

2023

Division A Virginia Science Olympiad



Sponsored by Langley High School Science Olympiad Team
6520 Georgetown Pike, McLean, VA 22101

Competition Dates
November 4 November 11
November 18 (ONLY IF NEEDED)

**NORTHROP
GRUMMAN**

We thank Northrop Grumman for helping to offer discounted registration fees for schools with large economically disadvantaged populations.



All portions of this manual are covered by Copyright 2023 Science Olympiad, Inc. and/or Copyright 2023 Virginia Science Olympiad
Updated: August 12, 2023

Table of Contents

2023 Competition Rules.....	3
Important Dates.....	3
General Information	3
Team Structure	4
Fee Structure	4
Awards and Scoring	5
Volunteer Requirements	5
Writing an Event	5
Setting up the Team	5
The Tournament	6
Preparation for Building Events	6
Science Olympiad Code of Ethics	7
Spirit of Competition.....	7
Students' Pledge	7
Coach's Pledge.....	7
Parent Information and Pledge.....	8
Parent's Pledge.....	8
Event Supervisor's Pledge	8
Tournament Schedule	8
3rd Grade Build-a-Barge (45 Minutes - Coach Scheduled Event)	10
3rd Grade Dynamic Planet – Plate Tectonics (30 Minutes - Based on Team Schedule)	12
3rd Grade Forces (30 Minutes - Based on Team Schedule)	13
3rd Grade Forestry (30 Minutes - Based on Team Schedule).....	14
3rd Grade Wright Stuff – Darts Target on the Wall (30 Minutes - Based on Team Schedule).....	18
Air Rockets – Flying through the Hoop (45 Minutes - Coach Scheduled Event)	20
Anatomy - Respiratory System (30 Minutes - Based on Team Schedule)	23
Brainstorm (45 Minutes - Coach Scheduled Event)	24
Bridge Building (45 Minutes - Coach Scheduled Event)	26
Crave the Wave - (Online Event - Based on Team Schedule)	28
Data Investigations (30 Minutes - Based on Team Schedule)	29
Dynamic Planet – Plate Tectonics (30 Minutes - Based on Team Schedule)	30
Fermi Questions (30 Minutes - Based on Team Schedule).....	31
Forestry (30 Minutes - Based on Team Schedule).....	33
Gravity Vehicle (Coach Scheduled Event – 45 Minutes)	35
Hydraulics (45 Minutes - Coach Scheduled Event)	38
Machines (30 Minutes - Based on Team Schedule).....	40
Morse Codebusters (45 Minutes - Coach Scheduled Event)	42
Optics (30 Minutes - Based on Team Schedule).....	44
Periodic Table (30 Minutes - Based on Team Schedule).....	46
Rubber Band Car (45 Minutes - Coach Scheduled Event)	47
Rubber Band Helicopter (45 Minutes - Coach Scheduled Event)	49
States of Matter (30 Minutes - Based on Team Schedule).....	51
Submersibles (45 Minutes - Coach Scheduled Event).....	52
Trial Event – Origami Glider Relay (45 Minutes - Coach Scheduled Event).....	54

2023 Competition Rules

This will be an in-person tournament.

Volunteers will proctor the 11 coach-scheduled building events and 14 team-schedule testing events.

Teams will provide the names of two volunteers to support these. (3 teams mean 6 volunteers.)

Important Dates:

- **November 4:**
- **Competition Day 1**

November 11:

- **Competition Day 2**

November 18:

- **Competition Day 3 if needed. We will use this date for a third competition day only if we receive more than 70 team registrations.** You will not be able to choose this date at the time of your registration. You will be able to switch to this date if it opens.

General Information:

- No Parents will be allowed in the testing or building competition site except to use the restroom when needed or when acting as the team's volunteers or designated chaperone. We will ask any Parents found in the building to leave immediately. Chaperones must also leave the building after delivering their charges to their testing site.

- For the competition day each team will provide 2 volunteers. If you have 3 teams at your school that is 6 volunteers. These volunteers will help with the running of events.
- Some events require that students wear eye protection. We do not have any events that require lab or protective clothing, but students may wear this if they wish.



Indirect Vent Goggles Example



Impact Safety Glasses Examples

- Any calculator used by teams must be four function, non-programmable.
- VASO will not run an event with less than two supervisors in the room at all times.
- Building Event Supervisors must stay with their event for the entire competition day.
- Each Event Supervisor and volunteer of an event will help until all examinations are graded and winners determined.
- Event Supervisors and volunteers must follow the same safety protocols as the participants and must ensure that all participants are following the safety protocols at all times. Wear your goggles and safety glasses!
- The Event Supervisor must be reachable for the entire competition day in the event of an appeal with the running of the event.
- Test writers will provide plans/assessments one month prior to the competition for review.
- Coaches will schedule their teams' building events times. These times may be changed by the coach if there is space in another time slot.
- Written test event times are set and will not change for any team.
- Students may participate individually in events where teams/coaches feel it feasible.

Team Structure

- A team is defined as a group of 15 or less students residing within the same school attendance zone and attending the same school. A school may have up to 3 teams.
- The head coach is the person chosen by the school to be responsible for all the actions of their team and parents.
- Teams must have one Head Coach and may have one designated Co-Head Coach that will answer all questions from their team and are the only adults that may talk with Virginia Science Olympiad officials.
- All other individuals working with a team are mentors and may not discuss the running of events or the interpretation of the rules with Event Supervisors.
- Students from different schools that attend the same after school or weekend activity may not enter as a team.
- Science Olympiad will recognize home schooled teams consisting only of students who live within the boundaries of two contiguous (side-by-side) geographic counties in Virginia.
- Students in grades 3-5 are eligible to participate in Division A. Smaller groups within a team may be mixed with some students from each grade level, or they may be based on grade level with students all coming from the same grade level.
- Students in grade 5 may choose to participate in either Division A or Division B. They may NOT compete in both divisions in the same school year.

Awards and Scoring

- Because of the size of our competition, it may be necessary to delay our awards ceremony.

- There are very few places indoors that hold 400 students plus families. Langley does not have a space large enough.
- In case we delay the awards, we will announce winners online through YouTube one week after the competition.
- Delaying also gives us time to check thoroughly all the computer logs and review the results for any mistakes.
- We will announce award placements no later than one week after the competition through our YouTube channel.
- The top 6 performing pairs of students in each event earns medals.
- Division A does not have team awards. So, it does not use results from the events to create a combined team score. This is to allow students and teams more flexibility in trying events, without the added pressure of filling all events to get a good team score.
- Scoring varies by event. Each event description includes an explanation of how it will be scored.
- There are also individual impact awards for students that, in the mind of an Event Supervisor, have shown the most Olympic spirit.

Volunteer Requirements

The Division A Tournament cannot be run without parents, teachers, students, and mentor volunteers helping on competition days.

- All teams will provide at least 2 volunteer names during the registration process. (3 school teams equal 6 volunteers.) Teams will not receive team numbers until this requirement is met.
- All volunteers must sign in at the volunteer room for their assignment.
- Schools will not receive their medals if they do not meet their volunteer obligations.

Writing an Event

- Division A will only reimburse expenses that the Division A treasurer approves before the purchase of materials.
- Writing an event involves creating a hands-on activity or written assessment based on the rules set forth in this event manual; running the event the day of the competition; providing materials for the event; and administering the event including setup, cleanup and scoring.
- Event Supervisors will provide plans/assessments one month prior to the competition for review.

Setting up the Team

- For clarification a school may register up to 3 teams of 15 students.

- Read the event rules carefully. They state how many students may attend an event based on the number of teams registered for a school and the number of students allowed in an event.
- All students from the same school will take all assessments at the same time. For example, elementary school team 105 has six students entered in the Anatomy event. All six students will test at the same time.
- It is up to the Head Coach of the team to schedule students, so they have no conflicts.
- In setting up your team schedule, be sure not to schedule one student for two events that meet at the same time. Please consult the schedule to determine those conflicts.
- When selecting student pairs, it is advisable that you select students that you know will work well together in a team situation. Both should be equal members of a partnership. If one member dominates the partnership, the two will most likely not work well on the day of the competition.
- **Students may participate individually.**

The Tournament

- Head Coaches are responsible for their students at the competition. Students will leave when they have completed their events. Coaches should communicate their expectations for their students prior to the tournament.
- **Parents will not be allowed in the building except for use of the restrooms at this year's competition.**
- **For safety we ask that they wait in their cars or return to pick up their competitor(s) at a later time. Crowding around the front door of the competition is a fire hazard.**
- **Coaches and families will complete the online VASO registration forms before competing. The combined online forms include a pledge signed by students and parents vowing to follow a code of ethics during the competition and a participation and consent form.**
- **Families that do not complete the online forms will not participate in the tournament.**
- **Each Head Coach will complete their online roster of the student names and the events they will participate in by October 21.**
- Division A reserves the right to turn away any schools, students, or parents that do not complete the forms by the published deadlines. Division A will refund registration fees of teams turned away.
- **Students must understand and follow all safety rules. Students that do not have proper safety equipment will not participate.**
- **Students may start an event without their partner. The missing partner may join an event in progress. (No extra time added for the team.)**
- **No student may leave an event once a test starts and return later.**
- The tournament can be long for some students, due to "down time" between their events. Coaches and families should plan accordingly.
- Students must make any event appeals in writing to the tournament director or designee using the **appeals forms with the help of their Head Coach or Co-Head Coach within 30 minutes of the end of their event.**
- Appeals will be dealt with on a first come, first served basis and will be resolved on competition day.
- **Division A does not return any written assessments given the day of competition.**

Preparation for Building Events

- **Building events have written tests about the basic principles of the topic, structure or device the team needs to build for the competition.**
- Division A does not allow teams to bring pre-built devices. Our objective is to ensure a team's performance is their own, and to have them learn and demonstrate skills they will need to compete successfully as they continue to Division B.
- Coaches can best prepare their teams for the competition by teaching underlying principles and skills, suggesting ideas, and advice on methods, tools or materials to accomplish the task. Students should

practice their events using different materials (suggested materials are included in each event description) and be familiar with the concepts so that they can apply them regardless of the materials provided at the tournament.

- Encourage the students to gather information and ideas from library books, teachers, parents, engineers, scientists and other available resources. The intent is not to reinvent the wheel nor to be given a finished design, but to integrate and build on information gathered. Example: A book on crossbows may contain information on how to make the trigger mechanism for a catapult.
- The students retain control of the process of preparing for a Science Olympiad event. This means that they should have the last word on how to practice for their events.
- An important part of any design process is brainstorming. The entire team may be encouraged to participate in the discovery process, not just the two or three that will be involved at the tournament. An adult may act as mentor for the group and ask questions or offer ideas. Don't forget the students should make the final choices.
- Some events require the collection and interpretation of data. Students will be most successful if they have had the opportunity to do this at their practice sessions.
- Keep in mind that the purpose of Science Olympiad is to encourage the exploration and pursuit of science while having fun in the process.

Science Olympiad Code of Ethics

✚ Student participants are expected to compete in tournament events with honest effort to follow the rules and the spirit of the competition. Team members are expected to be the builders of all the devices used in the events. The goal of competition is to give one's best effort while displaying honesty, integrity, and sportsmanship. Students, coaches, parents, and guests are expected to display courtesy and respect toward Olympiad officials, other teams, and guests of the Olympiad. Failure to show honesty and/or courtesy by a participant, coach, or guest of the team may result in the disqualification of the team from that event, the entire tournament or future tournaments.

