The Science Academy STEM Magnet's

Science Bowl Preparation Packet

For Virtual Competitions

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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 Chat

For virtual competitions, chat can be utilized in a way that gives you the upper hand against other teams. Here, I am going to give you a few strategies to use in chat that will bring your game to the next level:

- *Writing Down Crucial Information*: One of the most important strategies I can mention. Choose a teammate who during a question, when they hear specific numerical quantities, phrases like "least to greatest" or any other crucial descriptive phrases, makes sure to TYPE THEM IN CHAT. Similarly, for bonus multiple choice questions, it helps for someone to type abbreviations for each letter's answer so you do not forget which is which. Typically, the chosen teammate is the one who is the least specialized, but it is up to you.

- *Sharing the Answer (Toss-Ups)*: When a Toss Up is asked due to the rules, you may think that because you are allowed to talk, you should try explaining yourself. Do not. Ever. Do this. Instead, first be sure to share your answer in the chat box (if it is MCQ, put the letter) and only send your answer once, so all your other teammates can see each other's answers. If you feel confident in your answer, place a '!' right next to the answer you send. If you are unsure, place a '?'. If you think it could be two answers, type '__ or __' because it can help eliminate some of your teammates' other choices. And if you are completely unsure, you can just type a '?'. This all provides so much more information for your teammates to look at in a short period of time before someone must answer the question aloud.

- *Sharing the Answer (Bonuses)*: The same strategy for Toss Ups should be implemented here, with the only difference being actually quickly discussing why each of you chose your answers afterwards until "five seconds" is announced.

Problem Solving During a Question

- *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^2 / seconds^2)
  ^ 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.

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)

- *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.

Bonus

- *Team Captain:* Even though a Team Captain is not required in the rules for virtual competitions, I still recommend having one for Bonus questions in order to choose between multiple answers. Therefore, the captain should be someone with a lot of experience in most subjects.

- *Choosing Between Multiple Answers*: If multiple people are adamant about their answer, ask each one to explain their reasoning (or why it is *not* the other answers).

- *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. Trust me, this helps you make sure you never make silly mistakes.

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), 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)*

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), VSEPR(only up to 4)

Hybridization and Molecular Orbitals (Chapter 9):

Types of hybrid orbitals(match the molecules to orbitals), σ vs. π bonds, and paramagnetic vs. diamagnetic, delocalized π 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

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/ynes, 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, Ka and pKa, **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
Celcius to Farenheit *(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
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