



NORTH CAROLINA SCIENCE OLYMPIAD

2023

Division A (Elementary)

Rules Manual

North Carolina Science Olympiad ©2023

Table of Contents

Table of Contents	2
Elementary Tournament Schedule	3
Elementary Event Descriptions	4
3, 2, 1, Blast Off!	5
3,2,1 Blast Off! Score Sheet	7
Animal Adaptations	8
Backyard Biologist	9
Specimen List	10
Body Builders	11
Bone and Muscle List	11
Bridge-a-Roni	12
Bridge-a-Roni Score Sheet	14
Codebusters	15
Data Crunchers	16
Describe It, Build It	17
Movers and Shakers	18
Rock Star	19
Rocks & Minerals List	19
Science Sketchers	20
Word List	21
Sky Quest	22
STEM Design Challenge	23
STEM Design Challenge Score Sheet	26
Super Sleuths	27
Trajectory	29
Trajectory Score Sheet	31

Elementary Tournament Schedule

During an elementary Science Olympiad tournament in North Carolina, 15 events are run in three different time periods. The 2022-2023 elementary tournament schedule is given below. Each team at the tournament will be given a team number (e.g., 12). The team would follow the schedule for teams 11-20.

Event	8:00-8:30	9:00 - 10:15	10:30 - 11:45	12:00-1:15	2:00-3:00
3, 2, 1 Blast Off!	Registration and Impound	1 - 10	11 - 20	21 - 30	Closing Ceremony
Animal Adaptations		1 - 10	11 - 20	21 - 30	
Backyard Biology		21 - 30	1 - 10	11 - 20	
Body Builders		1 - 10	11 - 20	21 - 30	
Bridge-a-roni		11 - 20	21 - 30	1 - 10	
Codebusters		1 - 10	11 - 20	21 - 30	
Data Crunchers		21 - 30	1 - 10	11 - 20	
Describe It, Build It		1 - 10	11 - 20	21 - 30	
Movers and Shakers		11 - 20	21 - 30	1 - 10	
Rock Star		21 - 30	1 - 10	11 - 20	
Science Sketchers		11 - 20	21 - 30	1 - 10	
Sky Quest		21 - 30	1 - 10	11 - 20	
STEM Design Challenge*		11 - 20	21 - 30	1 - 10	
Super Sleuths		11 - 20	21 - 30	1 - 10	
Trajeggtory		21 - 30	1 - 10	11 - 20	
*Impound					

Think of elementary Science Olympiad tournaments like track meets. Team members pair up, or in some cases work in groups of three, to specialize and become experts in two or three events (out of the fifteen events) and compete in only these events at the tournament on behalf of their team. During a track meet, team members may compete in hurdles or the 100 meter dash and they work in practice to improve and get better at the events they are competing in. The team member may win a medal individually for each event, but his/her performance ultimately tallies into the team score. Similarly, in Science Olympiad, team members compete in events such as Describe It, Build It or Rock Star (with at least one partner) and work throughout the year to improve and get better at their events. On the day of the tournament, they compete in these events to win individual medals and to do as well as possible to bring home a team win. Put simply, each team member chooses 2 or 3 events to become “experts” in during the year, works with a partner, and then competes in chosen events at the tournament with his/her partner to medal and to post a high rank for the team.

A team will consist of up to 18 students. Only 5 sixth graders can compete per team. There is no minimum number of students needed to compete, but in order to be competitive across the 15 events, it is best to have approximately 12-15 students.

Elementary Event Descriptions

3, 2, 1, Blast Off! (3.P.1, 5.P.1, Science as Inquiry)

Prior to the tournament, teams will construct up to two rockets designed to stay aloft for the greatest amount of time.

Animal Adaptations (2.L.1, 4.L.1)

Teams will be assessed on their knowledge of various animal adaptations and how those adaptations benefit the animals.

Backyard Biologist (1.E.2, 1.L.1, 2.L.1, 3.L.2, 6.L.1)

Teams will demonstrate their knowledge of living organisms that they may encounter in their own backyard.

Body Builders (3.L.1, 4.L.2, 5.L.1)

Teams will demonstrate knowledge of the human skeletal and muscular systems.

Bridge-Roni (Science as Inquiry)

Prior to the tournament, teams will design and build a bridge constructed only of pasta and glue with the greatest structural efficiency. This means building a light but strong bridge capable of supporting a load of up to 10 kg.

Codebusters (Science as Inquiry)

Teams will decode encrypted messages using cryptanalysis techniques for historical and modern advanced ciphers.