Spirit of Competition

- ✚ It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.**
- All teams are expected to participate in the competition in a positive manner.
 - Science Olympiad will not tolerate the disrupting of the competition in any way by student competitors.
 - Students, who belittle or make fun of the work of other students, as determined by the judges, will be disqualified from their event and/or the competition.
 - Any team caught cheating or interfering with the work of another team during an event will be disqualified from that event.

Students' Pledge

I pledge to put forth my best effort in the Science Olympiad tournament and to uphold the principles of honest competition. In my events, I will compete with integrity, respect, and sportsmanship towards my fellow competitors. I will display courtesy towards Event Supervisors and Tournament Personnel. My actions will exemplify the proud spirit of my school, team, state and myself.

Coach's Pledge

On behalf of the coaches and assistants at this tournament, I pledge to encourage honesty and respect for tournament personnel, our fellow coaches, and other team members. We want our efforts to bring honor to our community and school.

Parent Information and Pledge

This competition is for your child.

- It is the students' and Head Coaches' responsibility to ask questions and discuss events with Event Supervisors.
- Parents are not to interfere with the judging of any event and may not discuss the administration of an event with the Event Supervisor.
- Division A has the right to ask any parent interfering with an event to leave the competition.

Parent's Pledge

On behalf of the parents, I pledge to be an example for our children by:

- respecting the rules of Science Olympiad,
- encouraging excellence in preparation and investigation,
- supporting independence in design and production of all competition devices,
- and respecting the decisions of event supervisors and judges.
- Our examples will promote the spirit of cooperation within and among all our participating teams

Event Supervisor's Pledge

On behalf of my fellow supervisors and tournament personnel, I pledge to run my event with fairness and respect for the participants and their coaches. Our actions will reflect the principles of the Science Olympiad program and display the pride we feel as representatives of our colleges, universities, companies, states or organizations.

Tournament Schedule

- The tournament is a one-day in-person event.
- This schedule assumes that there will be 30 teams registering per competition day.
- Schools will receive their team numbers after they register and have paid their fees. Use your team number to plan your team schedule.
- All schools will have simultaneous scheduled event conflicts. Most often these arise if a student wants to participate in two events at the same time. We will not modify this event schedule to accommodate student choice.

Sample 35 Team Regional Competition Schedule

101-107 are team numbers assigned after registration completion.

Do not assign events times until you know your team number.

All teams from the same school must participate at the same time for these events. No exceptions.

<u>Morning Sessions</u>	9:00-9:30	9:40-10:10	10:20-10:50	11:00-11:30	11:40-12:10
Anatomy	101-107	129-135	122-128	115-121	108-114
Crave the Wave	122-128	115-121	108-114	101-107	129-135
Data Investigations	108-114	101-107	129-135	122-128	115-121
Periodic Table	129-135	122-128	115-121	108-114	101-107
States of Matter	115-121	108-114	101-107	129-135	122-128
3 rd Grade Dynamic Planet	101-107	129-135	122-128	115-121	108-114
3 rd Grade Forestry	122-128	115-121	108-114	101-107	129-135

<u>Afternoon Sessions</u>	12:20-12:50	1:00-1:30	1:40-2:10	2:20-2:50	3:00-3:30
Dynamic Planet	101-107	129-135	122-128	115-121	108-114
Fermi Questions	108-114	101-107	129-135	122-128	115-121
Forestry	115-121	108-114	101-107	129-135	122-128
Machines	122-128	115-121	108-114	101-107	129-135
Optics	129-135	122-128	115-121	108-114	101-107
3 rd Grade Wright Stuff	101-107	129-135	122-128	115-121	108-114
3 rd Grade Forces	108-114	101-107	129-135	122-128	115-121

Teams from the same school may sign up for different times for these events.

<u>Tech Events</u>	9:00-9:45	10:00-10:45	11:00-11:45	11:45-12:30 Lunch	12:30-1:15	1:30-2:15
Air Rockets	<p><u>Tech Events (45 Minutes)</u></p> <p>Tech events are hands-on and require the students to create, test and compete with a student-built device.</p> <p>Teams sign up for event times based on their written test schedule.</p> <p>Some of these events will not take the full time.</p> <p>Signup: 7 teams per hour.</p>					
Brainstorm						
Bridge Building						
Gravity Vehicle						
Hydraulics						
Morse Code Busters						
Rubber Band Car						
Rubber Band Helicopter						
Submersibles						
3 rd Grade–Tower Building						
3 rd Grade–Build-a-Barge						

<u>Trials</u>	9:00-9:45	10:00-10:45	11:00-11:45	11:45-12:30 Lunch	12:30-1:15	1:30-2:15
Origami Glider Relay	Trials are events that the rules committee discussed but want to test them to see if we can modify them from the older divisions down to our competition. They are a great filler of time. Students will not earn awards for these events. This event may not take 45 minutes. Signup: 6 teams per hour.					
3:30-Building Project Pickup						

Updated: August 12, 2023

3rd Grade Build-a-Barge (45 Minutes - Coach Scheduled Event)

Description: Teams will build a barge on-site to hold the greatest amount of cargo, measured in grams, before sinking. This event has a short knowledge assessment.



Participants per team: 2

Spirit of the Competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area. Talking to the team members any time during the competition. Violation of this rule will place the team below all other teams.

Teams need to bring:

- Pen or pencil.
- Optional - Teams may also bring rulers, protractors, tape-measures and a non-programmable calculator.

Safety Requirements: Indirect-vent Safety Goggles.

- Because this is an event that uses liquids, all competitors must always wear their eye protection when competing.
- If a team does not have the required eye protection, they will have the opportunity to obtain it, time allowing, but will not receive extra time.
- If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.



Materials provided at event:

- Each team will receive a set of materials to build a barge. Materials may include items such as aluminum foil, small plastic sheets, clay, cardboard, water-proof tape, straws, Styrofoam, etc. The exact set of materials will not be announced prior to the tournament, but all teams will receive the same materials in the same amounts.
- Cargo items such as coins, washers, marbles, small bags of rice, or similar items will be provided for loading the barges. The mass of each type of cargo will be provided to the teams.
- A container at least 30 cm long by 30cm wide and filled to a depth of at least 20 cm with water.
- Equipment to measure the mass of building materials MAY be provided.

The Competition:

Building Phase

Teams will receive a set of materials with which to build their barge, and will have 15 minutes to complete a barge meeting the following criteria:

- The barge may have only one, continuous area for cargo (i.e., no separate cargo compartments), and must be open at the top for loading.
- The completed barge must fit completely within a box measuring 10cm x 10cm x 5cm.
- After completing their barge, the team will estimate the amount of cargo (in grams) that their barge will hold and give this estimate to the Event Supervisor (for use in breaking a tie).
- The barge may include components that help it stay afloat, remain stable or otherwise improve its cargo-carrying capacity.

- The Event Supervisor will measure the barge and note on the score sheet whether it meets all criteria (Tier 1) or does not (Tier 2). Teams in Tier 2 may test their barge but will be ranked below all teams in Tier 1.
- The team will then have 2 minutes to place their barge in a test container and load it with cargo.
- Teams load cargo one piece at a time, until the barge sinks, or is holding all the available cargo.
- Mass held will be the total mass held before the barge sinks (i.e., the mass of the last piece of cargo added, that causes the barge to sink, will not be in the total).
- A barge is "sunk" when the top of the cargo area is completely below the water surface. It is not necessary for the barge to settle to the bottom of the container. If a barge takes on water but the top of the cargo area remains above the water surface, the team may continue to add cargo, however the mass of any water in the barge will not count toward the total mass held. (Teams may not attempt to remove water that enters their barge during testing.)
- There may be multiple types of cargo. Teams can load cargo in any order but may not remove or adjust a piece of cargo once it is placed in the barge.
- The cargo is dried before weighing.

Written Test

Teams will take a short-written test on paper during the building phase. Topics may include but are not limited to, the principles of buoyancy, Archimedes' principle, types of barges, density, why objects float, parts of the barge etc.

Scoring:

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first.

- 25% of team score: A ranking based on their written test score.
- 75% of team score: A ranking based on the mass held by their barge.
 - The Event Supervisor ranks the tier 1 teams greatest to least for holding the most mass measured to the nearest gram.
 - The Event Supervisor ranks all Tier 2 teams from most mass held to least.

Tiebreaker:

The team whose prediction of the amount of mass their barge would hold is closer to the actual amount will be ranked higher.

Scoring Example:

Equation: (written test ranking x 0.25) + (building ranking x 0.75) = final ranking

- Team A ranks 3rd on the written test. This scores 0.75 ranking points. The team also scores 5th on their mass held. This scores 3.75 ranking points. The team's final ranking score is 4.5.
- Team B ranks 2nd on the written test. This scores 0.5 ranking points. The team also scores 7th on their mass held. This scores 5.25 ranking points. The team's final ranking score is 5.75.
- Team A places first in the rankings.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [The Guide to Types of Barges - Archway Marine](#)
- [Density Lesson for Kids: Definition & Facts - Video & Lesson Transcript | Study.com.](#)
- In preparing for this event, teams will want to learn about density and how objects float. They will want to practice by building vessels of various materials and shapes to see how these things affect the ability of the barge to hold cargo and will also want to practice loading cargo.

3rd Grade Dynamic Planet – Plate Tectonics (30 Minutes - Based on Team Schedule)

These rules will be in effect for both the 3rd and all grades' sessions. If 3rd graders attend the 3-5 student sessions, they will not receive scores for the 3rd grade session. 4th and 5th graders may not attend the 3rd grader session.



Description: Teams will demonstrate their understanding of plate tectonics and how it relates to continental drift. This event has a written test and may/may not include “hands-on” stations.

Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area. Talking to the team members any time during the competition. Violation of this rule will place the team below all other teams.

Teams need to bring: Pencils.

Safety Requirements: None

The Competition:

Teams will answer questions on a written test. Topics may include but not limited to:

- Mechanical & Chemical division of Earth's layers
- Driving forces of plate tectonics
- Plate boundaries & features found at plate boundaries
- Understanding of continental rifting, seafloor spreading, Island arcs, Back-arc basins, Mountain building, Polar wandering
- Evidence of plate tectonics
- Identification of major tectonic plates

African Plate	Cocos Plate	North American Plate
Antarctic Plate	Eurasian Plate	Pacific Plate
Arabian Plate	Indian Plate	Philippine Plate
Australian Plate	Juan de Fuca Plate	Scotia Plate
Caribbean Plate	Nazca Plate	South American Plate

Scoring:

- Points will be awarded for each correct response.
- Ties will be broken by the accuracy or quality of answers to select questions chosen by the event leader prior to the competition.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [SciOly - Dynamic Planet/Tectonics](#)

3rd Grade Forces (30 Minutes - Based on Team Schedule)

Description: This event tests participants' knowledge of Forces. This event has a written test and may/may not include "hands-on" stations.



Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Teams need to bring: Pencils, Optionally a 4-function calculator.

Safety Requirements: None

The Competition:

Students will take a written test to answer topic questions that may include but not limited to

- Definition of force
- Types of forces - Contact & Action-at-a- distance forces
- Newton's Laws of Motion
- Free body diagrams
- Net force calculation

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- <https://www.physicsclassroom.com>

3rd Grade Forestry (30 Minutes - Based on Team Schedule)

Description: This event tests participants' knowledge of native trees of Virginia. This event requires teams to explore and write about nature, has a written test and may/may not include "hands-on" stations.



Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.
- It is further a rules violation for a parent, mentor, or coach to research this event on behalf of the students.

Teams need to bring: Pencils, the team Field Report, and optionally teams may bring one field guide, a hand lens, and a 4-function calculator.

Safety Requirements: None

The Competition:

There are a possible three parts to this event:

Part 1: Students will submit a field report.

- It can be a visit to a local nature park, their backyard, school garden, or their neighborhood
- They will identify 3 - 5 trees on this trip and submit the details on how they identified the trees - sketches of the features, images.
 - The team at a minimum have three identifications.
 - A list of birds and animals that use each tree for food or shelter.
 - Research and explain how native Virginians used the parts of the trees.
 - With a length of no more than 2 double-sided pages.
 - The team report must include the school, student names, team number, and a declaration by the team that they did not have any help writing the report.

Part 2: Students will take a written test to answer topic questions that may include but not limited to:

- Common identification terminology used in identifying trees.
- Forest types.
- Forest succession.

Part 3: Hands-On Stations (if run): Students will identify trees based on real or images of leaves.

Scoring:

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first.

- 75% of team points will be awarded for each correct response on the written test and the hands-on stations.
- 25% of team points will be awarded for the team written report.
- Ties will be broken by the accuracy or quality of answers to select questions on the written test chosen by the event leader prior to the competition.

Scoring Example:

Equation: (written test ranking x 0.75) + (report ranking x 0.25) = final ranking

- Team A ranks 4th on the written test. This scores 3 ranking points. The team also scores 5th on their report. This scores 1.25 ranking points. The team’s final ranking score is 4.25.
- Team B ranks 2nd on the written test. This scores 1.5 ranking points. The team also scores 7th on their report. This scores 1.75 ranking points. The team’s final ranking score is 3.25.
- Team B places first in the rankings.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Virginia Department of Forestry](#)

Competition Tree List:

American Beech	Longleaf Pine
American Chestnut	Northern Red Oak
Atlantic White-Cedar	Pawpaw
Black Cherry	Pin Oak
Black Oak	Pitch Pine
Black Walnut	Pond Pine
Common Persimmon	Red Spruce
Eastern Hemlock	Sassafras
Eastern Redbud	Shortleaf Pine
Eastern Redcedar	Silver Maple
Eastern White Pine	Southern Red Oak
Flowering Dogwood	Swamp Chestnut
Laurel Oak	Oak Sycamore
Live Oak	White Oak
Loblolly Pine	Willow Oak

3rd Grade Tower Building (45 Minutes - Coach Scheduled Event)

Description: Teams will build a strong, stable tower from index cards and masking tape. The team that builds the highest tower with the fewest cards and the smallest area base while holding a mass no less than 100 grams and no more than 1000 grams will be the winner. This event has a written test.



Participants per team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Teams need to bring:

Pencil, pen or marker. Optionally a ruler/straightedge and protractor. No scissors.

Team Needs to Bring:

Safety glasses labeled ANSI Z87.1+ (impact rated)

- All competitors must always wear their eye protection during all phases of the competition.
- If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.
- If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.



Materials Provided at Event:

Index Cards (amount decided on competition day), 1 meter or 2.54 cm masking tape, a 5cm x 5cm square of plywood to place on top of the tower for testing, and an object with a mass no less than 100 grams and no more than 1000 grams.

The Competition: ***Construction and Written testing will occur at the same time.***

Part 1 – Written Test and Construction Phase: Timed 30 Minutes

- The team members will take a short test on the differences in building and practical use of guyed or cable-supported, free-standing or self-standing, and monopole types of towers.
- Teams will construct a tower that rises the greatest possible distance with the smallest area base while supporting the provided object placed at the highest point by the team.
- The amount, length and width of the index cards for this competition will remain secret until the day of the competition.
- The Event Supervisor will announce on the day of the competition the object and the mass of the object each tower is to hold.
- The tower must support the object for ten seconds.
- Teams may cut the tape into any shape or size.
- Index cards may not be cut or torn but may be bent by the teams.
- The Event Supervisor will record the amount of index cards left for each team.
- Any team using any tools or materials other than those listed above will be ranked below all other teams.

Part 2 – Tower Testing Phase

- Teams will place the tower on a flat surface.
- All support parts of the tower must rest on top of the flat surface.
- No sticky part of the tape may touch the top or sides of the flat surface
- The Event Supervisor will measure the height and area of the base of the tower to the nearest millimeter and millimeter²(1mm) before testing begins.
- To begin testing, the teams will place the 5cm x 5cm wood block on top of their structure. (The supervisor will not add the height of the block to the height of the tower measurement).
- Timing begins when teams place the mass on top of the wood block and remove their hand.
- Testing will end when the tower fails to hold the object or the end of the 10 seconds.
- The Event Supervisor or appointed judge will be the official timekeeper.

Event Supervisor Records:

- Height of tower to the nearest millimeter
- Area of the base of tower to the nearest millimeter²
- Time to structural failure to the nearest 1/100th of a second
- Amount of unused index cards by each team
- Team test score.

Scoring:

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first.

- 25% of team score: Teams receive a ranking based on their written test score.
- 75% of team score: Teams receive a ranking based on their tower. Teams with the highest tower and smallest area base will rank ahead of all others measured to the nearest millimeter and millimeter² (1mm) by the Event Supervisor or appointed judge.

Tiebreakers:

- Least amount of index cards.
- Time for structural failure.

Scoring Example:

Equation: (written test ranking x 0.25) + (building ranking x 0.75) = final ranking

- Team A ranks 3rd on the written test. This scores 0.75 ranking points. The team also scores 5th on their tower build. This scores 3.75 ranking points. The team's final ranking score is 4.5.
- Team B ranks 2nd on the written test. This scores 0.5 ranking points. The team also scores 7th on their tower build. This scores 5.25 ranking points. The team's final ranking score is 5.75.
- Team A is placed first in the rankings.

Possible Resources

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Tall Tower Challenge - TryEngineering.org Powered by IEEE](https://www.tryengineering.org/)

3rd Grade Wright Stuff – Darts Target on the Wall (30 Minutes - Based on Team Schedule)

Description: Teams will build two paper planes to try and accurately hit a target. This event may take place outside, inside, or both depending on site restrictions for events. If the event takes place outside it may be delayed or canceled if inclement weather with rain or lightning predicted, but not wind.



Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area. Talking to the team members any time during the competition. Violation of this rule will place the team below all other teams.

Safety Requirements:

Safety glasses labeled ANSI Z87.1+ (impact rated)

- All competitors must wear their eye protection during any competitor's flight phase of the competition.
- If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.
- If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.



Team members must bring:

Pencils, a ruler/straight edge, and/or scissors.

Materials Provided:

1 - 8 ½ x 11-inch 20-pound copy paper for each team member.

A timer accurate to the nearest 1/100 of a second.

The Competition:

Teams will be trying to hit the center of a target between 3- and 8-meters distance.

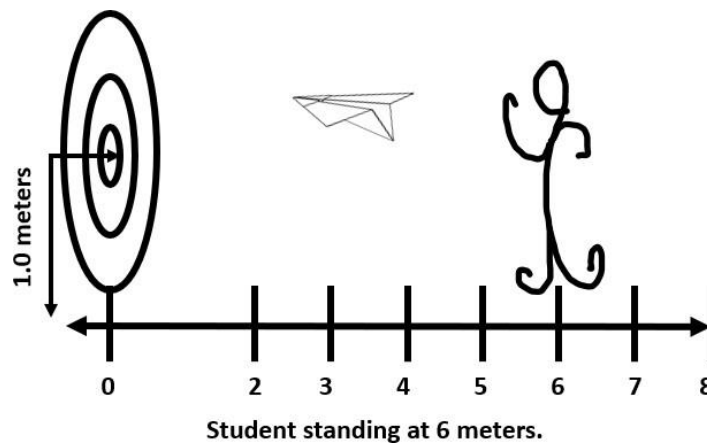
The estimated time to finish the written test and construction is 15 minutes and 45 minutes for the entire event.

Part 1 – Written Test and Construction Phase:

- The team members will take a test on the principles of glider flight.
- As a part of the written test the team will estimate the distance their “airplanes” will hit from the center of the target.
- The team will provide a chart showing testing results for the launching for a practice plane. The chart must contain a minimum of 5 practice launches and estimated flight times.
- The team members may use any type of plane design they desire except a wadded paper ball.
- The plane must have a wingspan of at least 10 cm.
- Team members must write their team designator on their plane.
- Team members may take practice up to 3 flights to adjust their plane.
- Practice flights will not count as an official flight.
- Team members must inform the Event Supervisor when they are ready for their official flight.

Part 2 – Flight Phase:

- All flights will start from a flat-footed position with both feet on the ground; No running or fast walking starts.
- Each team member will have 1 official launch.
- They will launch their planes at a target with a center point located 1 meter above the floor on a wall from their chosen start point between 2 and 8 meters from the wall.
- Each team member may choose a different start distance.
- Students may not artificially launch the plane.
- For tiebreaking purposes, the Event Supervisor will time the flight and timing will start when they see the plane leave the hand of a team member.
- During an official flight, time will continue if the plane bounces off an object but will stop when the plane gets stuck or comes to a complete rest.
- Team members will retrieve their plane only when prompted by the Event Supervisor after their official flight.



Scoring:

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first.

- 25% of team score: Teams receive a ranking based on their written test score.
- 75% of team score: Teams receive a ranking based on their distance to target. Teams with the smallest distance will rank ahead of all others measured to the nearest millimeter by the Event Supervisor or appointed judge.
 - Distance to target measurements will be the average of the two team members.
 - All teams will be ranked by their starting point, with teams starting further from the target receiving a better ranking. Team members may have different starting points.

Tiebreakers:

- Tiebreaker No. 1: The team with the closest measurement between their estimate and their distance to the center of the target for their first flight.
- Tiebreaker No. 2: Completeness of the team chart showing testing. Team members showing more testing details will be ranked above others. (Minimum requirement: 5 distance launches and 5 timed launches)

Scoring Example:

Equation: (written test ranking x 0.25) + (building ranking x 0.75) = final ranking

- Team A ranks 6th on the written test. This scores 1.5 ranking points. The team also scores 5th on their tower build. This scores 3.75 ranking points. The team's final ranking score is 5.25.
- Team B ranks 2nd on the written test. This scores 0.5 ranking points. The team also scores 7th on their tower build. This scores 5.25 ranking points. The team's final ranking score is 5.75.
- Team A is placed first in the rankings.

Possible Resources

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Basic dart, Flying Wing](#)
- [Dart Paper Airplane](#)

Air Rockets – Flying through the Hoop (45 Minutes - Coach Scheduled Event)

Description: Each team will build and fly a forced air propelled paper rocket using provided materials towards a target set at a distance while flying through an elevated hoop. This event may take place outside, inside, or both depending on site restrictions for events. If the event takes place outside it may be delayed or canceled if inclement weather with rain or lightning predicted, but not wind. This event has a written test.



Participants per team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Safety Requirements:

Safety glasses labeled ANSI Z87.1+ (impact rated)

- All competitors must wear their eye protection during any competitor's flight phase of the competition.
- If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.
- If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.



