SNet Events Guide: 2020-2021

This guide was compiled by volunteers in the Science Olympiad Student Network of Virginia (SNet) group, a team of Division C competitors from multiple Virginia schools.
The content of this guide does not reflect the opinions or statements of VASO or National Science Olympiad.
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General Advice

First and foremost, read your rules and clarifications! **This goes for any event** – you want to be properly prepared. Get your rules manual here and your (VASO) clarifications here (under each event on the right).

- Check the clarifications often! They might get added as people ask questions.
- Note that Virginia clarifications don't apply outside of Virginia, if you are competing in online invitationals!

Making Cheatsheets

- The three most important things:
    - Be concise
    - Be organized
    - Be readable
- Legibility is everything! If you can't read it, it's a waste of trees and precious printer ink.
    - The bane of readability is long lines. Use columns! Two for portrait and three for landscape is a good starting point.
- Organize your information! Again, if you can't find it quickly, it may as well not exist.
    - Use headings and bullet points! Though, be sure to keep the number of bullet levels to a minimum and adjust the indentation, because bullets also take up space.
    - Color code, underline, bold, italicize things!
- What to put?
    - Explain the basics clearly, though you can skip small parts that you're absolutely certain you have completely memorized – but do this judiciously, if you choose, just in case you need a refresher on test day.
    - Always have diagrams/charts/tables, they're much clearer than text/bullet points for certain topics.
    - Only add advanced topics that you would reasonably expect to appear on a test – there isn't space for every single detail!
- Always, always, *always* put things in your own words! DO NOT copy-paste, no matter how strong the temptation is. The process of writing down and explaining the content is what makes you understand – it's as important (if not more so!) than actually having that content on the cheatsheet.
- Familiarize yourself with your cheatsheet so you know where to look for certain things – again, you have limited time to look!

Making Binders

- Don't think too much about it! Take the notes you need to as you study for the event — many of these notes, after a bit of cleaning up, can be used directly in your binder.
- The advice for making cheatsheets applies to making binders as well! Make sure you know where the information is placed inside your binder so during competition, you aren't flipping through all sorts of pages trying to find what you're looking for. Use

different colored tabs to separate pages in your binder and highlight key information in your notes.
    - While it might seem convincing to print out Wikipedia articles and websites, please take the time to read through them (at the bare minimum).
- Some general things to include:
    - If an ID event: Well-organized information on each species is most important! Make sure you can find what you need quickly.
    - If a study event:
        - A reference sheet can be helpful; for instance, a sheet of often-used formulas and charts (resistor color code chart!) for Circuit Lab
        - Definitions of basic concepts
        - Notes on content, topics included in your event rules

The Learning Process & Recommended Resources

- The first place you look for an event should be soinc.org. There are often helpful, baseline resources to help you get started/practice!
- The next place is the scioly.org wiki. These often have very useful introductions to the *content* of the event, and sometimes include links to other resources.
- A few other learning resources:
    - Youtube is often a great place to learn, as is Google! Just look things up and soak it in as much as you can.
    - Khan Academy helps for many events, such as Machines, Food Science, etc.
- Once you are comfortable with the basics of the event, it's time to take **practice tests**.
    - A repository is available at https://scioly.org/tests.
    - A few universities also publish their test sets (some of these tend to be challenging!):
        - UT Austin (Regional and Invitational): https://www.atxscioly.org/resources
        - UFlorida Regionals: http://uf.floridascienceolympiad.org/index.php/past-tests/
        - Rustin Invitational: https://drive.google.com/drive/folders/1-h0tIxxtAH21nBPmtefdUq0yhocUO4Hz?usp=sharing
        - Harvard Invitational: https://drive.google.com/drive/folders/1AoJnnXHrfW1xZ9NioFsLwnjDFhQgd93J?usp=sharing
        - You can find Division C test sets online as well (such as Princeton University Invitational and MIT invitational), and some events will overlap with Division B — however, be aware that some content will be out of the scope of Division B.

Competing

Competitions are one of the most wonderful, memorable parts of Science Olympiad! Your hard work will pay off, so relax, be confident in what you know, and have fun.

