



CODEBUSTERS

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.



1. **DESCRIPTION:** Teams will cryptanalyze and decode encrypted messages using cryptanalysis techniques for historical and modern advance ciphers.

TEAMS OF UP TO: 3

EVENT TIME: 50 minutes

2. **EVENT PARAMETERS:**

- Teams must bring writing utensils and may bring up to three (3) stand-alone non-graphing, non-programmable, non-scientific 4-function or 5-function calculators.
- No resource materials, except those provided by the Event Supervisor, may be used.
- The Event Supervisor will provide scratch paper for each team to use.

3. **THE COMPETITION:**

- This event consists of participants using cryptanalysis techniques and advanced ciphers to decrypt and encrypt messages on a written exam.
- All teams will begin the event simultaneously at the indication of the Event Supervisor.
- Teams must not open the exam packet nor write anything prior to the “start” signal, nor may they write anything after the “stop” signal.
- Participants are allowed to separate the pages of the test to be free to answer the questions in any order, working individually or in groups, attempting whichever of the questions seem right for them.
- The code types that may be used on the exam at Invitational and Regional competitions are as follows:
 - the Atbash Cipher (in English, not Hebrew)
 - the Caesar Cipher, also called a shift cipher.
 - Mono-alphabetic substitution using K1, K2, or random alphabets as defined by the American Cryptogram Association (ACA)
 - Aristocrats with a hint - messages with spaces included, and with a hint
 - Aristocrats - messages with spaces included, but without a hint
 - Aristocrats - messages with spaces and hints, but including spelling/grammar errors
 - Aristocrats - messages with spaces and including spelling/grammar errors but no hints
 - Patristocrats with a hint - messages with spaces removed, and with a hint
 - Patristocrats - messages with spaces removed, but without a hint
 - Affine cipher – encrypting plaintext or decrypting ciphertext given the a and b values.
 - the Vigenère Cipher – encrypting plaintext or decrypting ciphertext given a key.
 - the Baconian Cipher – decrypting ciphertext encoded with the a b values represented as one or more letters, glyphs, symbols, or character rendering variations (e.g., bold, underline, italic).
 - Xenocrypt - no more than one cryptogram can be in Spanish
 - the Pollux and Morbit Ciphers – decrypting Morse code ciphertext encoded as digits and spaces given the mapping of at least 6 of the digits.
 - The Rail Fence Cipher – decrypting transposed text given the number of rails.
- The code types that may be used on the exam at State and National competitions are as follows:
 - All Invitational and Regional code types
 - Xenocrypt - at the state and national levels, at least one cryptogram will be in Spanish.
 - Cryptanalysis of the Vigenère cipher with a “crib” of at least 5 plaintext characters
 - Cryptanalysis of the Affine Cipher with a “crib” of at least 2 plaintext characters.
 - Cryptanalysis of The Pollux and Morbit Ciphers with a “crib” of at least 4 plaintext characters
 - Cryptanalysis of The Rail Fence Cipher with a “crib” of at least 5 plaintext characters and a range for the rails.
- For aristocrats, patristocrats, and xenocrypts: no letter can ever decrypt to itself.
- No more than 2 cipher questions will be an encryption on the exam.
- The exam packet will include a resource sheet with the Morse Code Table, English/Spanish letter frequencies, Vigenère table, Baconian mapping and modulus inverse tables as needed for the questions on the exam.
- The first question of the exam will be timed.
 - The first question will be the decoding of an Aristocrat as defined by rules 3e.iii.(1) or 3.e.iii.(2).
 - A team member should signal when his or her team has broken the cryptogram.
 - Before the exam begins, the event supervisor will announce the nature of the signal that must be used (e.g., shouting “bingo”, or quietly raising hand).
 - The time in seconds, to the accuracy of the device used, to solve the cryptogram will be recorded by the event supervisor or designee.



- v. If a team gets the timed question wrong, they may attempt to answer the question repeatedly without penalty. The Timing Bonus will be calculated from the start of the event until the question is successfully answered by the team with two or fewer errors, or until 10 minutes has elapsed. After 10 minutes, the timed question can still be answered but the Timing Bonus is zero.