Data Crunchers (Measurement & Data, 5.P.1, NC.4.MD.4, NC.4.NF.2, NC.5.MD.2, NC.6.SP.1-5.)

Teams will create and interpret data tables and graphs and perform simple experiments to collect data, graph their results, and make predictions.

Describe It, Build It (Science as Inquiry)

Teams will communicate effectively by having one team member write a description of how to build a device and having their partner construct the device from raw materials using that description.

Movers and Shakers (3.E.2)

Teams will demonstrate their knowledge of earthquakes and volcanoes and related land formations.

Rock Star (3.E.2, 4.P.2)

Teams will demonstrate their knowledge of rocks, minerals & the rock cycle.

Sky Quest (1.E.1, 3.E.1, 4.E.1, 6.E.1)

Teams will demonstrate their knowledge of the solar system.

Science Sketchers (Science as Inquiry)

Teams of up to 3 will take turns drawing and guessing scientific terms or concepts from across all Essential Standards for Elementary Science.

STEM Design Challenge (Science as Inquiry)

Teams of up to 3 must build a putting device on site using only the materials and tools specified. Teams must design (and redesign) and practice using their putting device many times before arriving at the competition to be successful.

Super Sleuths (3.P.2, 4.P.2, 5.P.2, Science as Inquiry)

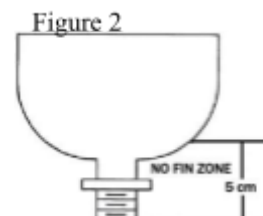
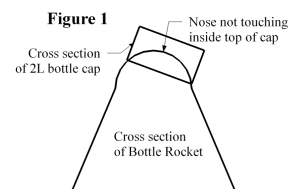
Given a mystery scenario, evidence, and a list of possible suspects, teams will be expected to perform a series of tests to solve the crime.

Trajectory (Science as Inquiry)

Teams will bring with them a device constructed out of specified materials to protect a raw egg from breaking.

3, 2, 1, Blast Off!

1. **DESCRIPTION:** Prior to the tournament, teams will construct up to two rockets designed to stay aloft for the greatest amount of time. **The pressure vessel must be a 1-liter carbonated beverage bottle.**
2. **ESSENTIAL STANDARDS ALIGNMENT:** 3.P.1, 5.P.1, Science as Inquiry
3. **TEAM OF UP TO:** 2
4. **MAXIMUM TIME:** 10 min.
5. **TEAMS:** Must bring up to 2 rockets, carbonated beverage bottle labels (if removed), and safety glasses (rated Z87+). Teams may also bring funnels, measuring cups, and/or other tools to help prepare their rockets.
6. **EVENT LEADERS:** Will provide water rocket launcher, water, score sheets, and timers.
7. **SAFETY REQUIREMENTS:** Teams must wear safety glasses rated Z87+ during the loading, launching, and retrieving of their rockets.
8. **IMPOUND:** No
9. **CONSTRUCTION PARAMETERS:**
 - a. **PRESSURE VESSEL:** The rocket pressure vessel is the part of the rocket that attaches to the launcher and is filled with water and air. The pressure vessel must meet the following requirements:
 - i. Made from a **single 1-liter plastic carbonated beverage bottle.**
 - ii. **LABELS:** May be removed from the pressure vessel, but labels must be presented at the safety inspection to prove that the bottle is **carbonated**. *Rockets without labels must not be launched, as this is a safety issue.*
 - iii. **BOTTLE OPENING:** Not all bottles are made the same, and there is no one specific brand that is guaranteed to work. Some bottles will not fit on the launcher. The easiest way to test this is by sliding a piece of 1/2 inch PVC into the bottle. If it fits loosely, the bottle will go on the launcher. If the PVC sticks and you have to apply any force to slide the PVC in, the bottle will not go on the launcher.
 - iv. **STRUCTURAL INTEGRITY:** The structural integrity of the pressure vessel must not be altered. This includes, but is not limited to: physical, thermal, or chemical damage (e.g., cutting, sanding, using any glues). Event supervisors must assess the structural integrity by looking through the nozzle and sides of the bottle for discoloration, bubbles, thinning or cuts in the walls or glue of any kind. *Rockets violating this rule must not be launched, as this is a safety issue.*
 - b. **MATERIALS:**
 - i. Metal of any type (including tape with metal fibers) is prohibited anywhere on the rocket. *Rockets violating this rule must not be launched; this is a safety issue.*
 - ii. Toy or professional rockets or parts of rockets are not allowed.
 - c. **NOSE CONE:** Rockets must use a blunt or round nose. The nose must be designed such that when a standard bottle cap is placed on top of the nose, no portion of the nose touches the inside top of the bottle cap (see Figure 1). Teams must not use a nose that is sharp, pointed, or consisting of a rigid spike regardless of the material used. *Rockets violating this rule must not be launched; this is a safety issue.*
 - d. **FINS and OTHER PARTS:** Fins and other parts added to the pressure vessel must be 5 cm or higher above the level of the bottle's opening to ensure the rocket fits on the launcher (see Figure 2). Teams will be permitted to fix if possible to allow for launch.
 - e. **ENERGY SOURCE:** Explosives, gasses other than air, chemical reactions, pyrotechnics, electric or electronic devices, elastic powered flight assists, throwing devices, remote controls and tethers are prohibited at any time. All energy imparted to the rocket at launch must originate from the water/air pressure combination. *Rockets violating this rule must not be launched, as this is a safety issue.*



