensive set of outside knowledge needed on any future test (though other concepts may come up on future tests). In addition, we have included just enough knowledge on each concept to ensure you get a question right on test day! To use this document most effectively:

1. Read through the entire document and highlight any concepts that you don't know well.
2. Quiz yourself on these concepts, continuing to eliminate the ones you know well.
3. Rinse and repeat Step 2 until there are no unfamiliar concepts remaining!

General Sciences

Components of Scientific Experiments

Independent Variable:	A variable (often on x-axis of a graph) that you are changing on purpose to see its effect on another variable.
Dependent Variable:	A variable (often on y-axis of a graph) whose value depends on the independent variable.
Control:	An unchanged element throughout an experiment that allows the relationship between other variables to be better understood.
Accuracy:	How close a measured value or values is/are to the actual value.
Precision:	How close measured values are to each other.

Units of Metric System

Length (meters)	Mass (grams)	Volume (Liters)
1 meter (m) = .001 kilometers (km)	1 gram (g) = .001 kilograms (kg)	1 liter (L) = .001 kiloliters (kL)
1000 m = 1 km	1000 g = 1 kg	1000 L = 1 kL
1 m = 100 centimeters (cm)	1 g = 100 centigrams (cg)	1 L = 100 centiliters (cL)
.01 m = 1 cm	.01 g = 1 cg	.01 L = 1 cL
1 m = 1000 millimeters (mm)	1 g = 1000 milligrams (mg)	1 L = 1000 milliliters (mL)
.001 m = 1 mm	.001 m = 1 mg	.001 L = 1 mL

Miscellaneous Math Formulas

Percentage Equation: $\% = \dfrac{part}{whole} \times 100$

Percent Error: $\left|\dfrac{measured - exact}{exact}\right| \times 100\%$

Average Equation: $\dfrac{sum\ of\ values}{\#\ of\ values}$

Slope Equation: $\dfrac{y_2 - y_1}{x_2 - x_1}$

Temperature Conversions

Celsius to Fahrenheit: $F = \dfrac{9}{5}C + 32$

Celsius to Kelvin: $K = C + 273$
$C = K - 273$

Fahrenheit to Celsius: $C = \dfrac{5}{9}(F - 32)$

Biology

Cellular Biology

Lysosomes:	Digest food and break down cell components with enzymes
Mitochondria:	Powerhouses of the cell that produce ATP.
Cell Nucleus:	Brain of the cell. Contains genetic information
Ribosomes:	Organelle that translates mRNA to protein
Cell membrane:	The semipermeable membrane containing the cytoplasm of a cell.
Plant Cells vs. Animal Cells:	Plant cells have a cell wall, chloroplasts, and vacuoles.
Chloroplasts:	Organelle containing chlorophyll where photosynthesis takes place.
Cellulose:	Exists in plants (not in animals) and is part of their cell walls.
Cholesterol:	Exists in animals and is part of their cell membranes.
Photosynthesis:	(Plant Cells Only) The process of converting carbon dioxide and water into nutrients and oxygen.

$$carbon\ dioxide + water \rightarrow glucose + oxygen$$
$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

Cellular Respiration:	The process plants and animals use to convert fuel (nutrients) into energy (ATP)

$$glucose + oxygen \rightarrow carbon\ dioxide + water$$
$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$

Prokaryotes vs Eukaryotes:	Two types of unicellular organisms. Prokaryotes lack a defined nucleus, while Eukaryotes have a defined nucleus.
Amoeba:	Eukaryotic, unicellular organisms with a nucleus.

Ecology

Order of Biological Classification:	(Domain), Kingdom, Phylum, Class, Order, Family, Genus, Species
Producers/Autotrophs:	Organisms that can make their own food for energy
Consumers/Heterotroph:	Organisms that must consume others for nutrients
Detritivores:	Organisms that feed on dead organic material.
Trophic level:	A position on the food chain. Organisms on same trophic level have similar feeding 'modes'.

Genetics/Sexual Reproduction

Gametes: Sex cells that combine to form zygote (fertilized egg). Each gamete holds 23 of the 46 chromosomes.

Sex-Linked Traits: Traits associated with genes found on sex chromosomes

Protein Synthesis: Entire process of converting DNA to mRNA to proteins.
Other explanation: Transcription + Translation

Transcription: Process of copying DNA to mRNA

Translation: Process of reading mRNA and synthesizing proteins.