4. **SCORING:**

- a. The high score wins. Final score = Exam score + Timing Bonus.
- b. Based on difficulty of the question, correct answers for each question will earn a clearly indicated number of points.
- i. The general point distribution by question type is:
- (1) An “easy question” = 100-150 pts
 - (2) A “medium question” = 200-300 pts
 - (3) A “hard question” = 350-500 pts
 - (4) A “very hard question” = 550-700 pts
- ii. For questions such as cryptograms, with answers composed of letters, the final points will be determined based on the number of errors found.
- (1) Two or fewer errors will result in full credit
 - (2) Each additional error results in a penalty of 100 points
 - (3) The penalty will not exceed the value of the question. For example, a 400-point question with 5 errors is worth 100 points whereas the same 400-point question with 7 errors would be worth 0 points, not -100 points.
- iii. The scores for each question will be added to determine the exam score.
- c. A Timing Bonus can be earned based on the number of seconds it takes a team to correctly decode the first question. The Timing Bonus is equal to $4 \times (600 - \text{number of seconds})$ For example, 6 minutes = $4 \times (600 - 360) = 960$ points.
- d. Scoring example: Team A earns 3600 points on the exam and solves the timed question in 435 seconds.
- | | | |
|-----------------------------|---|-----------|
| Exam Score | = | 3600 pts. |
| + Timing Bonus $4(600-435)$ | = | 660 pts. |
| Final Score | | 4260 pts. |
- e. Tie Breakers: For teams that are tied, select questions predetermined by the event supervisor, will be used to break the tie using the following criteria in this order: score, degree of correctness and attempted.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Codebusters Video Download and the Problem Solving/Technology CD; other resources are on the event page at soinc.org.

GENERAL RULES

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

GENERAL RULES, CODE OF ETHICS, AND SPIRIT OF THE PROBLEM

The goal of competition is to give one's best effort while displaying honesty, integrity, and good sportsmanship. Everyone is expected to display courtesy and respect - see Science Olympiad Pledges. Teams are expected to make an honest effort to follow the rules and the spirit of the problem (not interpret the rules so they have an unfair advantage). Failure by a participant, coach, or guest to abide by these codes, accepted safety procedures, or rules below, may result in an assessment of penalty points or, in rare cases, disqualification by the tournament director from the event, the tournament, or future tournaments.

1. Actions and items (e.g., tools, notes, resources, supplies, electronics, etc.) are permitted, unless they are explicitly excluded in the rules, are unsafe, or violate the spirit of the problem.
2. While competing in an event, participants may not leave without the event supervisor's approval and must not receive any external assistance. All electronic devices capable of external communication as well as calculator applications on multipurpose devices (e.g., laptop, phone, tablet) are not permitted unless expressly permitted in the event rule or by an event supervisor. Cell phones, if not permitted, must be turned off. At the discretion of the event supervisor, participants may be required to place their cell phones in a designated location.
3. Participants, coaches and other adults are responsible for ensuring that any applicable school or Science Olympiad policy, law, or regulation is not broken. All Science Olympiad content such as policies, requirements, clarifications/changes and FAQs on www.soinc.org must be treated as if it were included in the printed rules.
4. All pre-built devices presented for judging must be constructed, impounded, and operated by one or more of the 15 current team members unless stated otherwise in the rules. If a device has been removed from the event area, appeals related to that device will not be considered.
5. Officials are encouraged to apply the least restrictive penalty for rules infractions - see examples in the Scoring Guidelines. Event supervisors must provide prompt notification of any penalty, disqualification or tier ranking.
6. State and regional tournament directors must notify teams of any site-dependent rule or other rule modification with as much notice as possible, ideally at least 30 days prior to the tournament.

COVID-19 PANDEMIC RULES MODIFICATIONS

The COVID-19 pandemic requires that some general modifications be made to the Event Rules listed in this manual in order to permit Science Olympiad competitions to continue in a way that reflects best public health, disease prevention, and personal safety practices. The modifications listed here will be in effect for all Science Olympiad competitions, regardless of level (e.g., Invitational, Regional, State, National), or type (e.g., In-Person, Satellite SO, mini SO). As the pandemic is evolves, these modifications may be amended or rescinded according to local conditions. If changes are made, the Tournament Director for the affected tournament will make an announcement to all participating teams as soon as possible.

