

The Science Academy STEM Magnet's  
**Science Bowl Preparation Packet**

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As Science Bowl competitors, there is a lot to keep in mind. This document's goal is to help you get a better idea of tips and tricks for studying and the actual competition. Good luck!

## COMPETITION STRATEGIES

### **Taking Advantage of Communication Rules**

The current rules of the Science Bowl have finally allowed non-verbal communication, which is something important to utilize. There are multiple strategies you can implement to take advantage of this rule, so I will list a few.

- *Confidence In Answer:* When answering a Toss Up as a team, it can be difficult to gauge how good your guess to an answer is compared to your other teammates. To help, you can show with actions how sure you are of an answer. For example, a head nod during a certain multiple choice answer could show your confidence in that answer. Alternatively, you could give a thumbs up if you are confident in your answer or take your hands completely off the buzzer if you are clueless.
- *Sharing the Answer:* Sometimes, the other team will buzz in before you. When this happens, do not feel defeated, but instead try sharing your guessed answer with your teammates while the other team is answering. I best recommend doing this through using fingers during multiple choice for W, X, Y, and Z. And once again, facial expressions and hand emphasis can demonstrate your confidence in those answers. (But make sure time doesn't run out for your team as you are communicating!)

Make sure to speak to your teammates about how you plan to take advantage of nonverbal communication and remember, you can make your own nonverbal language, these are just suggestions.

### **Problem Solving During a Question**

- *Don't Give Up:* Time and time again, I have seen students who are solving a tedious math or physics toss up just give up after the other team buzzes in. I cannot emphasize how crucial it is to continue solving the problem as the other team answers. It gives you even more time to find the answer which could be given if the other team is incorrect.
- *Outsourcing:* A lot of times during a bonus, a competitor may find the way to get to an answer and is very confident in that method, but is struggling with arithmetic (multiplication or division) on larger numbers. When this happens, don't be afraid to shout out "What is \_\_\_\_ times \_\_\_\_?!?!". (And a piece of advice - when asking for help

with something like this, no one will typically answer you unless you call out their specific name, so determine who is the best at quick math arithmetic beforehand so you can specifically ask them.)

- *Units:* For physics and chemistry, it is best to prepare for being given a few quantities of units and being asked to solve for another by memorizing the simplest form of as many units as you can.  
(eg. Work = Joules = Newtons \* meters = kilograms \* meters<sup>2</sup> / seconds<sup>2</sup>)  
^ if you hear the word “Work”, you should think of ALL of these instantly  
This would allow one to simply do dimensional analysis to solve when given certain units instead of knowing the true formula.
- *When You Don't Know The Proper Formula:* “When in doubt, multiply or divide it out”. This strategy requires some common sense, but if the above situation occurs and you do not know the formula or proper units, your best bet is to either divide or multiply the numbers based on an educated guess. (There is a much smaller chance that you may need to add or subtract instead, but again, make your best educated guess based on your previous experience with that topic).
- *When You Don't Know Anything:* Ok so this is the worst case scenario and ironically happens mostly with Astronomy but also Quantum Physics and Energy questions. If you are asked for a quantity in units and are not given any numbers whatsoever, or if it is just a really weird question, the answer tends to be 0 or 1. Do not overuse this.

## **Buzzing Strategies**

- *Getting in the Right Mindset:* As you are listening to a toss up, I find it helpful to think about what each word in the question implies, and for every loaded word given, to think about potential answers they could be looking for. For example, a question mentioning a ‘peptide’ would get me to think about “amino acid”, “protein”, “dehydration reaction”, “hydrolysis”, “primary structure”, “chaperonin”, etc. And as the question is continued to be read, you can slowly narrow it down until you are semi-confident and then **INTERRUPT!!!!**
- *Tip of the Tongue:* A lot of times, when a question is read, we are searching our minds for the right answer or doing the math on our paper for the right answer and know that in a few seconds, we will have come to the right answer but not yet. In those moments, sometimes it is best to risk it and just buzz in. It takes about 2-3 seconds for the moderator to acknowledge you and then you have another 2 seconds or so before you

truly need to give your answer. So don't forget that once you buzz in, you still have 4-5 seconds to finish your thinking process.