Team members must bring:

Safety glasses, a standard hexagonal unsharpened "#2 pencil." With a hexagonal height of 6 mm and 19 cm length, a ruler/straight edge, scissors, and a team chart showing testing results for a minimum of 2 rocket designs with 10 test flights per design created before the competition.

Materials Provided:

Each team will receive two sheets of 8 ½ x 11-inch 20-pound copy paper, 2 paper straws of unknown diameter, and cellophane tape. Teams may use no other materials.

The Competition:

**Teams will be trying to hit the center of a target between 2- and 8-meters distance while flying through a hoop.
The estimated time to finish the written test is 15 minutes and 45 minutes for the entire event.**

Part 1 – Written Test and Construction Phase:

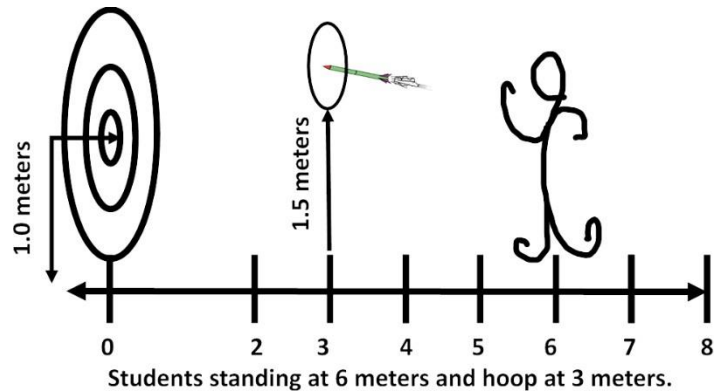
The team members will take a test on the principles of rocket flight. As a part of the written test the team will estimate the distance their "rocket" will hit from the center of the target.

- The team will provide a chart showing testing results for the launching of a practice "rocket". The chart must contain a minimum of 5 distances to target with launch and estimation times for each flight.
- Teams will have 20 minutes to build, weigh and may complete up to 3 test launches of 2 paper rockets of any design.
- Test launching will not occur at the same distance as the event target.
- There will be no extra time for testing.
- Teams will give one estimate for their distance to target without any penalties.

- An event judge will supervise the weighing of all rockets before flight.
- Teams must write their team number on their rocket.
- The flight phase will commence after each team has used their test launches.

Part 2 – Flight Phase:

- All launches will start from a flat-footed position with both feet on the ground; No running or fast walking starts.
- Using only the air in their lungs, the students will launch their rocket at a target with a center point located 1 meter above the floor on a wall from their chosen start point between 2 and 8 meters from the wall.
- Between the target and the start line will be a hoop with a diameter of between 15 and 20 cm at a height of 1.5 meters and halfway between their chosen start point and the wall.
- The rockets must pass through the hoop on the way to the target.
- Each team member may choose a different start distance.
- Students may not artificially launch the rocket.
- Each team member will have 1 official launch.
- For tiebreaking purposes, the Event Supervisor will time the flight with timing to start when they see the rocket launch by the student.
- During an official flight, time will continue if the rocket bounces off an object but will stop when the rocket gets stuck or comes to a complete rest.
- Team members will retrieve their rocket only when prompted by the Event Supervisor after their official flight.



Scoring:

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first. The distances and test score rankings will then be averaged to the 1/100 place value.

- 25% of team score: Teams receive a ranking based on their written test score.
- 75% of team score: Teams receive a flight ranking based on the below points.
 - The average of the two team members' flights.
 - All teams will be ranked based on their average start point; with teams starting further from the target receiving a better ranking. Team members may choose different starting points.
 - Teams will receive a ranking based on their average distance to the center of the target.
 - Teams not flying through the hoop will receive a tier violation.

Tiebreakers:

- Tiebreaker No. 1: The team with the closest measurement between their estimate and their distance to the center of the target for their first flight.
- Tiebreaker No. 2: Completeness of the team chart showing testing. Team members showing more testing details will be ranked above others. (Minimum requirement: 5 distance launches and 5 timed launches)
- Tiebreaker No. 3: The longest flight time.

Scoring Example:

Equation: (written test ranking x 0.25) + (building ranking x 0.75) = final ranking

- Team A ranks 3rd on the written test. This scores 0.75 ranking points. The team also earns 5th for their flight ranking. This scores 3.75 ranking points. The team's final ranking score is 4.5.
- Team B ranks 2nd on the written test. This scores 0.5 ranking points. The team also earns 7th for their flight ranking. This scores 5.25 ranking points. The team's final ranking score is 5.75.
- Team A is placed first in the rankings.

Possible Resources

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Student Project: Make a Straw Rocket | NASA/JPL Edu](#)
- [Lesson: Soda Straw Rockets](#)

Anatomy - Respiratory System (30 Minutes - Based on Team Schedule)

Description: This event tests participants' knowledge of the Respiratory System. This event has a written test and may/may not include "hands-on" stations.



Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Teams need to bring: Pencils and optionally a four-function calculator.

Safety Requirements: None

The Competition:

Students will take a written test to answer questions on the human respiratory system. The topics will include but are not limited to:

- Anatomy of the respiratory system
- The process of respiration - Pulmonary ventilation, Gas exchange, Transport of gas, Patterns of breathing, Regulation of respiration, Abnormal ventilation
- Spirometry, lung volumes & capacities
- Effect of exercise, high altitude, and aging on respiratory system
- Respiratory Disorders: Differentiate Restrictive & Obstructive Lung disease, Asthma, COPD, Respiratory Syncytial Virus (RSV), Common Cold and Pneumonia.

Scoring:

- Points will be awarded for each correct response.
- Ties will be broken by the accuracy or quality of answers to select questions chosen by the event leader prior to the competition.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [How Lungs Work | American Lung Association](#)
- [Respiratory system | Canadian Lung Association](#)

Brainstorm (45 Minutes - Coach Scheduled Event)

Description: Teams will receive a challenge at the competition. The challenge could be anything. For example, building a contraption, creating an ecosystem for an animal, or traveling to a distant star. The team will not have any advance notice of the topic.



Participants per Team: 2 to 3

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Safety Requirements: Safety glasses must be worn by all participants during any testing of any device.

Teams Need to Bring:

Safety glasses labeled ANSI Z87.1+ (impact rated)

- If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.
- If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.



- An Internet enabled device for researching the chosen topic and presenting their findings. Teams may bring one device per student. (Computer strongly recommended)
- Division A does not have technology to loan to students. Teams must provide their own for this event. It is up to the team to ensure they have connectivity at the competition site. Division A will not have onsite technology troubleshooting services.

Materials Provided at Event:

- Building materials if needed
- Classroom tools such as scissors and rulers if needed.

The Competition:

- The team of students will have a maximum of 30 minutes to construct a specified device and research, define and create a presentation for the challenge.
- All teams will be given the same building objective or challenge problem.
- The instructions will identify a device to build or a problem to solve:
- Examples of devices are the tallest tower to hold a baseball at the top; the longest bridge to hold a small milk carton full of sand in the center; the longest cantilever to hold a chalkboard eraser at the end; or a catapult to fire a marshmallow the furthest distance.

Challenge example: An Elephant is hungry and heading to your school cafeteria to eat lunch before you. How will you make it leave before eating everyone's lunch?

- If needed each team will be given tools and a bag containing the exact same type and number of building materials. Examples of materials are paper cups, drinking straws, paper clips, string, tape, paper,

thumbtacks, and Popsicle sticks. Materials are not limited to this list. The actual materials provided may be entirely different, but materials will be items that are readily available household items.

- Only those materials contained in the bag may be used to build the device.
- If the device is tested using any separate item(s) (e.g., support a load, launch a projectile, or roll a ball) item(s) of the specified characteristics (dimensions, mass, shape) will be available for each team to use in constructing/testing their device. Unless specifically stated in the instructions, devices must be freestanding and may not be attached to a tabletop, floor, ceiling, or other support.

Scoring:

Building Challenges

- Specific scoring will be provided to the teams at the event. Teams will be given the scoring information, including how ties will be broken, before they begin building.
- Teams will have 2 minutes to present their building solution.
- The dimensions specified in the building instructions will be measured and recorded as accurately as possible by the event leader.
- Devices that are required to accomplish a task (e.g., support a load for so many seconds) will be placed in tiers depending on whether they accomplish the task.
- Devices that accomplish the task will be ranked higher than all devices that do not.

Presentation Challenges

- Specific scoring will be provided to the teams at the event. A rubric will be provided for the task.
- Teams will have 2 minutes to present their challenge solution.
- Possible scoring points
- Is there evidence of team collaboration during the presentation?
- Have they created a creative solution to the challenge?
- Is there a solution based on scientific principles?
- Has the team acknowledged any limitations to their solution?

Tiebreaker

- Tiebreaks for either the building or the presentation challenge will be stated at the beginning of the event.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- Preparing for this event, teams may want to visit [SciOly.org](https://www.scioly.org) and study different building events.
- [Presentation Tips | DO-IT](#)

Bridge Building (45 Minutes - Coach Scheduled Event)

Description: Each team will build a strong, stable, and free-standing bridge from 25 paper drinking straws and 1 meter of tape. The team that builds the tallest bridge and holds an object for 10 seconds with the fewest straws will be the winner. This event has a written test component.



Participants per team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Safety glasses labeled ANSI Z87.1+ (impact rated)

- All competitors must always wear their eye protection during all phases of the competition.
- If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.
- If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.



Team Must Bring:

- Pencil, pen or marker, a ruler or straight edge, and one pair of scissors for each team member.

Materials Provided at Event:

25 paper drinking straws, 1 meter of 2.54 cm tape, an object with a mass no less than 100 grams and no more than 500 grams, 2-5 cm x 9.5 cm x 30.5 cm support structures, and a 5cm by 5cm loading block.

The Competition:

Construction Phase and Written Test: Timed 25 Minutes

- Teams will construct a bridge that is able to support an object placed on the loading block by the team and in the center of their bridge deck at a right angle to the length of the bridge.
- The bridge must have a width of at least 6 cm, outside edge to outside edge, with any length using the materials provided.
- The length and diameter of straws and the type of tape for this competition will remain secret until the day of the competition.
- The Event Supervisor will announce on the day of the competition the object and the mass of the object each bridge will have to hold. The mass of the object will be no less than 100 grams and no more than 500 grams.
- The bridge must support the object for one minute, with partial points given for any time above 10 seconds.
- Teams may cut both the straws and the tape into any shape or size. Teams may crimp and slide the straws inside each other.
- The Event Supervisor will record the number of complete straws left for each team.
- Any team using any tools or materials other than those listed above will receive a tier violation and be ranked below all other teams.

Bridge Testing Phase:

- The students will take a short test on bridge types.
- Teams will place their bridge on a flat and level surface such as a tabletop or floor.
- The Event Supervisor will measure and record the height to the nearest millimeter (1mm).
- The team will then place the 5cm by 5cm loading block in the center of the bridge deck.
- The Event Supervisor will start the team's time when the weighted object is placed on the 5cm-by-5cm block.
- During their minute the team may not touch or move their bridge without incurring a tier violation.
- No sticky part of the tape may touch the top or sides of the testing surface.
- Testing will end when the bridge fails to hold the weight, any part of the bridge sags and touches the tabletop, or the end of ten seconds.
- The Event Supervisor or appointed judge will be the official timekeeper.

Event Supervisor Records:

- Height of the bridge at the highest center point.
- Time to structural failure.
- Amount of unused whole straws by each team.