- f. **RECOVERY SYSTEM:** Any free-fall recovery system is allowed, but not required, provided that it does not violate any other rule; however, the recovery system must be judged as safe.

10. **THE COMPETITION:**

- a. Teams must arrive at the competition site ready to launch with proper eye protection on. Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows, otherwise they will not be allowed to compete and receive participation points only.
- b. Following the safety inspection of the rockets, teams may add any amount of water to the inspected rocket(s).
- c. All rockets will be launched at 60 psi. Once the rocket is pressurized, no team member may touch or approach the rocket.
- d. Time aloft is recorded in hundredths of a second. Timing begins when the rocket separates from the launcher and stops when any part of the rocket touches the ground, goes out of sight, or is noticeably slowed by and obstruction (e.g., a tree or building).
- e. Event leaders are strongly encouraged to use three independent timers on all launches. The middle value of the three timers must be the officially recorded time.

11. **SCORING:**

- a. Rockets that violate a safety-related rule under Construction Parameters will not be launched and will receive participation points only.
- b. Ranking within each tier is determined by the greatest time aloft for **one rocket** flight.
 - i. Tier 1: Rockets launched without any violations
 - ii. Tier 2: Any launch with competition violations, or a non-safety construction violation.
- c. Ties in tiers 1 and 2 are broken by the better score of each tied team's other rocket launch.

12. **EVENT RESOURCES:** <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

3,2,1 Blast Off! Score Sheet

School Name: _____ Team (Circle One): Varsity JV1 JV2 JV3

Student Names: _____

ROCKET 1	ROCKET 2
<p>Safety Criteria</p> <p>_____ 1-liter plastic carbonated beverage bottle</p> <p>_____ Bottle label present</p> <p>_____ Pressure vessel unaltered</p> <p>_____ No metal parts anywhere on rocket</p> <p>_____ No commercial rockets or toy parts</p> <p>_____ Rocket has a blunt or rounded nose</p> <p>_____ Recovery system is safe (if used)</p> <p>_____ Team wearing Z87+ safety glasses</p>	<p>Safety Criteria</p> <p>_____ 1-liter plastic carbonated beverage bottle</p> <p>_____ Bottle label present</p> <p>_____ Pressure vessel unaltered</p> <p>_____ No metal parts anywhere on rocket</p> <p>_____ No commercial rockets or toy parts</p> <p>_____ Rocket has a blunt or rounded nose</p> <p>_____ Recovery system is safe (if used)</p> <p>_____ Team wearing Z87+ safety glasses</p>
If any safety criteria above are not met, DO NOT LAUNCH.	If any safety criteria above are not met, DO NOT LAUNCH.
<p style="text-align: center;">Construction Criteria</p> <p>_____ ½ inch PVC fits in bottle opening</p> <p>_____ All parts 5 cm or higher above bottle opening</p>	<p style="text-align: center;">Construction Criteria</p> <p>_____ ½ inch PVC fits in bottle opening</p> <p>_____ All parts 5 cm or higher above bottle opening</p>
<p style="text-align: center;">Time Aloft (Circle Middle Time Below)</p> <p>Timer 1: _____ (in seconds)</p> <p>Timer 2: _____ (in seconds)</p> <p>Timer 3: _____ (in seconds)</p>	<p style="text-align: center;">Time Aloft (Circle Middle Time Below)</p> <p>Timer 1: _____ (in seconds)</p> <p>Timer 2: _____ (in seconds)</p> <p>Timer 3: _____ (in seconds)</p>
<p>Time aloft is recorded in hundredths of a second. Timing begins when the rocket separates from the launcher and stops when any part of the rocket touches the ground, goes out of sight, or is noticeably slowed by an obstruction (e.g., a tree or building).</p> <p>Circle One:</p> <p>Tier 1 No construction violations</p> <p>Tier 2 Competition violations/ non-safety construction violation</p>	<p>Time aloft is recorded in hundredths of a second. Timing begins when the rocket separates from the launcher and stops when any part of the rocket touches the ground, goes out of sight, or is noticeably slowed by an obstruction (e.g., a tree or building).</p> <p>Circle One:</p> <p>Tier 1 No construction violations</p> <p>Tier 2 Competition violations/ non-safety construction violation</p>