A few pieces of advice (mainly relevant to tests):

- Talk through your approach with your partner beforehand. You will be splitting up the test, so you need to have a plan of attack!
    - How will you communicate with each other — platform and in regards to questions you need checked/help with?
    - What topics are you focusing on?
- When taking the test, be mindful of timing and test length. Don't leave any question unanswered, and change your pace according to the length of the test (faster for longer tests, slower and more thorough for shorter tests).
- When answering free response, start simple and build up to ensure you cover all points.
- Never leave a test early! Check each others' answers, double-check your own answers… There's always stuff to do :)
- Again, be calm, be confident — you got this!

Life, Personal, and Social Science

Anatomy and Physiology

Crime Busters

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Introduction

Yeah forensics science! Fingerprints, powders, crime scene analysis… This event has it all, and it's also a great lead-in for the equivalent Division C event, Forensics.
The author of this section only has experience with Forensics, so advice will be brief and general — but relevant and useful for crimebusters!

Tips

- This is known to be a time-intensive event that requires strategizing.
    - You and your partner should establish in advance which sections each will be responsible for. Typically, one partner does powders while the other does polymers, and other topics can be split according to interest/comfort.
        - The author also recommends one partner being in charge of writing the analysis (a significant part of the final score!) — if this is done, the other partner will want to take on more of the conceptual-based (Physical evidence) questions
    - Practice makes perfect, and the virtual environment (as of the writing of this piece) makes practicing for this event much easier. It's important to develop a working approach between you and your partners: Not only which topics you take first, but also how you approach reading suspect profiles, communicating about evidence, and taking the test.
    - One potential approach: For the first five to ten minutes, scan through the test to see the types of questions present and take notes on the suspect profiles (what kinds of powders, hairs, etc. are associated with each person?). Then one partner jumps to powders while the other jumps to polymers. Incriminating evidence like blood, fingerprints, chromatography can come after (or even before, since they are particularly strong pieces of evidence!). At near the 20 minute mark, one partner may start working on analysis while the other takes trivia and conceptual questions left in the test.
- Look to the official crime busters page (https://www.soinc.org/crime-busters-b) and forensics notes page (https://www.soinc.org/forensics-notes) to get started on collecting and learning information. Scioly.org is also an **excellent** place to learn: https://scioly.org/wiki/index.php/Crime_Busters You may even want to peruse the

forensics page: https://scioly.org/wiki/index.php/Forensics These should cover the basics of what you need to know and help you get started on tests!
    - A few tests can be found on scioly.org/tests
- Cheatsheet: Tables are excellent for storing information on powders, plastics, and fibers. These tables should include various properties and test results, names (chemical formulas if appropriate), and uses (EXTREMELY helpful to know uses for matching samples to suspects and performing analysis). Cheatsheet should also include conceptual information on topics mentioned in the rules manual, and any information necessary (ex. fingerprinting) needed for other ID questions.
- Analysis typically includes:
    - A statement on who did the crime (can be one or more people), and what their motive was
    - Then going suspect by suspect…
        - What evidence incriminates this suspect, and why? (LiCl incriminates Suspect X because of bipolar medication) -- if you're short on time, sometimes the why isn't necessary
            - Sometimes evidence is also circumstantial: If a murder happened in a kitchen and you find food-related powders, that doesn't necessarily convict the cook suspect. Make sure to address these situations.
        - You can use bullet points for this section, just make sure you're writing clearly!

Disease Detectives

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Introduction

Disease Detectives is definitely one of the most intriguing and rewarding events Science Olympiad has to offer. At the time I'm writing this, it's also one of the most relevant thanks to the COVID-19 pandemic. This event definitely delves deep into epidemiology, and you come out a more educated individual on health in the world. Happy syndrome sleuthing!

Recommended Resources

- The *Principles of Epidemiology* textbook by the CDC is probably the single most helpful resource for this event - a lot of the questions are derived from here (it comes in both online and PDF format!)
- The training handouts and notes found on the official Science Olympiad website are also really helpful
- To find practice tests, go here

What Should Be on My Cheat Sheet?