1. **If not already allowed, each individual participant can have a personal set of reference materials (e.g., binders, single sheets of paper), calculator, or other academic resource as specified in the specific event rule for use during the competition to facilitate social distancing, isolation, and to prevent resource sharing. Personal sets of resource materials must meet all the criteria established in the specific event rule. This does not apply to Recommended Lab Equipment for Division B or Division C Chemistry Events or tool kits for Build Events.**
2. **Given local conditions, participants may not be able to be in the same location as their partner during competition. Tournaments will allow designated partners to compete from separate locations and competing teams will only need one device for Build or Hybrid with Build Events.**
3. **At the discretion of the Tournament Director, portions of Hybrid Events containing hands-on activities as well as Build and Lab Events may be dropped from the tournament or be conducted as trial events.**
4. **At the discretion of the Tournament Director and Event Supervisors, completion time may be used as a tiebreaker for Core Knowledge and other events where a written or online test is used.**



For Event Supervisors Only - Do Not Post
CHEMISTRY RECOMMENDED LAB EQUIP.

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

Each team may bring any or all of the items listed below for use in Division B Chemistry Events. Teams not bringing these items will be at a disadvantage as Event Supervisors will not provide Recommended Lab Equipment. A penalty of up to 10% may be given if a team brings prohibited lab equipment to the event.

Item & Expected Use	Likely to be used in:			
	Crime Busters	Can't Judge a Powder	Food Science	Potions and Poisons
Box - Containing all of the kit materials	X	X	X	X
10 ml Graduated Cylinder - Measuring volumes		X	X	X
25 ml Graduated Cylinder - Measuring volumes		X	X	X
100 ml Graduated Cylinder - Measuring volumes		X	X	X
50 ml Beakers - Doing reactions, developing chromatograms	X	X	X	X
100 ml Beakers - Doing reactions, developing chromatograms		X	X	X
250 ml Beakers - Doing reactions, developing chromatograms		X	X	X
400 ml Beakers - Doing reactions, developing chromatograms	X	X	X	X
50 ml Erlenmeyer Flasks - Doing reactions		X	X	X
125 ml Erlenmeyer Flasks - Doing reactions		X	X	X
250 ml Erlenmeyer Flasks - Doing reactions		X	X	X
Test Tubes - Mix Chemicals, heat chemicals	X	X	X	X
Test Tube Brush - Clean Test Tubes	X	X	X	X
Test Tube Holder - Holds test tubes for heating	X	X	X	X
Test Tube Rack - Hold Test Tubes	X	X	X	X
Petri Dishes - Doing reactions, developing chromatograms	X	X	X	X
Spot Plates - Doing reactions in semi-micro scale, testing solubility, pH	X	X	X	X
Slides - To put hairs, crystals, or fibers on for use with a microscope	X			
Cover Slips - To prevent items from coming off slides	X			
Droppers - Add small amounts of liquids to reactions	X	X	X	X
Spatulas or spoons - Getting small amounts of solids out of containers	X	X	X	X
Stirring Rods - Stirring mixtures	X	X	X	X
Thermometer - Determining the temperature of a solution		X	X	X
Metal Tongs, Forceps, or Tweezers - Holding objects, retrieving objects from liquids	X	X	X	X
pH or Litmus paper - Test acidity or alkalinity of solution	X	X	X	X
Hand Lens - Magnification of small items for identification	X	X		
9V or less Battery Conductivity Tester - Determining ionic strength of solution		X	X	X
Paper Towels - Cleaning	X	X	X	X
Pencil - Writing, Marking Chromatogram	X	X	X	X
Ruler - Measuring lengths	X	X	X	X
Magnets - For extraction and identification of iron filings	X	X	X	X



For Event Supervisors Only - Do Not Post CALCULATOR CLASS DESCRIPTIONS

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

The following document was prepared to offer some guidance to teams as they select calculators for use in different Science Olympiad events. By no means are the calculators listed here inclusive of all possible calculators; instead they are offered as common examples. The decisions of the event supervisors will be final.