Animal Adaptations

1. **DESCRIPTION**: Teams will be assessed on their knowledge of various animal adaptations and how those adaptations benefit the animals.
2. **ESSENTIAL STANDARDS ALIGNMENT**: 2.L.1, 4.L.1
3. **TEAM OF UP TO**: 2
4. **MAXIMUM TIME**: 60 min.
5. **TEAMS**: Must bring writing instruments. No other resources are allowed.
6. **EVENT LEADERS**: Will provide an event with all necessary items, objects, materials, questions, and response sheets for participants to complete the exam.
7. **SAFETY REQUIREMENTS**: None
8. **IMPOUND**: No
9. **THE COMPETITION**: The competition will consist of hands-on stations that cover any or all of the following topics.
 - a. Describe and explain how behaviors and body structures help different animals survive in a particular habitat.
 - b. Describe ways that animals can adapt their behavior to live in changing habitats and explain why the adapted behaviors work.

Observe the adaptations of different animals and describe the habitat that best supports those adaptations including:

 - i. How to get food
 - ii. How to avoid predators
 - iii. How to protect their young
 - iv. How to survive in different physical environments
 - c. Design (e.g. draw and label) an animal with certain adaptations that would allow it to survive under certain environmental conditions.
10. **SCORING**: Points will be awarded for the accuracy of responses. Ties will be broken by the accuracy or quality of answers to pre-selected questions chosen by the event leader.
11. **EVENT RESOURCES**: <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

Backyard Biologist

1. **DESCRIPTION:** Teams will be assessed on their knowledge of living organisms that they may encounter in their own backyard. **This year's focus will be on plants, reptiles, and amphibians.** Teams will be required to identify organisms from a provided list (see 2023 Official Specimen List below) and know about the habitat and conditions required for growth of the organisms. Additionally, teams must know which organisms are NC state symbols.
2. **ESSENTIAL STANDARDS ALIGNMENT:** 2.L.1, 3.L.2, 6.L.1, 6.L.2
3. **TEAM OF UP TO:** 2
4. **MAXIMUM TIME:** 60 min.
5. **TEAMS:** Must bring writing instruments. Teams may also bring up to 2 commercially produced field guides and/or 2 1-inch, 3-ring binders with pages in any form, from any source, contained in the rings. (This means 2 guides, or 2 binders, or a guide and a binder). Actual plant & leaf samples are allowed in the binders as long as they are in plastic sheet protectors. No animal parts are allowed in the binder. Teams may also bring up to two hand lenses.
6. **EVENT LEADERS:** Will provide an event with all necessary items, objects, materials, questions, and response sheets for participants to complete exams. Examples include but are not limited to: drawings, scenarios, questions, leaves, bark, seeds, photographs, and specimens.
7. **SAFETY REQUIREMENTS:** None
8. **IMPOUND:** No
9. **THE COMPETITION:** The competition will consist of an exam that covers any or all of the following topics.
 - a. Identification of specimens, by common name, from the Official Specimen List, including which are NC official state symbols. No more than 50% of the test will be identification of specimens.
 - b. Plants and trees
 - i. The structure and function of roots, stems, leaves, seeds, and flower parts.
 - ii. The life cycle of plants and how they make energy (e.g. basic photosynthesis, no chemical equations).
 - iii. The concepts of gravitropism, phototropism, thigmotropism, & hydrotropism.
 - c. Horticulture
 - i. What is needed to grow a successful garden and harvest food to eat, including how plants react in different conditions (no light, too much/too little water, addition of fertilizer, competition with other plants, etc).
 - d. Reptiles and amphibians
 - i. Basic characteristics and description of habitat.
 - ii. Eating habits and life cycles.
 - iii. Importance to the ecosystem and impact on humans or human activities.
10. **SCORING:** Points will be awarded for the accuracy of responses. Ties will be broken by the accuracy or quality of responses to pre-selected questions chosen by the event leader.
11. **EVENT RESOURCES:** <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

Specimen List

For identification, students only need to know the common name and if it is an official NC State Symbol. Scientific names are given for reference purposes only.