- Vocab - one of the easiest DD topics
    - Vocab comes up on nearly every DD test, and it's definitely easy points. Having all of the vocab in SOINC's Glossary of Epidemiology terms should be enough.
- Formulas - to do math with!
    - Math is also a huge component of DD and being able to do calculations quickly and accurately is key. Having the formulas necessary, which can all be found in the CDC's Principles of Epidemiology textbook (linked above) and most of which are listed in the DD rules sheet, such as odds ratio and sensitivity and specificity, can definitely make your life a lot easier.
- Types of Study Designs - to evaluate case studies with
    - Analyzing case studies is another component of any good DD test, and being able to identify what type of study (observational, experimental, cohort, etc.) the text is referring to is definitely helpful
- Everything else on the DD rules sheet (your coach should have it and you can also download it here)
    - Some useful things to have: Chain of infection, epi curves/line listing/spot maps, steps of outbreak investigation
    - If you don't have room, try adjusting your page margins, reducing font size, and adding in columns for readability - you should be able to fit most, if not all, of the information that you need on your cheat sheet :))

Other Advice

- Practice practice practice! This is one event where practice pays off tremendously — even reading answer keys can expand your knowledge quickly.

Earth and Space Science

Dynamic Planet

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Recommended Resources

- This may be a little high-level for division B, but reading some chapters off of *Oceanography: An Invitation to Marine Science* (by Tom Garrison) would really enhance your understanding of oceanography.
- https://www.youtube.com/c/scienceclassisgreat/playlists - check out this YouTube channel and find relevant playlists! The person usually does a good job of explaining and visualizing the concepts.

Reach for the Stars

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Recommended Resources

- Astronomy Notes -- Great resource for beginners as they break down astronomy topics into individual sections. The following sections should be useful for this event as this website encompasses a lot more material:
    - Electromagnetic Radiation (Light)
    - Determining Star Properties
    - The Sun and Stellar Structure
    - Lives and Deaths of Stars
    - The Interstellar Medium and the Milky Way.
- Astronomy Picture of the Day -- NASA posts one astronomy picture everyday, and you can use this website to find images of the DSOs in the rules.
- Australia Telescope National Facility -- Another website that covers general astronomy knowledge.
- Hyperphysics - Astrophysics -- Good resource that includes equations and the relationships between astrophysics topics.
- College lecture notes (they aren't scary I promise!) are very helpful too.
    - Penn State Astro 801 -- Lessons 2-12
    - Rutgers Astrophysics - HR Diagram, Stellar Evolution, Type Ia Supernova
    - Ohio State
- Chandra X-ray webinars (https://chandra.si.edu/edu/olympiad_2020.html) are released every year and they go through the topics that you need to know for Reach for the Stars. If you are just starting, this is your go-to-resource.

Physical Sciences

Circuit Lab

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Introduction

WELCOME to Circuit Lab! This is one of the most wonderful and useful events Science Olympiad offers (in the humble opinion of the author). It's been said many times, but circuits are literally everywhere — and without exaggeration, modern electronics is among humanity's greatest accomplishments. It's also really fun :) So make sure to enjoy this event!

Overview and Tips

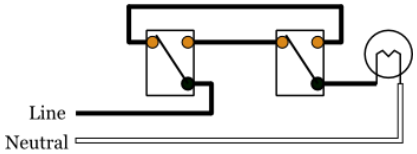
Most questions in Circuit Lab can be broken down as such:

- **History**: These are common — expect to see them! They typically ask you to identify a scientist associated with an achievement.
    - Ex: Volta made the first battery; Ohm stated that voltage is directly proportional to current, related by the resistance
- **Electricity and magnetism**: Coulomb's Law, capacitance calculations, and simple magnetism (like field lines) are basic ones I would expect
    - Powerpoints located on soinc.org should cover these well. If you don't know anything else, just know Coulomb's Law!
- **Basic electricity concepts**: Voltage (V), current (I), resistance (R), power (P), energy (E, sometimes U for potential energy), simple relationships between these, and the differences between DC and AC
    - Important relationships: V=IR, P=VI, E=P*time
    - Know your units, too!
    - Direct Current travels in one direction, Alternating Current switches directions
        - DC is used in batteries!
        - AC is used in power distribution (it's more efficient!), but it's also more dangerous than DC. Good to know: American outlets have 120 V AC at 60 Hz.
- **Circuit analysis**: Ohm's Law, series/parallel/combination resistor circuits, KVL and KCL
    - This definitely needs to be practiced, unlike some of the other knowledge-based topics on this list. Soinc.org and Khan Academy can be good places to look. Also just take practice tests!
- **LEDs**: Have a basic knowledge of what they are, how they work, what the anode and cathode are, and their I-V curve (a chart of colors to voltages is also helpful)
- **Miscellaneous**: Topics that don't show up as much, but may be expected:
    - Transformers — cool devices that allow **AC voltage** (AC, not DC!) to be "stepped up" (increased) or "stepped down" (decreased) through the use of coils. Most calculation questions ("If the primary coil has 10 coils and secondary has 8 coils,

