For Event Supervisors Only - Do Not Post

EXPERIMENTAL DESIGN

1. **DESCRIPTION:** This event will determine the participant's ability to design, conduct, and report the findings of an experiment entirely on-site.

   A TEAM OF UP TO: 3 **EYE PROTECTION:** C **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. Participants must bring goggles and writing utensils. Experiments will not require any other safety equipment.
   b. Division B teams may bring one timepiece, one linear measuring device, and one stand-alone non-programmable non-graphing calculator.
   c. Division C teams may bring one timepiece, one linear measuring device, and one stand-alone calculator of any type.
   d. The Event Supervisor will provide each team with identical sets of materials either at a distribution center or in an individual container.
   e. The Event Supervisor will supply a report packet, based on the Experimental Design Checklist, posted on the event page at soinc.org, for recording their experimental information and data.
3. **THE COMPETITION:**
   a. The teams must design, conduct, and report the findings of an experiment conducted on site that addresses the assigned question/topic area provided by the Event Supervisor. The assigned question/topic area should be the same for all teams and allow the participants to conduct experiments involving relationships between independent and dependent variables (i.e., height vs. distance).
   b. During the first 20 minutes of the event, participants will receive the assigned question/topic area, materials, and Part I of the report packet. Participants will focus on designing and conducting their experiment.
   c. After the first 20 minutes, participants will receive Part II of the report packet and will focus on analyzing their experiment and reporting findings. Participants may continue experimenting throughout the entire event.
   d. Each team must use at least two of the provided materials to design and conduct an experiment. The materials will be listed on the board or placed on a card for each team. If provided, both the card and the container will be considered part of the materials. The identity of the materials will be unknown until the start of the event.
   e. When a team finishes, all materials must be returned to the Event Supervisor including both parts of the report packet.
4. **SCORING:**
   a. High score wins. Scoring will be done using the Experimental Design Checklist found on the Science Olympiad website (soinc.org).
   b. Points will be awarded depending upon the completeness of the response. Zero points will be given for no responses as well as illegible or inappropriate responses.
   c. Ties will be broken by comparing the point totals in the scoring areas of the checklist in the following order:
      i. J. Analysis of Claim/Evidence/Reasoning
      ii. E. Procedure and Set-Up Diagrams
      iii. C. Variables
      iv. G. Data Table
      v. H. Graph
   d. Any participant not following proper safety procedures will be asked to leave the room and will be disqualified from the event.
   e. Any team not following clean-up procedures will have their final score multiplied by 0.95.
   f. Any team not addressing the assigned question/topic area will have their final score multiplied by 0.75.
   g. Any team not collecting data by conducting an experiment on-site will have their final score multiplied by 0.25.

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

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EXPERIMENTAL DESIGN CHECKLIST

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

2021 Experimental Design Division B Checklist

(Note: The maximum points available for each task are shown.)

Part I – Design and Construction of the Experiment **(58 pts)**

A. **Statement of the Problem (2 pts)**

② ① ⓪ **Statement addresses the experiment including variables (Not a yes/no question)**

B. Hypothesis (6 pts)

② ① ⓪ Statement predicts a relationship between the independent and dependent variables
② ① ⓪ Statement gives specific direction to the prediction(s) (e.g., a stand is taken)
② ① ⓪ A rationale is given for the hypothesis.

C. Variables (**16** pts)

a. Independent Variable (IV) (6 pts)
② ① ⓪ **Correctly identified and defined**
④ ③ ② ① ⓪ Levels of IV given

b. Dependent Variable (DV) (4 pts)
④ ③ ② ① ⓪ **Correctly identified and defined**

c. **Controlled Variables & Constant** (CV) **(6 pts)**
② ① ⓪ **First** CV correctly identified
② ① ⓪ **Second** CV correctly identified
② ① ⓪ **Constant correctly identified**

D. Materials (4 pts)

② ① ⓪ **All materials are listed and quantified**
② ① ⓪ No extra materials are **listed**