<p>Trees (Identify by leaves, bark, and seeds): American Beech (<i>Fagus grandifolia</i>) Black Gum (<i>Eucalyptus ovata</i>) Bradford Pear/Callery Pear (<i>Pyrus calleryana</i>) Crepe Myrtle (<i>Lagerstroemia</i>) Eastern white pine (<i>Pinus strobus</i>) Hickory (<i>Carya</i>) Loblolly pine** (<i>Pinus taeda</i>) Longleaf pine ** (<i>Pinus palustris</i>) Magnolia (<i>Magnolia grandiflora</i>) Oak (<i>Quercus</i>) Red Maple (<i>Acer rubrum</i>) River Birch (<i>Betula nigra</i>) Shortleaf pine (<i>Pinus echinata</i>)** Sweetgum (<i>Liquidambar styraciflua</i>)</p> <p>Bushes, Vines, and Flowers English ivy (<i>Hedera helix</i>) Carolina lily (<i>Lilium michauxii</i>) *NC State Wildflower Eastern poison ivy (<i>Toxicodendron radicans</i>) Kudzu (<i>Pueraria lobata</i>)</p> <p>Scuppernong grape (<i>Vitis rotundifolia</i>) *NC State Fruit</p> <p>Venus flytrap (<i>Dionaea muscipula</i>) *NC State Carnivorous Plant</p> <p style="margin-top: 20px;">* State Symbol ** Pine trees (generic) are the NC state tree</p>	<p>REPTILES</p> <p>Alligators - Order Crocodylia American Alligator (<i>Alligator mississippiensis</i>)</p> <p>Lizards - Order Squamata: Sauria (Lacertilia) Green Anole (<i>Anolis carolinensis</i>) Southeastern Five-lined Skink (<i>Eumeces inexpectatus</i>) Eastern Glass Lizard (<i>Ophisaurus ventralis</i>) Eastern Fence Lizard (<i>Sceloporus undulatus</i>)</p> <p>Snakes - Order Squamata: Serpentes Copperhead (<i>Agkistrodon contortrix</i>) Cottonmouth (<i>Agkistrodon piscivorus</i>) Eastern Diamondback Rattlesnake (<i>Crotalus adamanteus</i>) Black Rat Snake (<i>Elaphe obsoleta obsoleta</i>) Dekay's Brownsnake (<i>Storeria dekayi</i>) Eastern Hognose Snake (<i>Heterodon platirhinos</i>) Eastern Kingsnake (<i>Lampropeltis getula getula</i>) Banded Water Snake (<i>Nerodia fasciata</i>) Eastern Garter Snake (<i>Thamnophis sirtalis sirtalis</i>)</p> <p>Turtles - Order Testudines Snapping Turtle (<i>Chelydra serpentina</i>) Painted Turtle (<i>Chrysemys picta</i>) Spotted Turtle (<i>Clemmys guttata</i>) Eastern Box Turtle (<i>Terrapene carolina carolina</i>)* Yellow-bellied Slider (<i>Trachemys scripta</i>)</p> <p>AMPHIBIANS</p> <p>Frogs and Toads - Order Anura American Toad (<i>Bufo americanus</i>) Pine Barrens Treefrog (<i>Hyla andersonii</i>)* Bullfrog (<i>Rana catesbeiana</i>) Southern Leopard Frog (<i>Rana sphenoccephala</i>)</p> <p>Salamanders - Order Caudata Marbled Salamander (<i>Ambystoma opacum</i>)* Red-backed Salamander (<i>Plethodon cinereus</i>) White-spotted Slimy Salamander (<i>Plethodon cylindraceus</i>)</p>
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Body Builders