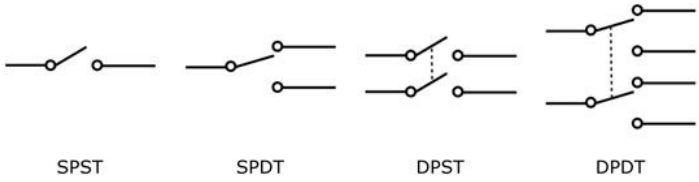
and the primary voltage is 100 V, what is the secondary voltage?") can be answered with the following formula:

- $\frac{V_P}{V_S} = \frac{I_S}{I_P} = \frac{N_P}{N_S}$ Where the first coil is primary, second coil is secondary, and N stands for the number of turns on each coil.

- Switches — mostly, naming switch types and drawing 3-way light switches.
  - 3-way light switch allows for turning light on/off from two different locations, no matter what the other switch has done! Use this diagram if you are asked to draw it:



  - A switch can be named according to its poles and throws: (like "single-pole-double-throw," AKA SPDT)
    - Poles are the number of nodes from which current comes in
    - Throws are number of nodes for each pole that current can be set to flow out to
    - Ex:



- Semiconductors devices, operational amplifiers, and digital logic are Division C topics, so they shouldn't be tested, but I've heard of topics appearing occasionally. If you have an abundance of time, it certainly does not hurt to study them! (and they are, in my opinion, some of the best parts of Circuit Lab :))

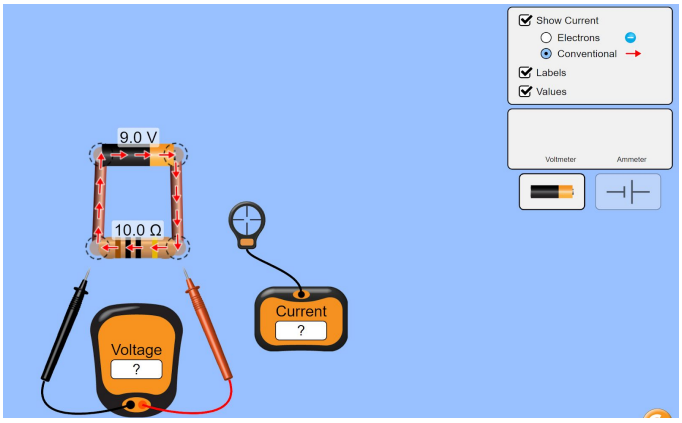
General Advice

- Binder: Extremely useful!! Do have a good binder.
  - Things to have:
    - If you are new to Circuit Lab, some definitions can be helpful. Definition of KVL/KCL is likely to come up!
    - Chart of electrical quantities (V, I, R, etc.) and their symbols and units — these can be found online!
    - Resistivity and conductivity constants for different materials — a good list can be printed from wikipedia or the soinc homework generator
    - A sheet of formulas (with constants as necessary) you will need: Basic relationships (mentioned in the previous section), Coulomb's Law, resistivity-to-resistance, series/parallel formulas — and others you can't memorize
    - Notes on conceptual topics, if you have them

- Practice, practice, practice. Tests often have recurring and predictable problems, so the more you do, the better prepared you'll be!
- Ideally, both partners should have the same knowledge, but if you are low on time, there are several ways to split these topics!
- Enjoy. Circuit Lab may seem formidable at first, but once you're into it, you discover it's not bad at all! In fact, it's so, so much fun :) Relax and get into the circuit groove. Good luck!