DNA: Carrier of genetic information and blueprint for protein synthesis

mRNA: Convey genetic information from DNA to ribosomes, which facilitate protein production.

Genes: Unit of heredity transferred from parent to offspring that determines some characteristics of the offspring.

Alleles: One of the possible variations of a gene. Typically, each gene has 2 alleles. Alleles can be dominant or recessive.

Heterozygous Alleles: Two different alleles (one dominant and recessive).
Examples: Aa and aA

Homozygous Alleles: Two copies of the same allele (both dominant or both recessive).
Examples: AA (dominant) and aa (recessive)

Dominant Traits: Expressed in an offspring through a dominant allele (AA or Aa).

Recessive Traits: Only expressed in offspring if homogenous (aa).

Biochemistry

Fats: Made up of Carbon (C), Hydrogen (H), and Oxygen (O), with carbon as the most prominent element.

Amino Acids: Building block of protein. N-C-O backbone.

Proteins: Chains of amino acids.

Nucleic Acids: Building block of DNA/RNA. Have nitrogenous base, sugar group, and phosphate group.

Chemistry

Miscellaneous Chemistry

Solubility: Ability of a given substance (solute) to dissolve in a solvent

Solutions vs. Mixtures: Solutions are homogenous (same uniform appearance).

Mixtures are heterogenous (consists of visibly different substances)

Concentration of Solution: Amount of substance per unit of space. ($\frac{grams}{liter}, \frac{moles}{liter}, ppm$)

Basics of Gas Laws: At constant temperature, volume and pressure are inversely proportional.

At constant pressure, temperature and volume are directly proportional.

At constant volume, temperature and pressure are directly proportional.

pH Scale: $1 < pH < 7 \rightarrow$ Acidic

$pH = 7 \rightarrow$ Neutral (water has pH of 7)

$7 < pH < 14 \rightarrow$ Basic

pH Meter Bromothymol Blue Litmus Paper Phenolphthalein: All can be used to measure pH

Phase Changes

Phase Changes: Solid - temperature less than freezing/melting point

Liquid – temperature above freezing/melting but below boiling point

Gas – temperature above boiling point

Kinetic Molecular Theory of Matter: Particles have least energy, and are closest together, in solids

Particles have most energy, and are farthest apart, in gases.

Boiling/Freezing Point of Water: Water freezes (liquid to solid) and melts (solid to liquid) at 0℃ / 32℉

Water is a liquid between $0 - 100℃$ / $32 - 212℉$

Water boils (liquid to gas) or condenses (gas to liquid) at 100℃ / 212℉

Density: Density is mass per unit of volume (D = m/v).

Objects *more dense* than surrounding fluid *sink*.

Objects *less dense* than surrounding fluid *float*.

Usually solid → liquid → gas goes most to least dense

Basic Molecular Structure

Protons: Positively charged (+1) subatomic particles present in the nucleus.
Mass $\approx 1\ amu$

Neutrons: Neutrally charged (0) subatomic particles present in the nucleus.
Mass $\approx 1\ amu$

Electrons: Negatively charged (−1) subatomic particles that orbit the nucleus in clouds
Mass $\approx \frac{1}{2000}\ amu$

Chemical Equations & Reactions

Chemical Equations: Reactants → Products

Balancing Chemical Equations: Number of atoms of each element MUST be equal on both sides of equation (conservation of mass and energy).
Add coefficients to ensure both sides are balanced!

Molar Mass: Mass of 1 mole of atoms/molecules for a particular element/molecule

Avogadro's Number: $6\ x\ 10^{23}$, used to model number of atoms or molecules in one mole of a substance

Endothermic Reaction: A chemical reaction that absorbs heat from its surroundings, leaving the container of the reaction feeling cold.

Exothermic Reaction: A chemical reaction that releases heat into its surroundings, leaving the container for the reaction feeling hot.

Physics

Directional Forces: Gravity points downward.
Friction/drag/resistance point in opposite direction of an object's motion.
Buoyancy points up

Mass vs. Weight: Weight depends on the force of gravity (on Earth, $9.8\ m/s^2$)

Magnetism: Like charges repel; opposite charges attract.

Astronomy

Order From Sun: Mercury → Venus → Earth → Mars → Jupiter → Saturn → Uranus → Neptune

Relative Masses of Planets: Jupiter > Saturn > Neptune > Uranus > Earth > Venus > Mars > Mercury