1. **DESCRIPTION:** Teams will demonstrate knowledge of the human skeletal and muscular systems.
2. **ESSENTIAL STANDARDS ALIGNMENT:** 3.L.1, 4.L.2, 5.L.1
3. **TEAM OF UP TO:** 2
4. **MAXIMUM TIME:** 60 min.
5. **TEAMS:** Must bring a writing instrument. No other resources are allowed.
6. **EVENT LEADERS:** Will provide a hands-on event with all necessary items, objects, materials, questions, and response sheets for participants to complete stations. Examples include but are not limited to: models, pictures, or diagrams.
7. **SAFETY REQUIREMENTS:** None
8. **IMPOUND:** No
9. **THE COMPETITION:** This event will be run in a station format. Teams will rotate through stations that assess any or all of the following topics with any combination of questions, models, pictures, or diagrams:
 - a. Structure and function of the skeletal system (see Official List Bone and Muscle List below)
 - b. Structure and function of the muscular system (see Official Bone and Muscle List below)
 - c. Problems and disorders associated with these systems (bunions, fractures, osteoporosis, rheumatoid arthritis, rickets, sprains, cramps)
 - d. Sample activities:
 - i. Identify the bones in the human leg from a picture, model, or x-ray
 - ii. Match each joint type to its description
 - iii. Label if listed actions are caused by a muscle or a tendon
 - iv. Skeletal, Cardiac, or Smooth, which muscle type is shown?
10. **SCORING:** Points will be awarded for the accuracy of responses. Ties will be broken by the accuracy or quality of responses to pre-selected questions chosen by the event leader.
11. **EVENT RESOURCES:** <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

Bone and Muscle List

Bones and Joints:

Ankle
Arm (humerus, radius, ulna)
Clavicle (collar bone)
Cranium (frontal, parietal, mandible, teeth)
Foot (calcaneus, tarsals, metatarsals, phalanges)
Hand (carpals, metacarpals, phalanges)
Hip
Leg (femur, fibula, tibia, patella)
Rib cage (true ribs, sternum)
Scapula
Spine (cervical, thoracic, lumbar vertebrae, coccyx)
Wrist

Muscles and Tendons:

Abdominals
Achilles tendon
Arm (deltoid, biceps brachii, triceps brachii)
Back muscles (latissimus dorsi, trapezius)
Calves (triceps surae)
Chest muscle (pectoralis major)
Diaphragm
Gluteus maximus
Hamstrings (biceps femoris)
Heart (cardiac muscle)
Quadriceps (quads)

Bridge-a-Roni

1. **DESCRIPTION:** The objective of this event is to design and build the lightest bridge, constructed only of pasta and glue, with the greatest structural efficiency, capable of supporting a load of up to 10 kg. Each team may bring and enter only one pasta bridge.
2. **ESSENTIAL STANDARDS ALIGNMENT:** Science as Inquiry
3. **TEAM OF UP TO:** 2
4. **MAXIMUM TIME:** 10 min.
5. **TEAMS:** Teams must bring a bridge and safety glasses.

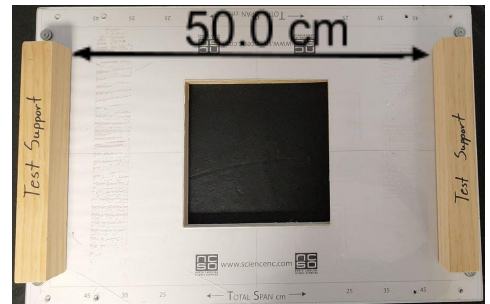


Figure 1

6. **EVENT LEADERS:** Will provide all equipment, except for eye protection, needed for testing and scoring. The equipment needed is as follows:
 - a. The bridge must be designed to sit on top of two identical test supports that must be **at least** 1-½ inches by 1-½ inches by 6 inches and are 50. cm apart (see **Figure 1**).
 - b. A square loading block, 5.0 cm long x 5.0 cm wide x 2.0 cm tall (+/- 1 mm) with a hole drilled in the center of the square face. Connected through this hole will be a ¼” eyebolt (with wing nut and washer) connected to a chain. The loading block and chain assembly is placed on the bridge by the team during testing and used to suspend the bucket and sand beneath the bridge (see **Figure 2**).
 - c. An electronic balance or scale that can mass up to 12 kg (the “sand scale”) and one that can mass a bridge up to 400 g to the nearest .01 g (the “bridge scale”). Bridges exceeding the capacity of the bridge scale will be massed on the sand scale instead.
 - d. A plastic tarp to protect the floor from sand, if needed.