Recommended Resources

- As always, the official Science Olympiad website is an excellent place to start: https://www.soinc.org/circuit-lab-c
    - The powerpoints are very useful — powerpoints 1-7 are a good place to start!
        - This playlist contains associated videos for the powerpoints: https://www.youtube.com/playlist?list=PL1t-RzwecjdO367jIBDod1Cri65jHNPb6
    - The homework generator is also an excellent source for practice.
        - Start with the simple circuits and build upwards!
        - Resistor identification practice is especially useful
- Khan Academy Electrical Engineering videos: https://www.khanacademy.org/science/electrical-engineering
    - Great place to go for learning circuit analysis. There are some advanced/Division C topics located on the page — just be aware :)
- This set of Circuit Lab notes, located on scioly.org/tests, is useful, particularly for getting a quick start on history: https://scioly.org/tests/files/circuitlab_2020_b_ssss-risheethagb_notes.pdf
- Free electronics textbook: *Lessons In Electric Circuits: Volume I - DC* https://www.ibiblio.org/kuphaldt/electricCircuits/DC/index.html
    - May not be as friendly if you are on a time crunch, but great if you have the time to read — it goes into good detail.
- PhET Circuit Simulator: https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc Great place to play around as you get used to circuits.
    - For beginners: Try building a basic circuit — a battery connected to a resistor by two wires — then measure voltage across the resistor and current through the resistor using the voltmeter and ammeter. Do the values match what Ohm's Law tells us?



    - Next challenge: Can you set a battery on fire with itself and a wire? How about a resistor using a battery? (Not to be done in real life… But fun on a website!)
- Another great place to practice tinkering with circuits is Tinkercad! With its circuit designer, you can get a hands-on experience with using breadboards, resistors, LEDs, and a lot of other components. It's a level up from the PhET simulator, in both features and complexity. Video tutorials should be simple to find online!

Food Science

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Introduction

When I competed in this event, it was definitely one of my favorites. I remember one particular snow day where I did no other work besides studying for Food Science. While you may or may not have the same level of interest in this event, I guarantee that you will enjoy it nonetheless! Food Science heavily focuses on chemistry, with a bit of biology and some building. I hope you all enjoy competing in this event and gain some knowledge from it!

General Advice

Since the Food Science topics cycle from year to year (for 2020-21 season it focuses on fermentation and pickling), it can be a bit difficult to find resources for this event - that was definitely something I struggled with when I competed. That's why there are resources listed down below; so you guys can have a starting point when it comes to making your cheat sheet. From the Food Science tests that I've taken, there does appear to be a good amount of trivia on the tests, so do prepare accordingly. Also, although having a working salinometer does mean easy points, not having a perfectly accurate one does not mean a bad event placement (our's broke the day of the competition [RIP] and we still managed to place 4th). Due to corona, a lot of you will not need to have a salinometer anyway, so don't worry too much about that.

Resources

- Khan Academy was one of my best friends in this event, particularly for higher level topics such as the Citric Acid Cycle
- Campbell's AP Biology Textbook
    - As someone who is currently taking Bio with this textbook, I will say that it does cover a lot of same topics that Food Science does, particularly respiration and fermentation, although it is higher level than will probably be tested
    - If you have an older sibling/know someone who is currently taking the class, just take a glance through the relevant sections, but don't feel the need to memorize word-for-word
    - I would not recommend buying this textbook specifically for the purpose of studying for this event, however; you can do just fine without it!
- Unfortunately, the SOINC powerpoints on Food Science as of January 2021 don't cover the current year's topics, so don't waste your time going over them

What Should Be on My Cheat Sheet?

- The 2021 rules for Food Science state that "Each participant may bring one 8.5" x 11" sheet of paper"
    - When I was competing, this meant that each team could have two sheets of paper instead of the regular one, provided that both partners showed up
    - I'm not completely sure what this may mean for the virtual setting and there are no VASO clarifications on that rule at this time, make sure to check with your coach/tournament to see if you are allowed to bring one or two sheets
- Citric Acid Cycle
    - Although this varies from test writer to test writer, the citric acid cycle is generally sure to be tested. Having a diagram of it and knowing the different components, the inputs, and the outputs can be super helpful

Machines

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Introduction

Welcome to Machines! For starters, Machines is a great event to get started on learning physics before you take a physics class in school, and it's also an interesting event when you have the chance to compete in person with the levers you build :) Although the physics concepts are often abstract and might be difficult to grasp right away, don't be intimidated! All it takes is practice to get familiar with what types of problems are on the tests and how to solve them during a time crunch (you got this!!).