E. Procedure **and Set-up** Diagrams (**14 pts**)

② ① ⓪ Procedure **is presented in list form**
② ① ⓪ Procedure is in a logical sequence
② ① ⓪ Steps for repeated trials are included
② ① ⓪ **Multiple diagrams** of setup are provided
② ① ⓪ **All diagrams are appropriately labeled**
④ ③ ② ① ⓪ Enough information is given so another could repeat procedure

F. Qualitative Observations (**6 pts**)

② ① ⓪ Observations about procedure provided
② ① ⓪ Observations about the results provided
② ① ⓪ Observations given throughout the course of the experiment

G. Quantitative Data - Data Table (1**0 pts**)

② ① ⓪ All raw data is **provided**
② ① ⓪ **A condensed data table showing only the data to be graphed provided**
② ① ⓪ Tables **and columns** labeled properly
② ① ⓪ All data has units
② ① ⓪ **Example calculations for derived variables are given**

Part II – Data, Analysis and Conclusions (**66 pts**)

H. Graph (1**2 pts**)

④ ③ ② ① ⓪ Appropriate **Graph is provided**
④ ③ ② ① ⓪ Graph properly titled and labeled
④ ③ ② ① ⓪ Appropriate scale and units included

I. Statistics (**14 pts**)

④ ③ ② ① ⓪ Statistics of Central Tendency (i.e., best fit, median, mode, mean)
④ ③ ② ① ⓪ **One example calculation is given for each statistic including units**
④ ③ ② ① ⓪ **Statistics of Variation (i.e., min, max, range)**
② ① ⓪ Calculations are accurate

J. Analysis **of Claim/Evidence/Reason (CER) (18 pts)**

② ① ⓪ **Statistics Claim completed logically**
② ① ⓪ **Statistics Evidence completed logically**
② ① ⓪ **Statistics Reasoning completed logically**
② ① ⓪ **Outliers Claim completed logically**
② ① ⓪ **Outliers Evidence completed logically**
② ① ⓪ **Outliers Reasoning completed logically**
② ① ⓪ **Data Trend Claim completed logically**
② ① ⓪ **Data Trend Evidence completed logically**
② ① ⓪ **Data Trend Reasoning completed logically**

K. Possible Experimental Errors (8 pts)

④ ③ ② ① ⓪ **One specific error is identified and effect on results discussed.**
④ ③ ② ① ⓪ **Second specific error is identified and effect on results discussed.**

L. Conclusion (8 pts)

② ① ⓪ Hypothesis is re-stated
② ① ⓪ **Hypothesis Claim completed logically**
② ① ⓪ **Hypothesis Evidence completed logically**
② ① ⓪ **Hypothesis Reasoning completed logically**

M. Recommendations for Future Experimentation (**6** pts)

② ① ⓪ Suggestions to improve the experiment are given
② ① ⓪ Suggestions for practical applications of experiment are given
② ① ⓪ Suggestions for future experiments are given

School: _____**Team#**_____

Point Total: _____**/124**

Deduction multiplier(s): _____
Non-clean up (0.95), Off topic (0.75), or Non-lab (0.25)

Final Score: _____

(revised 8/23/2019)

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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.**

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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

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CALCULATOR CLASS DESCRIPTIONS

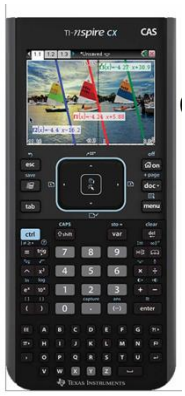
See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

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.

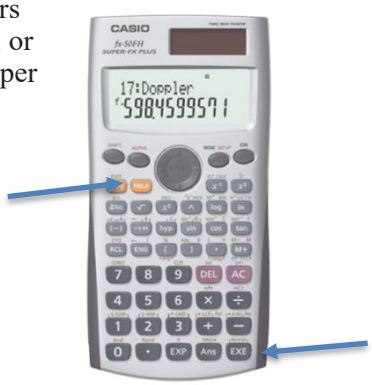
Class I - Stand-alone non-graphing, non-programmable, non-scientific 4-function or 5-function calculators
are the most basic type of calculators and often look like the one shown to the right. These calculators are limited to the four basic mathematics functions and sometimes square roots. These calculators 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.



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

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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

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