- *Z Buzz*: This is one of the easiest strategies that everyone who is on the A Team needs to use. All you need to do is during a toss up multiple choice, if answers W, X, and Y do not make sense, just buzz before they read out Z!!! Process of elimination!
- *Educated Guesses*: Toss up multiple choice tends to be the hardest category to **interrupt** on because in order to get the points, you must say either the exact letter or wording they require. However, there is a way to still properly guess the right wording. If they have finished reading the question and you have a good idea of what the answer is, but just not to word it, listen to how W is read (and if that doesn't help, listen to X too). If you read through a bunch of Toss Up questions, you will notice that all four multiple choice answers tend to be worded the same way, so if you understand how one is worded, you can get an idea of how to word the correct answer.  
One example of this is whether or not the answer is in its scientific name or household name. Or whether the word is plural or not. Or for example, if it is "northeast" or "northeastern hemisphere".

## Tips and Tricks

- *Read All The Rules*: Trust me, you will learn so many helpful things.
- *Know When to Challenge*: If you provide an answer that you truly believe should have been accepted because it is synonymous to the correct answer, raise your hand immediately and challenge the moderator. Odds are, they will count your answer as correct. (Challenges are limited to 2 unsuccessful ones per round)
- *Know When to Challenge a Challenge*: A bit more complex, but if anyone corrects the moderator on the way they are running the competition, trying to alter a judgment made in their favor, reference Rule 7-2 and say they are not allowed to challenge. Here are some examples of moderator calls that cannot be challenged:
  - Whether a question has been interrupted; whether full time has elapsed before a player answers; whether two verbalizations of a mathematical expression are equivalent; whether the nonplaying team has engaged in distracting behavior during a question; whether a stall or blurt has occurred; whether players have audibly communicated during a toss-up; whether a player has given a first response; whether an answer has been pronounced correctly; whether an answer to a multiple-choice question is exact; whether a verbal answer to a short-answer list question is sufficient

- *Team Spirit Is Not Cliché*: The teams I have had with the most positivity, team spirit, and collaboration have gotten the farthest. Do what you will with that information...
- *Stay Calm and Focused*: Stress can very easily break even the smartest and most skilled player. You can combat this through practicing [box meditation](#) as well as making sure that once a question is finished being answered, to not think about it **at all** anymore and move on completely to the next one.
- *Preventing a “Cold Brain”*: Make sure that if you haven’t done a round of questions for a period greater than 30 min, have someone read you at least 3 science bowl questions that you can practice raising your hand to buzz on in order to warm up your brain. Once your brain is warmed up, you will be able to remember more information quicker.
- *Don’t Disrespect the Moderator*: Just - don’t, even if you disagree with their verdicts.
- *Writing Down Crucial Information*: One of the most important strategies I can mention. If during a question, you hear specific numerical quantities, phrases like “least to greatest” or any other crucial descriptive phrases, make sure to write it down and circle it. Similarly, for bonus multiple choice questions, it helps to write down abbreviations for each letter’s answer so you do not forget which is which.
- *Team Captain*: Typically, I suggest putting the person best at math as the team captain, so during bonus questions, there does not need to be a game of telephone where the person with the answer has to tell all the number jargon to the team captain.

## **Bonus**

- *Choosing Between Multiple Answers*: If multiple people are adamant about their answer, ask each one to explain their reasoning
- *Know Your Roles!!!!*: If you are unsure of who’s guess is right, go with the person who’s subject it is. I cannot stress how important this is. The person who is best at that specific subject will be the most likely to have the right answer, so typically, go with them. However, the power of choice is in the team captain, and I have seen multiple occasions where the team captain goes against the team’s joint answer or chooses the answer of someone who everyone disagrees with and is proved right. For the team captain, at the end of the day, the decision-making is a mix of gut instinct and logic and can only be developed through practice with your team.

- *Five Second Rule:* When answering a bonus question you MUST WAIT until they say five seconds before providing your answer and if you have extra time after you reach a mutual answer, spend the rest of your time either explaining the logic behind your answer or checking your work. (The only exception to this is when you need as much time as you can to catch up to the other team)

**Don't Forget!!!**

- You have to say the exact answer wording for short answers, so it is better to say the letter.
- Any “ums” or long pauses can be considered stalling
- Always use the 5 Second Rule
- Constantly think about potential answers as a question is being read
- Write down information crucial to the question

Below, with the collaboration of my students, I have created a list of what I think is most important to know for each subject. The black font color is applicable to both MS and HS, while the green is only for HS and MS nationals.

Along with the list below, however, I also HIGHLY recommend utilizing [this study guide](#) made by one of our students, as it will provide a much more in depth coverage of many of these topics.