Figure 2

7. **SAFETY REQUIREMENTS:** Teams must wear safety glasses throughout the event.
8. **IMPOUND:** None
9. **CONSTRUCTION:**
 - a. The bridge is to be a single structure constructed of **ONLY** pasta, multi-purpose glue, and/or hot glue. Multi-purpose glue must be labeled safe and non-toxic (e.g. Elmer’s). Other materials are not allowed, including paint, rubber bands, twist ties, other types of glue, etc.
 - b. The bridge must be free standing and span a **50.0 cm** gap while resting on top of the testing platform.
 - c. The bridge shall not exceed **70.0 cm** in length, **10.0 cm** in width, and not extend below the top of the testing platform when unloaded.
 - d. The minimum height of the bridge is **15.0 cm**; the maximum height of the bridge is **40.0 cm**.
 - e. The bridge must support, at the center of its span, the loading block and chain assembly described in 6.b. The bridge must have an adequately sized opening at its center that allows the bolt and chain to pass through the bridge and hang below the bridge. The loading block assembly must rest freely on the bridge and cannot be rigidly attached to the bridge.
 - f. If the bridge has multiple levels, the team may decide which level to place the loading block on, as long as it remains at the center of the span.
10. **THE COMPETITION:**
 - a. Once teams enter the event area to compete, they may not leave the area or receive outside assistance, materials, or communication until they are finished competing. Only contestants and judges will be allowed in the event area while teams are competing. Teams violating this rule will be disqualified.

- b. All bridges must be measured and weighed prior to testing.
- c. Teams must strive to handle the bridge themselves throughout the process of measuring and loading. Event leaders should only handle bridges as a last resort.
- d. Teams must place the bridge on the testing platform themselves so that the ends of the bridge rest on the highest surfaces of the testing platform.
- e. Teams will place the loading block on the bridge at the center of its span so the chain hangs freely without touching the testing platform, and connect a 5-gallon bucket to the chain below the testing platform.
- f. The team will be given **3 minutes** to load sand into the bucket once the loading block and bridge are positioned.
- g. Loading must stop when failure of the bridge occurs, when the maximum load of 10 kg is supported, or when the time expires. Failure is defined as the inability of the bridge to support additional load, or something other than the bridge is supporting the load (i.e., the bridge leans and the chain touches the edge of the platform or sags enough that the bucket touches ground or part of the bridge sags below the top of the testing platform).
- h. Event leaders will remove sand added after failure occurs. Event leaders will also remove any pasta bits that fall into the sand. The Load Supported at that time will be used to calculate the Structural Efficiency.
- i. The mass of the loading block assembly, bucket, and sand are included in the Load Supported.

11. **SCORING:**

- a. The best structural efficiency (highest number) wins, determined by the following equation:
Structural Efficiency = Load Supported (grams) ÷ Mass of Bridge (grams)
- b. Bridges that hold more than 10 kg will be scored using 10 kg (10,000 g) as the maximum Load Supported.
- c. Bridges will be scored in 2 tiers:
 - i. Tier 1: Bridges with no violations
 - ii. Tier 2: Bridges with construction violations
 - iii. Bridges that cannot be tested for any reason (e.g. cannot accommodate the loading block or team does not have proper eye protection) will be given participation points only.
- d. Ties will be broken in favor of the team with the lighter bridge.

12. **RESOURCES:** <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

Bridge-a-Roni Score Sheet

School Name: _____ Team (Circle One): Varsity JV1 JV2 JV3

Student Names: _____

NEVER HANDLE TEAMS' BRIDGES. LET THEM PLACE IT ON THE SCALE, ON THE PLATFORM BLOCKS, AND ALLOW THEM TO PLACE LOADING BLOCK AND CHAIN ASSEMBLY ON THEIR OWN BRIDGES. YOU DON'T WANT IT TO BE YOUR FAULT THAT A BRIDGE BREAKS PRIOR TO TESTING.

PRIOR TO TESTING, What is the mass of the bridge to the nearest 0.01 g? _____ g

Teams must wear proper eye protection at all times during bridge testing.

	YES	NO
1. The bridge is a single structure constructed of ONLY pasta, multi-purpose glue, and/or hot glue	_____	_____
2. The bridge is free standing and spans a 50.0 cm opening while resting <u>on top</u> of the testing platform blocks.	_____	_____
3. The bridge is ≤ 70.0 cm in length, ≤ 10.0 cm in width, ≥ 15.0 cm and ≤ 40.0 cm in height <u>and</u> does not extend below the top of the testing platform when unloaded.	_____	_____
4. The bridge supports the loading block and chain assembly at the center of its span and allows the chain to hang freely.	_____	_____

Teams with a “no” checked above will be placed in Tier #2.