Scoring:

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first.

- 25% of the team score is a ranking based on the team's written test score.
- 75% of the team score is a ranking based on the team's height of their bridge measured at the center point.
- Teams in Tier 1 will be ranked from highest to lowest, followed by any teams with Tier 2 building penalties.

Tiebreaker:

- The least number of whole straws used.
- Time to structural failure

Scoring Example:

Equation: (written test ranking x 0.25) + (building ranking x 0.75) = final ranking

- Team A ranks 3rd on the written test. This scores 0.75 ranking points. The team also scores 5th on their tower build. This scores 3.75 ranking points. The team's final ranking score is 4.5.
- Team B ranks 2nd on the written test. This scores 0.5 ranking points. The team also scores 7th on their tower build. This scores 5.25 ranking points. The team's final ranking score is 5.75.
- Team A is placed first in the rankings.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Bridge - Wiki - Scioly.org](#)
- [What Makes Bridges So Strong? | Engineering for Kids | STEAM | SciShow Kids](#)
- [Straw Bridges - The Stem Laboratory](#)

Crave the Wave - (Online Event - Based on Team Schedule)

Description: This event tests participants' knowledge of waves. This event has a written test and may/may not include "hands-on" stations.



Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Teams need to bring: Pencils and an Internet enabled device for taking the test through Scilympiad. Optionally teams may bring a four-function calculator.

Safety Requirements: None

The Competition:

Students will take a written test to answer topic questions on the waves. The questions may include but are not limited to:

- Waves & Categories of waves
- Longitudinal, Transverse, Surface, Electromagnetic, Mechanical
- Understanding of Light, Sound, and Seismic Waves
- Properties of Waves
- Anatomy of a wave (Crest, Trough, Amplitude, Wavelength, Compression, Rarefaction)
- Frequency, Period, Speed, Wave equation
- Reflection, Refraction, and Diffraction
- Interference
- Doppler Effect

Scoring:

- Points will be awarded for each correct response.
- Ties will be broken by the accuracy or quality of answers to select questions chosen by the event leader prior to the competition.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Crave the Wave - Wiki - Scioly.org](https://www.scioly.org/wiki/Crave_the_Wave)

Data Investigations (30 Minutes - Based on Team Schedule)

Description: This event tests participants' knowledge of creating and interpreting data tables and graphs. This event has a written test and may/may not include "hands-on" stations.



Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Teams need to bring: Pencils, and a four function Calculator.

Safety Requirements: None

The Competition:

Teams will demonstrate understanding of this content in any or all of the following ways:

- Collect data with metric measuring devices (length, mass, or volume) and represent that data in a correctly labeled graph or data table
- Plot data points, make and interpret data tables, draw and interpret graphs, including what trends can be predicted from the data shown
- Make estimates of data between or beyond the data points given.
- Calculate fractions or percentages based on charts, tables or data.
- Calculate the mean, median, and mode for a set of data.
- Distinguish between accuracy and precision and identify outliers in a set of data.
- Identify types of questions (numerical, categorical, data that changes over time) when collecting data.

Scoring:

- Points will be awarded for each correct response.
- Ties will be broken by the accuracy or quality of answers to select questions chosen by the event leader prior to the competition.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Data Crunchers | NC Science Olympiad](#)

Dynamic Planet – Plate Tectonics (30 Minutes - Based on Team Schedule)

These rules will be in effect for both the 3rd grade and the regular session. If 3rd graders attend the 3-5 student sessions, they will not receive scores for the 3rd grade session. 4th and 5th graders may not attend the 3rd grade session.



Description: Teams will demonstrate their understanding of plate tectonics and how it relates to continental drift. This event has a written test and may/may not include “hands-on” stations.

Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area. Talking to the team members any time during the competition. Violation of this rule will place the team below all other teams.

Teams need to bring: Pencils

Safety Requirements: None

The Competition:

Teams will answer questions on a written test. Topics may include but not limited to:

- Mechanical & Chemical division of Earth’s layers
- Driving forces of plate tectonics
- Plate boundaries & features found at plate boundaries
- Understanding of continental rifting, seafloor spreading, Island arcs, Back-arc basins, Mountain building, Polar wandering
- Evidence of plate tectonics
- Identification of major tectonic plates

African Plate	Cocos Plate	North American Plate
Antarctic Plate	Eurasian Plate	Pacific Plate
Arabian Plate	Indian Plate	Philippine Plate
Australian Plate	Juan de Fuca Plate	Scotia Plate
Caribbean Plate	Nazca Plate	South American Plate

Scoring:

- Points will be awarded for each correct response.
- Ties will be broken by the accuracy or quality of answers to select questions chosen by the event leader prior to the competition.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Scilympiad - Dynamic Planet/Tectonics](#)

Fermi Questions (30 Minutes - Based on Team Schedule)

Description: This event tests participants' ability to provide rough estimates of a quantity to a series of Fermi Questions.



Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area. Talking to the team members any time during the competition. Violation of this rule will place the team below all other teams.

Teams need to bring: Pencils, and Scrap paper. A four-function calculator is a big must.

Safety Requirements: None

The Competition:

In physics or engineering education, a Fermi problem (or Fermi quiz, Fermi question, Fermi estimate), also known as order-of-magnitude problems (or order-of-magnitude estimate, order estimation), is an estimation problem designed to teach dimensional analysis or approximation of extreme scientific calculations, and such a problem is usually a back-of-the-envelope calculation.

- Example of a Fermi question: How many pennies would it take to make a stack the height of Mt. Everest? The students will be given the height of Mt. Everest but will not receive the thickness of a penny.
- The Event Supervisor will provide not commonly known values, namely distance between the US & Australia or how much an aircraft carrier weighs. The students are however expected to estimate measurements of things they come across on a daily basis, namely the thickness of a penny or paper.

All answers are to be written to the correct power of ten (exponent) as follows:

- For a number in the form $C \times 10^E$, the guide for rounding of the coefficient (C) is: if C is 5 or greater (to 9.99...), round C up to 10. For example, if the number is
- 5.001×10^3 , the correct power of ten is 4. Responses recorded as 5.001×10^3 will be
- marked as incorrect. If C is below 5 (and greater than 1), round C down to 1. For example, if the number is 4.99×10^6 , you record 6 as your answer.
- Positive exponents are the default. For negative exponents, the minus (-) sign must be included in the answer. If the number is 1.5×10^{-3} , the correct power of ten is -3.

Students may be asked questions related to these units:

- Length - Common units of length in metric and standard systems, including inch, foot, yard, furlong, rods, and chains
- Mass - Common units of mass in metric and standard systems, including ounce, pound, tons, milligrams, grams, kilograms, and metric tons
- Time - Millennium, Century, Score, Decade, Year, Month, Day, Hour, Minute, Second, Millisecond.
- Volume - Common units of volume in metric and standard systems, including milliliters, liters, cubic meters, cubic centimeters, gallons, quarts, pints, cups, tablespoons, and standard barrels
- The Event Supervisor will give the students a formula/conversion sheet of any uncommon measurements for this test.

Scoring:

Method of scoring - Points are scored if the response is:

- Equal to the accepted value: 5 points
- ± 1 of the accepted value: 3 points
- ± 2 of the accepted value: 1 point

High score wins.

Tiebreakers:

- Ties are broken by counting the highest number of answers that receive five (5) points. If the number of 5-point answers is the same, the number of 3-point answers will be used. Time is used as the third tiebreaker, if needed.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Fermi Questions](#) from Scioly.org
- [Fermi Questions](#) from Science Olympiad

Forestry (30 Minutes - Based on Team Schedule)

Description: This event tests participants' knowledge of native trees of Virginia. This event has a written test and may/may not include "hands-on" stations.



Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.
- It is further a rules violation for a parent, mentor, or coach to research this event on behalf of the students.

Teams need to bring: Pencils and the team Field Report. Optionally teams may bring one field guide, a hand lens, and a 4-function calculator.

Safety Requirements: None

The Competition:

There are three parts to this event:

Part 1: Students will submit a field report.

- It can be a visit to a local nature park, their backyard, school garden, or their neighborhood
- They will identify 3 - 5 trees on this trip and submit the details on how they identified the trees - sketches of the features, images.
 - The team at a minimum have three identifications.
 - A list of birds and animals that use each tree for food or shelter.
 - Research and explain how native Virginians used the parts of the trees.
 - With a length of no more than 2 double-sided pages.
 - The team report must include the school, student names, team number, and a declaration by the team that they did not have any help writing the report.

Part 2: Students will take a written test to answer topic questions that may include but not limited to:

- Common identification terminology used in identifying trees.
- Forest types.
- Forest succession.

Part 3: Hands-On Stations (if run): Students will identify trees based on real or images of leaves.

Scoring:

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first.

- 75% of team points will be awarded for each correct response on the written test and the hands-on stations.
- 25% of team points will be awarded for the team written report.
- Ties will be broken by the accuracy or quality of answers to select questions on the written test chosen by the event leader prior to the competition.

Scoring Example:

Equation: (written test ranking x 0.75) + (report ranking x 0.25) = final ranking

- Team A ranks 4th on the written test. This scores 3 ranking points. The team also scores 5th on their report. This scores 1.25 ranking points. The team’s final ranking score is 4.25.
- Team B ranks 2nd on the written test. This scores 1.5 ranking points. The team also scores 7th on their report. This scores 1.75 ranking points. The team’s final ranking score is 3.25.
- Team B places first in the rankings.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Virginia Department of Forestry](#)

Competition Tree List:

Eastern White Pine	Eastern Redcedar	Eastern Hophornbeam
Black Oak	Fraser Magnolia	Sugar Maple
Shortleaf Pine	Black Willow	American Hornbeam
Scarlet Oak	Yellow-Poplar	Red Maple
Loblolly Pine	Eastern Cottonwood	American Beech
Blackjack Oak	Pawpaw	Silver Maple
Longleaf Pine	Bigtooth Aspen	American Chestnut
Pin Oak	Sassafras	Striped Maple
Pitch Pine	Black Walnut	Allegheny Chinkapin
Water Oak	Sweetgum	Yellow Buckeye
Virginia Pine	Butternut	White Oak
Willow Oak	Sycamore	American Basswood
Pond Pine	Bitternut Hickory	Post Oak
American Elm	Downy Serviceberry	Flowering Dogwood
Table Mountain Pine	Shagbark Hickory	Chestnut Oak
Slippery Elm	Black Cherry	Sourwood
Red Spruce	Mockernut Hickory	Swamp Chestnut Oak
Winged Elm	Eastern Redbud	Black Gum
Eastern Hemlock	Pignut Hickory	Live Oak
Hackberry	Honey Locust	Water Tupelo
Bald Cypress	River Birch	Laurel Oak
Red Mulberry	Black Locust	Common Persimmon
Atlantic White-Cedar	Yellow Birch	Northern Red Oak
Cucumber Tree	American Holly	White Ash
Northern White-Cedar	Sweet Birch	Southern Red Oak
Sweetbay	Boxelder	Green Ash

Gravity Vehicle (Coach Scheduled Event – 45 Minutes)

Description: Teams will build a device out of given materials to travel a distance while holding a golf ball and stopping as close to a designated finish point as possible. All building of devices will take place during the competition. This event will have a short-written test about the basics of gravity.



Participants per team: 2

Spirit of the Competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area, or talk with team members at any time during the competition. Violation of this rule will place the team below all other teams.