Lastly, I do not condone the use of [this collection of free textbooks](#), as it provides many many useful textbooks for Science Bowl that you do not have to pay for to look at.

## BIOLOGY

Properties of Water (*and how they relate to one another and work together*)

Cell and Cell Membrane Composition and Function

Cell Ecm And Its Inner Structural Components (*Ex: Microfilaments*)

Osmolarity (*Ex: Hypertonic, Hypotonic Plasmolyzed, Especially U-Tube [Osmosis] Problems*)

Cellular Respiration (*process of oxidative phosphorylation, importance of gradient in body*)

Photosynthesis (*Calvin cycle, etc*)

Mitosis (*Stages, Checkpoints and Their Chemicals, Etc.*)

Meiosis (*Mendel*)

Gene Expression (*Details Of Replication, Translation, And Opérons*)

Biotechnology (*PCR Crispr, etc.*)

Plants (*Transport Tubes Like Xylem And Sieve Tubes, Hormones, Plant Types And Their Examples, Sporophyte/Gametophyte, etc*)

Gymnosperms And Angiosperms (*Especially Characteristics Of Monocots And Eudicots*)

Hardy Weinberg Equilibrium Problems

Types Of Genetic Drift and Natural Selection

Mutation Types and Examples (For both DNA and chromosomal)

Invertebrates and Vertebrates (*Especially Each New Evolutionary Adaptation And Examples Of Each*)

Viruses

Animal Behavior Chapter (Ex: Fixed Action Pattern, Taxis)

Vitamins and Minerals Functions

Human Hormone Functions

Cardiovascular and Respiratory System

Bacteria (*Gram Staining, Phyla, etc.*)

Fungi

Protists

All Other Human Body Systems (*Especially Immune System*)

Embryo Development (germ layers are required)

## Fish and Bird Anatomy

### SA Bio Extra Resources

## CHEMISTRY

### *Classification of Matter (Chapter 1):*

Physical vs Chemical Props/Changes, Types of Mixtures and Separating Them, Pure Substances, Compounds, and Elements

### *Atoms, Molecules, and Ions (Chapter 2):*

Understanding the Fundamental Laws, The Periodic Table basics, Binary Ionic and Covalent Compounds

### *Stoichiometry and Limiting Reactant (Chapter 3):*

The Mole and Molar Mass, Determining Emp. and Mol. Formulae, Basic Stoichiometry, Determining Limiting Reactant, and Percent Yield

### *Solution Stoichiometry, Redox, and Neutralization Reactions (Chapter 4):*

Solubility Rules (what precipitates and what doesn't & whether a reaction will occur), The types of Reactions (i.e. The outcome or determine type), Oxidation Number, pH and pOH, identifying oxidizing agent, reducing agent etc.

### *Atomic Structure and Periodicity (Chapter 7):*

Dual Nature of Matter, Electromagnetic Spectrum, Quantum Numbers, Electron Configs., Pauli Prin, Aufbau Prin., Hund's Rule, The Periodic Trends (*Especially Shielding and Z Eff; Understand 1st and 2nd Ionization Energy*), Bond Strength

### *Ionic Bonds, Lewis Structures and VSEPR (Chapter 8):*

The Basics of Ionic Bonds (like which has a higher melting point), Covalent Bonding (EN, polarity, dipole moments), Lewis Dot Structures (all about them & drawing quickly), VSEPR (only up to 4)

### *Hybridization and Molecular Orbitals (Chapter 9):*

Types of hybrid orbitals (match the molecules to orbitals),  $\sigma$  vs.  $\pi$  bonds, and paramagnetic vs. diamagnetic, delocalized  $\pi$  bonding

### *Acids and Bases (Chapter 15)*



Buffers, Simple Titration and Dilution Word Problems, Indicators, Strong Acids and Bases, Identifying Acids and Bases by Their Molecular Formula, Conjugate Bases and their Strength

*Gasses and KMT, and Real Gasses (Chapter 5):*

The pressure units and tools, The Gas Laws, Ideal Gas Law, 22.42 L/mol at STP, Dalton's Law, KMT basics, Real Gasses (High Temp and Low Press.), Effusion and Diffusion

*Thermodynamics (Chapter 6 and 16):*

Energy, Specific Heat and Calorimetry, Hess's Law, Fuel Sources, Exothermic and Endothermic, Entropy, Gibbs Free Energy, Laws of Thermodynamics