General Advice

- Learning the general foundations of physics is important (such as one-dimensional motion, Newton's Laws, energy) to understand how the machines work
    - Sometimes there are questions on Machines tests that aren't directly related to simple machines either and they're just testing whether you know your basic physics.
    - The SOINC 2021 Learning Notes is a great resource on how to get started with learning the basics of physics -- they list out specific sections in Khan Academy's physics videos that are good to watch. (Khan Academy is also an amazing resource for learning about other general subjects such as biology, chemistry, astronomy etc.) The Khan Academy questions in each section are also helpful for practice.
    - Understand the metric system and their units -- you can make a chart listing a specific physics concept, their name in the metric system, and its breakdown into the basic units. For example, the unit for force is Newtons (N), but it consists of $kg * m/s^2$ as the basic units of kilogram (kg), meters (m), and seconds (s).
- Take as many practice tests as possible! This is the best way to prepare because often Machines tests have the same type of questions show up regarding the simple machines. With practice, you can learn how to solve them and solve them quickly too.
    - You can find some previous Machines tests here: https://scioly.org/tests
- When taking the test, you can split up the questions with your partner into someone answering the multiple choice questions and someone answering the free response questions.
    - Usually, test graders will give you partial credit for answering a question and listing out the steps you took, so try to answer all of the questions of the test, even if it's only listing out an equation that you know is useful if you're running out of time.
- Mechanical advantage and efficiency are crucial to Machines
    - You will often see different equations for mechanical advantage, but the main thing to understand is mechanical advantage is the RATIO of the force produced by the machine TO the force that is applied to it -- in other words, $MA = Fout/Fin$. So, if a simple machine has a greater mechanical advantage, that means its output force is much greater than the force we apply to it. This is why we use simple machines -- they make our lives easier by increasing the output force.
        - For instance, if you are pushing a block up a hill, the hill is an inclined plane (which is a simple machine). The force that you need to exert in order to push the block up the hill is less than the force needed to lift the block up vertically. (The force you apply = The force you exert to push up the block, the output force = force needed to lift the block vertically). That's why you see ramps when people are loading items off and on trucks -- it's easier to push a box up a ramp vs. lifting the box vertically onto the truck.

    - Different simple machines will have different formulas that will give you mechanical advantage, but they all revolve around the same concept. This simple machines website is a good introduction to the different ways you can find mechanical advantage: http://www2.phy.ilstu.edu/pte/489.01content/simple_machines/simple_machines.html
    - Note that there are two different types of mechanical advantage -- ideal mechanical advantage (IMA) and actual mechanical advantage (AMA). IMA is the theoretical mechanical advantage that is calculated in a perfect world without any friction, while AMA is the mechanical advantage when there is friction and energy loss. Efficiency is the ratio of IMA to AMA. I won't explain them into too much detail here as this is the general gist of things, but feel free to review the resources below for more information.

Recommended Resources

- General Resources
    - Hyperphysics: http://hyperphysics.phy-astr.gsu.edu/hbase/index.html#mechcon -- Good for learning how physics concepts connect with each other
    - SOINC resources: https://www.soinc.org/machines-b -- The powerpoints about the simple machines are very helpful and the PDF textbooks that are linked.
    - Openstax: https://openstax.org/books/college-physics-ap-courses/pages/1-connection-for-ap-r-courses -- Textbook for general physics, but might go too in depth for Division B Machines. After reviewing Khan Academy physics videos and you want to learn more, then feel free to take a look at this link.
    - ILectureOnline: http://www.ilectureonline.com/lectures/subject/PHYSICS/1 (Youtube Channel: https://www.youtube.com/channel/UCiGxYawhEp4QyFcX0R60YdQ) -- Has video playlists of physics concepts and oftentimes walkthroughs of problems that you see on Machines tests
- Simple machines:
    - Khan Academy Mechanical Advantage video: https://www.khanacademy.org/science/physics/work-and-energy/mechanical-advantage/v/introduction-to-mechanical-advantage
    - Wikipedia Mechanical Advantage: https://en.wikipedia.org/wiki/Mechanical_advantage
    - Simple explanation of mechanical advantage: https://sciencing.com/calculate-ama-ima-simple-machines-7418860.html
    - Useful lever related websites:
        - http://www.comfsm.fm/~dleeling/physics/torque.html
        - https://www.engineeringtoolbox.com/levers-d_1304.html