Team Needs to Bring:

Something to write with and may bring only 1 picture no larger than 8.5" x 11" of their device concept. This must be 1 picture, not a collage. No other resources are allowed.

Safety Requirements:

Safety glasses labeled ANSI Z87.1+ (impact rated)

- Glasses must be worn during all practice and test runs.
- If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.
- If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.



Materials Provided at Event:

- Building materials may include (but not limited to) K'nex pieces, Lego bricks, wooden blocks, popsicle sticks, pipe cleaners, wheels, wooden dowels etc. Materials provided will be easily available household 'craft' items.
- Gravity Car Ramp with a starting height of less than 1 meter.
- Golf Ball
- Masking tape or any sticky substance needed to create the device may be given for this event.

The Competition:

Part 1 – Written Test

- The team members will take a test on the principles of gravity.
- As a part of the written test the team will estimate how close their vehicle will stop from the center of the target in millimeters.
- The estimated time to finish the written test is 15 minutes and 45 minutes for the entire event.

Part 2 – Construction and Competition General Information

Teams will build a 3 or 4 wheeled device out of the given materials to travel down a ramp and up to a distant target point.

- The event supervisor will state the exact distance on the day of competition.
- The device will be powered solely by the gravitational energy of rolling down a ramp.
- The device must have a fixed piece of material extending above its front edge and close to the track surface. The point directly below this material will be used to measure the scoring distance.
- The device must transport a golf ball, that must remain in the device, until the Event Supervisor completes

the competition measurements.

The Ramp:

- Will have multiple start lines at 20 cm intervals for the students to choose from.
- It will be at least 50 centimeters tall with the exact measurement given on competition day.

The Track:

- The track will be a relatively smooth, hard surface. Most likely a classroom, hallway, or gym floor.
- A target point will be marked and announced at either 4.0, 4.5, 5.0, 5.5, or 6.0 meters.
- A center line will extend from the center front of the ramp in a straight line to the finish point.
- Teams will have a maximum of 30 minutes to construct and test their device.
- Teams that complete and test their device early may complete their official runs early.
- Teams may have up to 3 test runs with their device during the build time.
- Teams may not modify their device after the construction period has ended.

Official runs:

- When the team is ready for official testing, they will notify the Event Supervisor.
- Teams will have 2-minutes to make 2 official runs.
- The team may position the device on the ramp at any of the start lines and in any way.
- No part of the device except the fixed point may touch (or hover above) the start line.
- Teams may adjust the angle of the ramp left or right of the center line, but may not move it forward, backward or side to side.
- When teams have permission from the Event Supervisor, they will release their device to start official runs.
- They cannot push the device.
- Teams may not chase their device down the track, they must wait until they are called by the Event Supervisor to retrieve their device.
- Event Supervisors will measure from the center of the finish point to the fixed point on the front of the device. If there is no fixed point, judges will measure to the furthest point on the device from the finish point.
- If the golf ball or any other part of the device comes off, the Event Supervisor will use its placement as the point of measurement.

Scoring:

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first.

- 75% - Teams will be ranked based on the averaged straight-line distance for their two runs from the fixed point on the device to the center of the finish point, measured to the nearest millimeter (or from the part or golf ball should they fall off).
- 25% - Teams will be ranked based on their written test score.
- Teams will be placed in tiers based on adherence to the challenge instructions. Within each tier, teams will be ranked based on the scoring criteria for the challenge.
- Tier 1: Teams with no violations.
- Tier 2: Teams whose device loses a part or has golf fall out.

Tiebreakers:

1. Teams will be ranked based on the difference between their estimated distance and their averaged actual distance.
2. Further ties will be broken by finding the best team measurement closest to the finish point for one run.

Scoring Example:

Equation: (written test ranking x 0.25) + (building ranking x 0.75) = final ranking

- Team A ranks 3rd on the written test. This scores 0.75 ranking points. The team also scores 5th on their distance. This scores 3.75 ranking points. The team's final ranking score is 4.5.
- Team B ranks 2nd on the written test. This scores 0.5 ranking points. The team also scores 7th on their distance. This scores 5.25 ranking points. The team's final ranking score is 5.75.
- Team A places first in the rankings.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Gravity Vehicle - Wiki - Scioly.org](#) – This resource is from Division B and C and may not have enough information to help with the Division A event.

Hydraulics (45 Minutes - Coach Scheduled Event)

Description: Each team will build a device that will use a hydraulic system to accomplish a task. This event has a written test.



Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Safety Requirements:

Safety glasses labeled ANSI Z87.1+ (impact rated)

- Glasses must be worn during all practice and test runs.
- If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.
- If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.

Indirect Vent Goggles



ANSI Z87.1-2015 certified and meets CE EN166 & D3 Splash/Droplet standards.
Eyeglasses and Safety Glasses are not safety rated for this event!

Team members must bring:

- Pencils and scissors
- Optionally the team may bring a straight edge measuring device

Materials Provided:

- 1 meter of masking tape
- 2 brass brads
- 2-12 ml syringes
- 50 cm of PVC Tubing 1/8"ID X 1/4"OD Flexible Clear Vinyl Hose
- 20 Craft Ice Sticks with Holes
- Water

The Competition:

The estimated time to finish the written test is 15 minutes and 45 minutes for the entire event.

Part 1 – Written Test: The team members will take a test on the principles of hydraulics.

Part 2 – Building Phase:

- Each team will have the same task to build a device that uses hydraulics to perform a task. Examples: a drawbridge, a door opener, a lifting device, etc.
- The nature of the device will not be advertised in advance of the competition.
- The teams do not have to use all of their materials but must use at a minimum both syringes.
- Only those materials provided may be used to build the device.
- If the device is tested using any separate item(s) (e.g., support a load, launch a projectile, or roll a ball) item(s) of the specified characteristics (dimensions, mass, shape) will be available for each team to use in constructing/testing their device. When finished building, students must remove the item from their device testing by the judges.

- The team will have a maximum of 30 minutes to construct the specified device.
- Unless specifically stated in the instructions, devices must be freestanding and may not be attached to a tabletop, floor, ceiling or other support.

Scoring:

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first.

- 25% of team score: Teams receive a ranking based on their written test score.
- 75% of team score: Teams receive a ranking based on their tower. Teams with the highest tower and smallest area base will rank ahead of all others measured to the nearest millimeter and millimeter² (1mm) by the Event Supervisor or appointed judge.
- Specific scoring of the team build will be provided to the teams at the event. Teams will be given the scoring information, including how ties will be broken, before they begin building.
- The dimensions specified in the building instructions will be measured and recorded as accurately as possible by the Event Supervisor.
- Devices are required to accomplish a task (e.g., lift a load for so many seconds) and will be placed in tiers based on whether or not they accomplish the given task.
- Devices that accomplish the task will be ranked higher than all devices that do not.

Scoring Example:

Equation: (written test ranking x 0.25) + (building ranking x 0.75) = final ranking

- Team A ranks 3rd on the written test. This scores 0.75 ranking points. The team also scores 5th on their hydraulics build. This scores 3.75 ranking points. The team's final ranking score is 4.5.
- Team B ranks 2nd on the written test. This scores 0.5 ranking points. The team also scores 7th on their hydraulics build. This scores 5.25 ranking points. The team's final ranking score is 5.75.
- Team A is placed first in the rankings.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Young Engineers: Easy Hydraulic or Pneumatic Machine - Engineering Projects for Kids](#)
- [Modern Marvels: Hydraulic Force Transforms Society \(S11, E17\) | Full Episode | History](#)

Machines (30 Minutes - Based on Team Schedule)

Description: This event tests participants' knowledge of machines. This event has a written test and may/may not include "hands-on" stations.



Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area. Talking to the team members any time during the competition. Violation of this rule will place the team below all other teams.
- It is further a rules violation for a parent, mentor, or coach to research this event on behalf of the students.

Teams need to bring: Pencils, and the team written report. Optionally a four-function calculator.

Safety Requirements: None

The competition:

Part 1 - Teams will submit a written report on a common household compound machine. The team report must include the school, student names, team number, and a declaration by the team that they did not have any help writing the report. With a length of no more than 3 single sided pages.

The report must include:

- The simple machines that make up the compound machine
- How it makes life easier
- A history of the machine
- A short a list of references or bibliography
- Teams may want to, but do not have to include:
 - Patent numbers and registrations
 - Information about the company that made the machine
 - Any improvements they can make to the machine

Part 2 - Teams will answer questions but not limited to what is listed below.

- Energy, force, motion, and work
- Types of simple machines
- Differences between simple and compound machines
- Identifying the simple machines within a compound machine
- Calculation of ideal and mechanical advantage, efficiency, load, and effort

Scoring:

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first.

- 75% of team points will be awarded for each correct response on the written test.
- 25% of team points will be awarded for the team written report.
- Ties will be broken by the accuracy or quality of answers to select questions on the written test chosen by the event leader prior to the competition.

Scoring Example:

Equation: (written test ranking x 0.75) + (team report x 0.25) = final ranking

- Team A ranks 3rd on the written test. This scores 2.25 ranking points. The team also scores 5th on their report. This scores 1.25 ranking points. The team's final ranking score is 3.5.
- Team B ranks 2nd on the written test. This scores 1.5 ranking points. The team also scores 7th on their report. This scores 1.75 ranking points. The team's final ranking score is 3.25.
- Team B is placed first in the rankings.

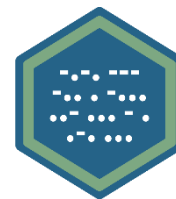
Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [USPTO : United States Patent and Trademark Office](#)
- [Machines - Wiki - Scioly.org](#)

Morse Codebusters (45 Minutes - Coach Scheduled Event)

Description: Teams will create a simple lighted telegraph to send and receive messages in morse code between two stations placed between 1 and 2 meters apart.

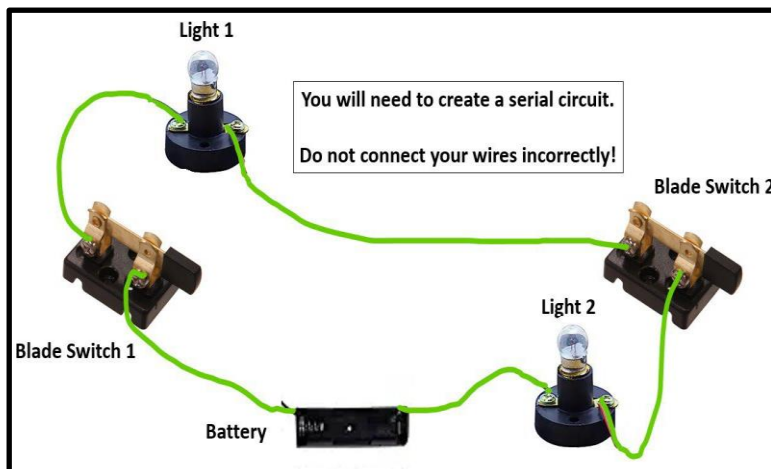


Participants per team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Safety Requirements: DO NOT TOUCH WIRES TOGETHER!



Materials:

- Teams may bring writing utensils and blank scratch paper.
- The Event Supervisor will provide materials: batteries and holders, wires, lights and holders, switches and a privacy divider. Only the materials provided can be used.
- Teams may not use any externally sourced resource materials or research notes during the competition.