Class I - Stand-alone non-graphing, non-programmable, non-scientific 4-function or 5-function calculators

are the most basic type of calculators and often look like the one shown to the right. These calculators are limited to the four basic mathematics functions and sometimes square roots. These calculators can often be found at dollar stores.



Class II - Stand-alone non-programmable, non-graphing calculators look like the calculator to the right or simpler. There are hundreds of calculators in this category but some common examples include: CASIO FX-260, Sharp EL-501, and TI-30X.



Class III- Stand-alone, programmable, graphing calculators and stand-alone non-graphing, programmable calculators, often look like the calculator shown on the right. Some examples are: Casio 975 0/9850/9860, HP 40/50/PRIME, and TI 83/84/89/NSPIRE/VOYAGE.

To identify a stand-alone non-graphing, programmable calculators are look for the presence of the 'EXE' button, the 'Prog' button, or a 'file' button. Examples include but are not limited to: Casio Super FXs, numerous older Casio models, and HP 35S. A calculator of this type with the buttons labeled is shown to the right.



PROG Button

EXE Button



Class IV - Calculator applications on multipurpose devices (e.g., laptop, phone, tablet, watch) are not allowed unless expressly permitted in the event rule.



EYE PROTECTION GUIDE

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

This resource was created to help teams comply with the Science Olympiad Policy on Eye Protection adopted on July 29, 2015 and posted on the Science Olympiad Website (soinc.org).

Participant/Coach Responsibilities: Participants are responsible for providing their own protective eyewear. Science Olympiad is unable to determine the degree of hazard presented by equipment, materials and devices brought by the teams. Coaches must ensure the eye protection participants bring is adequate for the hazard. All protective eyewear must bear the manufacturer's mark Z87. At a tournament, teams without adequate eye protection will be given a chance to obtain eye protection if their assigned time permits. If required by the event, participants will not be allowed to compete without adequate eye protection. This is **non-negotiable**.

Corresponding Standards: Protective eyewear used in Science Olympiad must be manufactured to meet the American National Standards Institute (ANSI) standard applicable at its time of manufacture. The current standard is ANSI/ISEA Z87.1-2015. Competitors, coaches and event supervisors are not required to acquire a copy of the standard. The information in this document is sufficient to comply with current standards. Water is not a hazardous liquid and its use does not require protective eyewear unless it is under pressure or substances that create a hazard are added.

Compliant Eyewear Categories: If an event requires eye protection, the rules will identify one of these three categories. Compliance is simple as ABC:

CATEGORY A

- Description: Non-impact protection. They provide basic particle protection only
- Corresponding ANSI designation/required marking: Z87
- Examples: Safety glasses; Safety spectacles with side shields; and Particle protection goggles (these seal tightly to the face completely around the eyes and have direct vents around the sides, consisting of several small holes or a screen that can be seen through in a straight line)

CATEGORY B

- Description: Impact protection. They provide protection from a high inertia particle hazard (high mass or velocity)
- Corresponding ANSI designation/required marking: Z87+
- Example: High impact safety goggles

CATEGORY C

- Description: Indirect vent chemical/splash protection goggles. These seal tightly to the face completely around the eyes and have indirect vents constructed so that liquids do not have a direct path into the eye (or no vents at all). If you are able to see through the vent holes from one side to the other, they are NOT indirect vents
- Corresponding ANSI designation/required marking: Z87 (followed by D3 is the most modern designation but, it is not a requirement)
- Example: Indirect vent chemical/splash protection goggles

Examples of Non-Compliant Eyewear:

- Face shields/visors are secondary protective devices and are not approved in lieu of the primary eye protection devices below regardless of the type of vents they have.
- Prescription Glasses containing safety glass should not be confused with safety spectacles. "Safety glass" indicates the glass is made to minimize shattering when it breaks. Unless these glasses bear the Z87 mark they are not approved for use.

Notes:

1. A goggle that bears the Z87+ mark and is an indirect vent chemical/splash protection goggle will qualify for all three Categories A, B & C
2. VisorGogs do not seal completely to the face, but are acceptable as indirect vent chemical/splash protection goggles