Technology, Engineering, and Design

Boomilever

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General Advice/Resources

- Great starting point: https://scioly.org/wiki/index.php/Boomilever
- Read the rules!! Don't get tiered from Contact Width or Contact Depth or Length violations
    - As a general rule of thumb, vertically taller and horizontally shorter booms will do better (what this means is you should maximize the distance from the hook to the bottom of your base, and minimize the distance from the wall to the distal (loading) end). However, this is not a hard and fast rule, so you can start by following this and experimenting
- If you've never built a balsa structure before: a pretty effective way to go about this is drawing the side view of your design on a piece of graph paper, taping that down to a corkboard, taping a sheet of clear wax paper over that, and placing your pieces of wood on top according to your drawing. Use pins to keep the wood in place, and glue. Leave the pins in to hold it as it dries, and voila - you have half of your structure done. Repeat for the other side, and glue the two sides together.
- Find a good supplier for balsa wood and CA glue. Most people like Bob Smith Industries (BSI) for glue, and go to a Hobby Lobby for wood, or maybe an online supplier like http://www.specializedbalsa.com (might be a little pricier, I'm not sure). Other popular choices for materials include bass wood and Gorilla glue.
    - Use glue sparingly! Remember you want to build a light boomilever, so don't slather it on. Accordingly, don't use high-density, thick wood for everything.
- If you want to test designs without using up materials or too much time, you can choose to use an online simulator to approximate the efficiency of your designs. These include SkyCiv (there are free and paid versions), or if you google something like "3D structural analysis simulator" you'll probably find something
- When you test structures at home, take a video. When/if your structure fails, play the video back in slow motion, and try to determine why/how it broke and which area failed first. Use this to inform your adjustments for your next structure.
- You will probably need fewer trusses than you think (not a guarantee, but usually the case. When you start cutting your boom's weight, cut aggressively and creatively)
- Good luck!! Boomi is a very fun event, and I hope you enjoy it as much as I did :) Last piece of advice: try not to jump too hard when booms break - I'm a jumpy person and I spilled a LOT of sand on myself while loading the bucket.

Digital Structures

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General Advice/Resources

- Quick tutorial: https://youtu.be/yDYGt_hX09c
- Good walkthrough: https://skyciv.com/docs/education/science-olympiad/science-olympiad-app/
- Another good starting point: https://scioly.org/wiki/index.php/SkyCiv#Defining_Loads
- Your structure can be *very* simple. Once you settle on a solid design, make sure you test it for varying widths and lengths and optimize your design accordingly to make sure you're prepared for whatever parameters they give you in competition
- Optimization:
    - So you've got a solid design - it's time to cut weight by shaving millimeters at a time until you've reached the optimal dimensions!
    - If you only have one section, mix it up and experiment - add different sections, vary the sizes and material density
        - If you're struggling to hold the full 15 kg: Click on the "Solve" function in the top right next to the "Model" tab. Click on the "Stress" tab on the left. Use this to evaluate which members are taking on the most stress, and adjust your sections accordingly so that these members are thicker/denser/stronger somehow. When you test with the SciOly add-on, it will also tell you which member is breaking and needs help.
    - Optimizing your structure is basically a lot of trial and error - have patience and you'll be able to improve your score (maybe by a lot!)
- Barring unforeseen circumstances, this event will probably not rotate in again in the future. Have fun with it while it's here! As it is the low-stakes sibling of Boomilever, there's a lot of room to experiment :)

Ping-Pong Parachute

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General Advice/Resources

- Good starting point: https://scioly.org/wiki/index.php/Ping_Pong_Parachute
- Good homemade launcher tutorial if you don't want to buy one: https://www.instructables.com/Easy-to-build,-easy-to-use,-water-bottle-launcher!/
    - Ignore the part about water, we don't use water in this event
- It's easy to get tiered in this event if you don't read the rules carefully - make sure you get a bottle for **carbonated liquid** with the **correct capacity (1 L)** and with the **correct opening diameter (2.2 cm)** and **correct neck length (1.6 cm from flange to opening).** The nose must not touch the inside of standard bottle cap (3.1 cm diameter, 1.25 cm tall), and your fins must not reach into the no fin zone (5 cm above the opening)

    - This is all in the rules, just make sure you don't forget any of it! Go through and highlight the specifications if you need it, just do not violate them and get tiered
- Try to buy a bottle with a less textured shape - they tend to be more aerodynamic
- **Remember to bring the bottle label to every competition**