*The Nucleus (Chapter 19):*

Types of particle decay, Types of Nuclear Reactions and Reactors, Rules for Stable Nuclides

*Organic Chemistry*

**Basic IUPAC Naming Conventions, The Major Functional Groups, Alkanes/enes/yne**s, Structural Terms (*Chirality, Enantiomers, Ketones, Esters, Aldehydes*)

*The Representative Elements and Coordination Chem. Chapters*

Skim through this, find what you think is important'

*Liquids and Solids (Chapter 10):*

Intermolecular Forces, Types of Solids, Network Solids, Unit Cells, and Ionic Solid hole types

*Equilibrium, Kinetics, More Acids and Bases (Chapters 12-15):*

Basics of Equilibrium, Collision Theory and Act. Energy, Polyprotic Titrations (or with different molar ratios between acids and bases) and Different Indicators,  $K_a$  and  $pK_a$ , **Strengths of Different Acids and Bases Depending On Their Composition (ex: how many oxygens it has), Application of Le Chat's Principle**

*Electrochemistry (Chapter 17):*

Galvanic Cells, Standard Reduction Potential, Electrolytic Cells and Work

 SA Chem Extra Resources

Practice questions to most of these, although more time consuming than SB questions, can be found [here](#)

## PHYSICS

*To Be Added*

☰ SA Physics Extra Resources

## MATH

30-60-90 and 45-45-90 Triangles

Area and Perimeter of 2-D Shapes

Slope Intercept Formula

Binomial Squares

Binomial Theorem

Sum Of Cubes Difference Of Cubes

Simplifying Fractions

Determining Angles in a Triangle

Sig Figs and Scientific Notation

Celsius to Fahrenheit (*and vice versa*)

Finding the nth Term in a Binomial Expression (Pascals Triangle)

Minimum, Maximum, Range, Median, Mean, Mode

Numbers of Faces, Edges, and Vertices of Different 3-D Shapes

Surface Area and Volume of 3-D Shapes

Degrees of Functions

Scale Factors

Quadrants

Solving Arithmetic and Geometric Sequences

*(ex: given some terms and asked to find other terms in the sequence)*

Function Composition

Distance Formula

GFC and LCM for Big Numbers (*ex: Adding Fractions With Different Denominators*)

Translation, Rotation, and Reflection of Functions

Estimating Computations

Simplifying Radicals

Simple Permutations and Combinations

Factoring Quadratics (*Into Standard, Vertex, and Factored Form*)

Simple and Conditional Probability (*ex: coin flips and game turns*)

Evaluating Polynomials At A Certain Value

Inverses

Simple Matrices

## Simple Trigonometry

### Unit Circle

Trigonometric Identities (ex:  $\sin^2 + \cos^2 = 1$ )

### Log Rules

Simple Application Of HM-AM-GM-RMS Inequality

### Combinators

### Calculus

Memorize:

Squares of 1 to 25

1/6, 1/7, 1/8, 1/9, 1/11

Square Roots of 2, 3, 5

 SA Math Extra Resources

## EARTH AND SPACE

### **Types of Clouds**

### **Plate Boundaries and Many Examples of Each**

### **Soil Horizons**

Geologic Features and Activity (Oceanic Crust, Active/Continental Margins, Island Arc, etc.)

Earthquake Features (epicenter, focus, etc.)

Different Scales of Natural Disasters (Richter, etc.)

Types of Weather Fronts

Glaciers (Important Vocab, Types of Features, Albedo)

Minerals and Rocks & Their Composition (very important!!!)

Natural Cycles (Especially Nitrogen Cycle)

Biomes and Their Properties (*Estuaries, Mangrove Forests, Intertidal Zones, Desert Types, Etc.*)

Types of Weathering and Erosion

River and Lake Features and Types (*Ex: Oligotrophic, Perennial, Etc.*)

Layers of Lakes, Oceans, the Atmosphere, and the Earth

Volcanoes (Types of lava and viscosity, types of volcanoes, Pyroclastic Flows, examples)

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Kepler's Laws

Color vs Temperature Stars

Types of Stars


Composition (temp., gas content, etc), Moons (and their details), and Phenomena of All Planets (ex: craters)

Synchronicity/Occultation/Resonance

Cepheid Variables

Properties of Main Sequences Stars

Layers of the Sun  
Comets, Meteors, Meteorites

 SA Earth Science Extra Resources