The Competition:

- This is a timed event with teams sending, decoding and replying to as many messages within a 10-minute session.
- Teams will build a simple two station lighted telegraph.
- Teams are not allowed to communicate with each other during the sending and receiving of messages, except through morse code.
- Each team member will alternate sending, decoding and replying to messages.
- Each message sent will be in the form of a question related to the history of Morse Code.
- No message will have a readability higher than 9th grade.
- Each team member will write down their decoding of the message they receive and the answers they send.
- Teams may use only traditional abbreviations and prosigns to send their messages.
- Time will not stop between messages.

Scoring:

- The high score wins.
- Teams scores are calculated on the total number of correct messages coded, deciphered, and answered in

the shortest amount of time measured to the nearest 1/10 of a second.

Tie Breakers:

- Teams that create a correct and working circuit will rank ahead of all others
- Time teams take to complete their first message

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Morse Code: The Ultimate Archive | The Daily Dabble](#)
- [How to Use Morse Code With Light | The Daily Dabble](#)
- [How to Learn Morse Code](#)
- [Morse Code Translator](#)

Optics (30 Minutes - Based on Team Schedule)

Description: Teams will participate in an activity involving the positioning of mirrors to direct a laser beam towards a target. The event has a written test on the geometric and physical concepts of optics.



Participants per team: 2 or 3

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Safety Requirements:

- No AC power will be used.
- The Event Supervisor will operate the laser.
- Division A uses a Class 2 Laser Pointer: A Class 2 laser is safe because the blink reflex will limit the exposure to no more than 0.25 seconds. It only applies to visible-light lasers (400-700 nm). Class-2 lasers are limited to 1 mW continuous wave, or more if the emission time is less than 0.25 seconds or if the light is not spatially coherent. Intentional suppression of the blink reflex could lead to eye injury. Many laser pointers are class 2.

Teams must bring:

- Sharpened pencils (2-3), Protractor, and a Ruler. Optionally a four-function calculator.

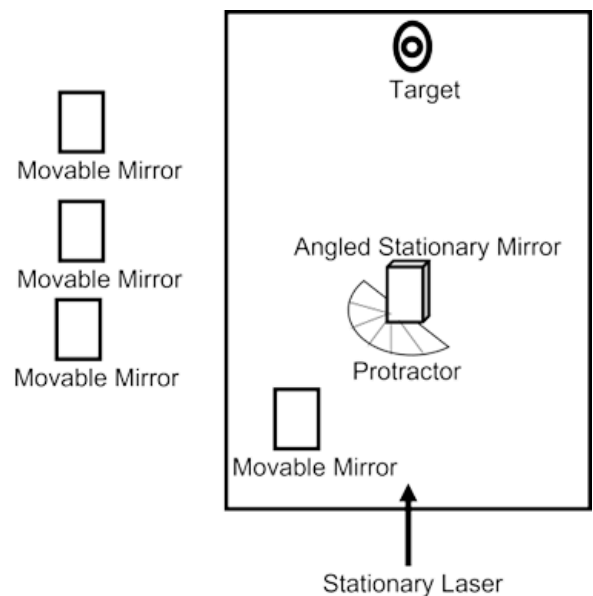
Materials provided at event:

- Event supervisors will provide mirrors, a class 2 laser, 1 stationary and 4 movable mirrors.
- Event supervisors will provide a paper exam based on the vocabulary listed below.
- Target size 2 cm diameter
- Mirror size \approx 6.5 cm by 7.5 cm

The Competition: *The practical application will take place during the knowledge test. Teams will be called one at a time for the practical application.*

Part 1 - Practical application:

- Teams will use up to 4 mirrors to direct a beam of light from a stationary laser pointer mounted inside 50 cm by 30cm device.
- The device will have a mounted laser pointer, a stationary target, and an angled stationary mirror.
- The angle of the stationary mirror will not be known until the day of the competition and will only be posted in the testing room.
- Teams will use one movable and the stationary mirror to bounce a light to the target within three minutes.
- Teams may not move the mirrors after they have been set or during the operation of the laser pointer.
- Teams receive a bonus, up to three, for each extra mirror used to reach the target.
- Teams will have 2 minutes to direct the beam of light



- through as many mirrors as possible.
- Teams may move and adjust their mirrors after each laser pointing but may not exceed the three-minute total time limit.
- Teams must use a minimum of two mirrors to hit the target, one of them being the stationary mirror
- A protractor will be placed under the stationary mirror.
- Teams may use their own protractor when setting bonus mirrors.
- The Event Supervisor or designee will time the teams.

Part 2 - Knowledge Application:

Teams will demonstrate their understanding of basic optics, and light properties. Vocabulary is limited to the provided list.

absorb	amplitude	concave	convex
crest	electromagnetic	electromagnetic spectrum	energy
frequency	infrared	lens	mirror
opaque	radiation	rainbow	reflect
reflection	refract	refraction	solar radiation
spectrum	translucent	transmit	transparent
trough	ultraviolet	visible light	visible spectrum
wave	wave speed	wavelength	white light

Scoring:

Teams receive cumulative points:

- 1 point for each whole second under three minutes (time is rounded to the nearest second) used to complete the first mirror task.
- 5 points for each mirror used after the stationary and first mirror (maximum 15 points).
- 1 point for each correct response on the written test

Tiebreakers:

- 1st Tiebreaker – time
- 2nd Tiebreaker – targets hit
- 3rd Tiebreaker - the accuracy or quality of answers to selected questions chosen by the Event Supervisor prior to competition.

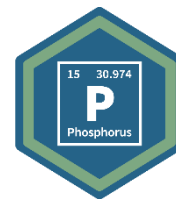
Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Optics | Science Olympiad](#)

Periodic Table (30 Minutes - Based on Team Schedule)

Description: This event tests participants' knowledge of atoms and the trends seen in the Periodic Table. This event has a written test and may/may not include "hands-on" stations.



Participants per team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Teams need to bring: Pencils. Optionally a four-function calculator. Teams **may not** bring notes or resources of any type.

Safety Requirements: None

The Competition:

Part 1 - Students will answer questions on a written test not limited to the topics listed below.

Atomic Structure:

Atoms, Protons, Neutrons, Electrons
Atomic and Mass Numbers
Isotopes
Chemical Symbols

Atomic Bonding:

Ionic
Covalent
Metallic

Periodic Table:

Groups
Periods
Properties of Periodic table groups
Trends

Part 2 – Hands-On Station(s). This may or may not be run each year. Students should always prepare for hands-on to run.

- Students will receive a set of materials to build a simple molecule or atom of elements on the periodic table.

Scoring:

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first.

- 75% of team points will be awarded for each correct response on the written test.
- 25% of team points will be awarded for the team atom/molecule build.
- Ties will be broken by the accuracy or quality of answers to select questions on the written test chosen by the event leader prior to the competition.

Scoring Example:

Equation: (written test ranking x 0.75) + (team build x 0.25) = final ranking

- Team A ranks 3rd on the written test. This scores 2.25 ranking points. The team also scores 5th on the team build report. This scores 1.25 ranking points. The team's final ranking score is 3.5.
- Team B ranks 2nd on the written test. This scores 1.5 ranking points. The team also scores 7th on the team build. This scores 1.75 ranking points. The team's final ranking score is 3.25.
- Team B is placed first in the rankings.

Possible Resources:

- [The Periodic Table Lesson for Kids: Structure & Uses - Video & Lesson Transcript | Study.com](#)
- [Protein Modeling - Wiki - Scioly.org](#) – This resource may not help students with this event but has valuable information on how molecules may be represented.

Rubber Band Car (45 Minutes - Coach Scheduled Event)

Description: Teams will build a simple 3-wheeled vehicle that uses power provided through an elastic source to travel a specified distance within a specified area.



Participants per team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Safety Requirements:

Safety glasses labeled ANSI Z87.1+ (impact rated)

- All competitors must wear their eye protection during any competitor's flight phase of the competition.
- If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.
- If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.



Materials Provided:

- Three – ≈4 cm plastic wheels
- Two – ≈7.5 cm cooking skewers
- One – ≈20 cm paper straw
- One – ≈11 cm by ≈9 cm piece of cardboard
- 50 cm of masking tape
- 2 Rubber bands – student choice from an assortment of sizes #64, #33, and #19

The Competition:

The estimated time to finish the written test is 15 minutes and 45 minutes for the entire event.

Teams will be trying to stop at the center of a target between 5- and 10-meters distance.

Part 1 – Written Test: The team members will take a test on the principles of elasticity.

As a part of the written test the team will estimate the distance their vehicle will stop from the center of the target.

Part 2 – Construction Phase:

- The Event Supervisor will announce the distance to the target center on the day of the competition.
- Teams will use their materials to build a 3 wheeled vehicle.
- Each team will have one scored run.
- Teams may cut their materials to any size they deem appropriate.
- Teams may not request any additional materials. A request will result in a tier violation. This means that the team may still participate but will be placed below all teams that do not violate this rule.
- Teams will have 40 minutes to build and test their car in the competition area. Teams may test their car at any time during this time with permission of the Event Supervisor.
- Releasing a car down the track without permission of the Event Supervisor during both the testing and scoring phases of the competition will result in a tier violation.

- Teams must state their intent that they are ready to launch and must wait for the Event Supervisor to acknowledge their intent.
- Teams may ask for their scored run at any time during the competition.

Scoring:

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first

- 75% - Teams will be ranked in order with the team whose car comes the closest to the marked end point measured to the nearest millimeter ranked first.
- 25% - Teams will be ranked based on their written test score.
- Tier 1: Teams with no violations.
- Tier 2: Teams whose device loses a part or has golf fall out.

Scoring Example:

Equation: (written test ranking x 0.25) + (car ranking x 0.75) = final ranking

- Team A ranks 3rd on the written test. This scores 0.75 ranking points. The team also scores 5th on their distance. This scores 3.75 ranking points. The team’s final ranking score is 4.5.
- Team B ranks 2nd on the written test. This scores 0.5 ranking points. The team also scores 7th on their distance. This scores 5.25 ranking points. The team’s final ranking score is 5.75.
- Team A places first in the rankings.

Tiebreakers:

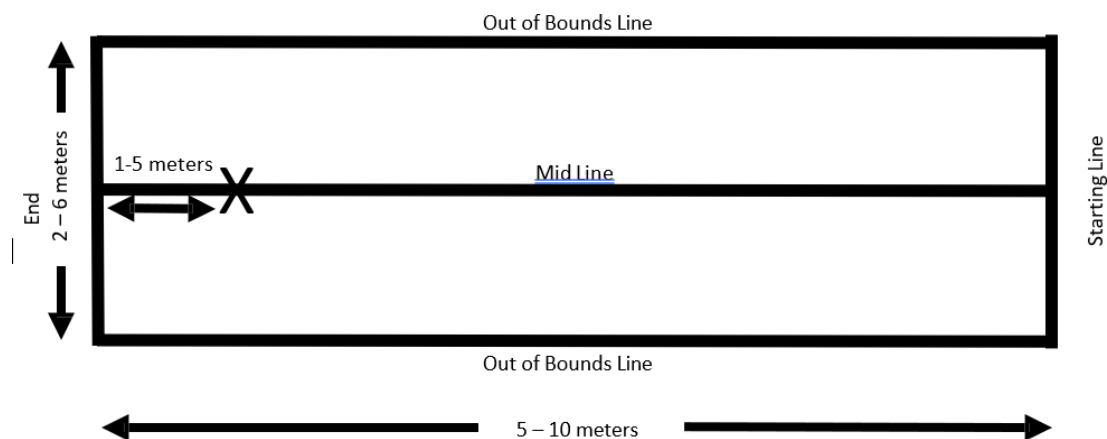
1. Teams will be ranked based on the difference between their estimated distance and their averaged actual distance.
- Further ties will be broken by finding the best team measurement closest to the finish point for one run.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Build a Rubber Band–Powered Car - Scientific American](#)

Example of the Elastic Vehicle Course



Rubber Band Helicopter (45 Minutes - Coach Scheduled Event)

Description: Contestants will build and test one paper cup helicopter of any design using the materials provided at the competition.