Strategy

- ***These are just general tips, not hard and fast rules. Do your own research and experimentation to find what specifications work for you.***
- Do not spend too much of your time on the body of the rocket - **the most important part of this event is the parachute**
- Experiment with parachute properties - size, shape, number of strings, thickness of plastic
    - General trends: bigger is better (but there is usually an optimal size, so test with many different sizes with your selected material)
    - Circle is a popular and usually reliable shape, though you're welcome to try out others
    - More strings usually gives a more uniform "puff" when the parachute is open, but again, there is an optimal number (which means if you go over the optimal number, it hurts your score instead of helping it)
    - Thinner plastic usually works better! It's more flexible, unfurls more easily, and gives a gentler ride down. Be on the lookout for thin plastics!! Grocery store basic brand trash bags may work
- Get a long plastic tube. A popular strategy for seasoned ping-pongers is to buy 2 of the same bottle. Cut one bottle so that it can be attached to the bottom of the other bottle, such that there is a cap on both ends (see picture for reference). On the end that you just cut (the top side in the picture), attach the long plastic tube as you see fit. When testing, the ping-pong ball and parachute would sit on top of the tube. In essence, this extends the height that your rocket can reach, without needing to increase the air pressure.
    - Higher air pressure shoots the rocket higher, but also makes its motion more aggressive, which can mess up the performance of the parachute. Using the tube means you can reach the same height with lower pressure, so you can have a smoother flight.

Inquiry & Nature of Science

Codebusters

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General Advice

Hello and welcome to one of the most fun events out there (in my opinion)! Codebusters is a super interesting and fast-paced event, and an all-around exhilarating experience :) With that, here are some general tips for practicing/testing:

- It's very important to stay organized while testing. Splitting one test among 3 people involves a lot of shuffling loose papers, which can get messy fast. It may be helpful to give each person on your team a "role" (ex. One person specializes in more math heavy ciphers, one person specializes in Aristocrats/Patristocrats, etc.). These roles can be as rigid or loose as you want, whatever helps you communicate better during tests.
- It is generally a bad idea to have all 3 teammates work on the timed question together - it gets crowded! A good strategy is usually to have 1 or 2 people working on the timed question, and the others move ahead to the rest of the test.
- It's easier to work with a 0-indexed alphabet as opposed to a 1-indexed alphabet. This means A=0, B=1, C=2, etc…
    - It may be helpful to memorize some "landmarks" in the alphabet so that you can connect a letter to its corresponding number faster. For example, I like to memorize every 5th letter: A=0, F=5, K=10, P=15, U=20, Z=25

Resources

Helpful sites:

- https://scioly.org/wiki/index.php/Codebusters
- https://toebes.com/codebusters/TestGuidance.html

Atbash cipher:

- Atbash and Caesar notes sheet
- http://practicalcryptography.com/ciphers/classical-era/atbash-cipher/

Caesar cipher:

- Atbash and Caesar notes sheet
- http://practicalcryptography.com/ciphers/caesar-cipher/

Aristocrats:

- cryptograms.org is the holy grail for this event - If you practice a lot on here, you'll get pretty good at solving Aristocrats and Patristocrats.
- If you're just starting out, check out this tutorial for tips
- Aristocrats notes sheet
- K1/K2 ciphers:
    - K1/K2 notes sheet

Affine cipher:

- Affine notes sheet
- http://www.practicalcryptography.com/ciphers/affine-cipher/
    - The “inverse” can be a confusing concept - if you don’t understand, don’t worry too much about it. On each test you should be given a notes sheet which will give you an inverses table. It looks like this:

a	1	3	5	7	9	11	15	17	19	21	23	25
a^{-1}	1	9	21	15	3	19	7	23	11	5	17	25

    - You can either memorize this for easy reference, or use the provided table on the test.

Vigenere cipher:

- Vigenere notes sheet

Baconian cipher:

- Baconian notes sheet
- http://www.practicalcryptography.com/ciphers/baconian-cipher/

Xenocrypt:

- These are Aristocrats, but in Spanish. If you don’t already know Spanish, don’t spend your time trying to learn it just for this event. However, it is very helpful to have at least one Spanish speaking teammate.

Pollux and Morbit ciphers:

- Pollux and Morbit notes sheet

Rail Fence cipher:

- https://crypto.interactive-maths.com/rail-fence-cipher.html

Write It Do It/Write It CAD It

Hello! In general WIDI and WICI are events that require a lot of practice, so make sure you work with your partner a lot and practice a ton. Check our folder for practice tests!