Participants per team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Safety Requirements:

Safety glasses labeled ANSI Z87.1+ (impact rated)

- All competitors must wear their eye protection during any competitor's flight phase of the competition.
- If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.
- If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.



Teams Need to Bring:

- Pencils, a ruler/straight edge, scissors, and a team chart showing testing results for flying a practice helicopter on a ≈22 cm by 30 cm sheet of paper. Minimum requirement: 6 tests with different rubber band sizes, with and without weights.

Materials Provided at Event:

- 1 ≈15cm Propeller
- 1 ≈Craft Stick
- 1-Jumbo Paperclip
- 2- Rubber bands – student choice from an assortment of sizes #64, #33, and #19
- 1-Sheet of Card stock ≈22 cm by 30 cm.
- 50 cm of 2.54 cm Masking tape
- 1 ≈ 150 ml Paper Cup
- 2 ≈ 1.6-gram tin split shot fishing weights
- Pliers

The Competition:

The estimated time to finish the written test is 15 minutes and 45 minutes for the entire event.

The written test and the construction phase may occur simultaneously.

Teams will be trying to have their helicopter hover without touching the highest point in the launch area.

Part 1 – Written Test: Timed 15 minutes

The team members will take a test on the principles of rotary flight.

As a part of the written test the team will estimate the time their helicopter will stay aloft.

Part 2 -Construction Phase: Timed 15 Minutes

Teams will build their helicopter using any of the materials provided. They do not have to use all of the materials provided.

- If the team chooses to use the weights a pair of pliers will be available.

- Rotation of the helicopter (clockwise, counterclockwise, horizontal, or vertical) is a team choice.
- The height distance will be announced during the building phase.
- Contestants may test their devices in the building area, and at the discretion of the event supervisor, test them from the official launch location.
- Teams must write their team number on their helicopter.
- During the construction phase the team will give the Event Supervisor their estimate for the time that their helicopter will stay airborne without touching the highest point of the launch area.

Part 3 - Flight Phase: 15 Minutes

- Each team will have two launches of their helicopter.
- Maximum height will depend on the launch area ceiling or obstruction.
- All teams will release their helicopter from a height 1 meter from the floor of the launch area.
- Participants will announce their intention to launch their helicopter by saying “3, 2, 1, Launch.”
- Time will start when judges see the helicopter leave the hand of the student.
- The Event Supervisor and at least one judge will record the time a team’s helicopter stays airborne without touching the top of the launch area or any obstruction.
- Timing will continue until the helicopter touches the top of the launch area, an obstruction, or lands on the floor.
- The Event Supervisor will record and average the flight times for both launches. Times will be recorded in seconds to the nearest 1/100.

Scoring:

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first.

- 75% - Teams will be ranked based on the longest combined flight times to the nearest 1/100 of a second.
- 25% - Teams will be ranked based on their written test score.

Teams are also placed in tiers based on adherence to the challenge instructions. Within each tier, teams will be ranked based on the scoring criteria for the challenge.

- Tier 1: Teams with no violations.
- Tier 2: Teams whose device loses a part or has golf fall out.

Scoring Example:

Equation: (written test ranking x 0.25) + (car ranking x 0.75) = final ranking

- Team A ranks 3rd on the written test. This scores 0.75 ranking points. The team also scores 5th on their distance to target. This scores 3.75 ranking points. The team’s final ranking score is 4.5.
- Team B ranks 2nd on the written test. This scores 0.5 ranking points. The team also scores 7th on their distance to target. This scores 5.25 ranking points. The team’s final ranking score is 5.75.
- Team A places first in the rankings.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point, Division A does not endorse one method over another, and it is up to the competitor to research further.

- [Instuctables: How to make a helicopter for kids out of a coffee cup.](#)
- [University of West Virginia: Rubber Band Helicopter - STEMCARE Lesson](#)
- [Rubber Band Helicopters](#)

States of Matter (30 Minutes - Based on Team Schedule)

Description: This event tests participants' knowledge of matter and might be asked to build a model of a common compound. This event has a written test and may/may not include "hands-on" stations.



Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Teams need to bring: Pencils. Optionally a four-function calculator.

Safety Requirements: None

The Competition: Students will answer questions on the states of matter that may include but are not limited to the topics below.

Classification of Matter:

- Solids, Liquids, Gases, Plasma
- Pure Substances
- Mixtures
- Elements
- Allotropes, Compounds, Colloids

Common Compounds or Mixtures:

- carbon dioxide
- methane
- water
- ammonia
- sodium chloride
- milk

Properties of Matter:

- Properties of Liquids – Viscosity, Surface, Tension
- Properties of Gases – Effusion, Diffusion
- Properties of Solids – Crystalline, Amorphous
- Properties of Plasma – Conductivity

Atomic Structure:

- Atoms, Protons, Neutrons, Electrons
- Atomic and Mass Numbers
- Isotopes
- Chemical Symbols

Atomic Bonding:

- Ionic
- Covalent
- Metallic

Scoring:

- Points are awarded for each correct response on the written test.
- Ties will be broken by the accuracy or quality of answers to select questions chosen by the event leader prior to the competition.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [States of matter \(video\) | Khan Academy](#) - [States of matter follow-up \(video\) | Khan Academy](#)

Submersibles (45 Minutes - Coach Scheduled Event)

Description: Teams will build a device to create neutral buoyancy within a saline water environment using a set of given materials. This event has a building component and a written test.



Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Safety Requirements:

Safety glasses labeled ANSI Z87.1+ (impact rated)

- Glasses must be worn during all practice and test runs.
- If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.
- If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.

Indirect Vent Goggles



**ANSI Z87.1-2015 certified and meets CE EN166 & D3 Splash/Droplet standards.
Eyeglasses and Safety Glasses are not safety rated for this event!**

Teams Need/May Bring:

- Sharpened pencils and scissors. Optionally one four-function calculator
- One chart or graph on 8 ½ x 11 paper showing at least 5 experiments to achieve buoyancy in different saline solutions.

Materials provided at event:

Plasticine clay, play dough, or plumbers' putty, paper straws, 25 cm of masking tape, small paper clip, a 30cm to 40cm tall container filled at least ¾ full of a 1% to 10% saline solution.

The Competition:

Part 1-Written Test

- Teams will take a written test on buoyancy concepts. The questions may relate to fish, submersibles, and underwater exploration. This will account for 25% of the team score. As a part of the test teams will estimate how far they will be from the midway point.

Part 2- Constructing the Submersible

- Teams will build a Cartesian submersible using the given materials. The submersible will then be placed in the container of saline solution so that it comes to rest at a designated midway point in the container.
- Teams will mark a reference line near the center of their submersible. This Event Supervisor will use this reference line to measure in millimeters the distance between the midway point and the reference point.
- No teams may squeeze the container.
- No teams will test their submersible in the container at any time.

Scoring:

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first

- 75% - Teams will be ranked based on their midpoint measurement. Lowest distance to farthest.
- 25% - Teams will be ranked based on their written test score.

Teams will be placed in tiers based on adherence to the challenge instructions. Within each tier, teams will be ranked based on the scoring criteria for the challenge.

- Tier 1: Teams with no violations.
- Tier 2: Teams with a rule or building violation.

Tiebreakers:

- Tiebreaker No. 1: The closest estimate to the midway point.
- Tiebreaker No. 2: First incorrect answer on the test will rank lower.

Scoring Example:

Equation: (written test ranking x 0.25) + (submersible ranking x 0.75) = final ranking

- Team A ranks 6th on the written test. This scores 1.5 ranking points. The team also scores 5th on their submersible distance. This scores 3.75 ranking points. The team's final ranking score is 5.25.
- Team B ranks 2nd on the written test. This scores 0.5 ranking points. The team also scores 4th on their submersible distance. This scores 3.0 ranking points. The team's final ranking score is 3.5.
- Team B places first in the rankings.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Fluids | Physics library | Science | Khan Academy](#)
- [Mad about Science: Cartesian Diver](#)

Trial Event – Origami Glider Relay (45 Minutes - Coach Scheduled Event)



Trail Events are created for students to explore upcoming events. We need as many students as possible to attempt these rules. This event will run if it is successful in 2024.

Description: Teams will build their choice of a Dihedral Magnus Effect or Tumblewing Glider. They will then use their glider to navigate an “obstacle” course for the fastest time. This event will take in a large room or hallway. This event does not have a written test this year.

Participants per Team: 2

Spirit of the competition:

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area. Talking to the team members any time during the competition. Violation of this rule will place the team below all other teams.

Safety Requirements:

Safety glasses labeled ANSI Z87.1+ (impact rated)

- All competitors must wear their eye protection during any competitor’s flight phase of the competition.
- If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.
- If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.



Team members must bring:

- Safety glasses
- Pencils, a ruler/straight edge, and scissors.
- The top of a large pizza box.

Materials Provided:

- Masking Tape
- 40 GSM tracing paper
- A timer accurate to the nearest 1/100 of a second.

The Competition:

Part 1 – Construction Phase (15 Minutes)

- Team members must write their team designator on their glider.
- Team members may practice at any time to adjust their glider within the 30-minute construction phase.
- Practice flights will not count as an official flight.
- Team members must inform the Event Supervisor when they are ready for their official flight.

Part 2 – Flight Phase: (15 Minutes)

- The team may choose to use the pizza box top or their hands to move their glider through the air.

- Team member #1 will stand behind start/finish line and notify the Event Supervisor they are ready to begin their official time.
- The Event Supervisor and assistant will start their timers on the first movement over the start line.
- Team member #1 will move as fast as they can through the course to the far end of the course and over the transfer line.
- Once over the transfer line member #1 will try to “hand off” the team glider to member #2.
- Member #2 will then move as fast a possible back over the start/finish line.

Scoring:

The Event Supervisor and judge will record times from both timers to the 1/100th of a second. These times will be averaged for the team time.

- **Teams will add these times to their official timing.**
 - 5 seconds for each touching of the glider by either team member after the start.
 - 10 seconds if the glider touches the floor.
 - 30 seconds if the transfer between team members occurs over the course side of the transfer line.
 - 30 seconds if either team member leaves the transfer area before the team’s final time.
 - Disqualification if a team member enters the relay area during another team’s official timing.

The winning team will have the lowest time including penalties.

There are no tiebreakers for this as a trail event.

Possible Resources:

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

Templates, building directions, and video help:

- [Make Paper Walkalong Gliders - SciencetoyMaker](#)
- [Surf an Origami Big Mouth Tumblewing on a Wave of Air - SciencetoyMaker](#)
- [Dihedral Glider – SciencetoyMaker](#)

Advanced Gliding: If you are interested.

- [Build and Surf an Origami Hang Glider on a Wave of Air - SciencetoyMaker](#)