Tier = _____

Check the reason testing stopped: _____ Bridge failed _____ Load Completely held

Maximum mass to be supported = 10,000 g.

$$\frac{\text{_____ g}}{\text{(mass supported)}} \div \frac{\text{_____ g}}{\text{(mass of bridge)}} = \frac{\text{_____}}{\text{(Structural Efficiency)}}$$

Tier* (Circle one): 1 2 P DQ

Final Rank: _____

(Ties broken by the lowest bridge mass)

***Note:** P means a safety violation occurred or the bridge could not be tested for some reason (the loading block won't fit, for example).
 DQ would only be used in the case of a sportsmanship issue.

Codebusters

1. **DESCRIPTION:** Teams will cryptanalyze (decode) encrypted messages using cryptanalysis techniques and show skill with ciphers by decrypting a message.
2. **ESSENTIAL STANDARDS ALIGNMENT:** Science as Inquiry
3. **TEAM OF UP TO:** 2
4. **MAXIMUM TIME:** 50 minutes
5. **TEAMS:** Must bring writing utensils. No other resource materials are allowed.
6. **EVENT LEADERS:** Will provide scratch paper and a resource sheet for each team to use. The resource sheet will include English letter frequencies, AtBash, DancingMen, and Vigenère tables but will NOT provide the PigPen or TapCode Cipher tables
7. **SAFETY REQUIREMENTS:** None
8. **IMPOUND:** No
9. **THE COMPETITION:** This event consists of participants using cryptanalysis techniques to decrypt messages on a written exam.
Teams must not open the exam packet nor write anything prior to the “start” signal, nor may they write anything after the “stop” signal.
 - a. Participants are free to answer the questions in any order, working individually or in pairs, attempting whichever of the questions seem right for them.
 - b. The code types that may be used on the exam at competitions are as follows:
 - i. Mono-alphabetic substitution Aristocrats – messages with spaces included – with or without a hint
 - ii. Atbash Cipher (in English, not Hebrew)
 - iii. The Caesar Cipher, also called a shift cipher, with a shift of no more than 3 characters in either direction. (e.g. ‘a’ can map to x,y,z,b,c,or d).
 - iv. The Vigenère Cipher – Decrypting ciphertext given a key.
 - v. The PigPen Cipher, also called the Masonic Cipher – Decrypting ciphertext with no mapping table provided.
 - vi. The Tap Code Cipher – Decrypting ciphertext encoded by a pair of numbers indicating a coordinate in a standard 5x5 table (not provided with the test) with c and k sharing the same cell.
 - vii. The DancingMen Cipher – Decrypting ciphertext encoded by symbols DancingMen based on the Sherlock Holmes story “The Adventure of the Dancing Men”
 - viii. For Aristocrats Cipher - no letter can ever decrypt to itself.
10. **SCORING:**
 - a. High score wins.
 - b. Based on difficulty, each question will be worth a clearly indicated number of points.
 - c. For all questions, the final points will be determined based on the number of errors found
 - i. Two or fewer errors will result in full credit.
 - ii. Each additional error results in a penalty of 100 points.
 - iii. The penalty will not exceed the value of the question. For example, a 400-point question with 5 errors is worth 100 points whereas the same 400-point question with 7 errors would be worth 0 points, not -100 points.
 - d. The scores for each question will be added to determine the exam score.
 - e. Tie Breakers: For teams that are tied, select questions predetermined by the event supervisor, will be used to break the tie using the following criteria in this order: score, degree of correctness and attempted.
9. **EVENT RESOURCES:** <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

Data Crunchers

1. **DESCRIPTION**: Teams should be able to create and interpret data tables and graphs and perform simple experiments to collect data, graph their results, and make predictions.
2. **ESSENTIAL STANDARDS ALIGNMENT**: Measurement & Data is a unifying concept for all grade levels across the Common Core Standards. It also aligns with 5.P.1 and Science as Inquiry in the Essential Standards for all grades and with these standards in the mathematics curriculum: NC.4.MD.4, NC.4.NF.2, NC.5.MD.2, NC.6.SP.1-5.
3. **TEAM OF UP TO**: 2
4. **MAXIMUM TIME**: 60 min.
5. **TEAMS**: Must bring writing utensils. No other resource materials are allowed.
6. **EVENT LEADERS**: Must provide tests and student response sheets for each team. Event leaders may also provide items such as: rulers, calculators, meter tapes, meter sticks, objects to measure and various types of graphs and data sets to be analyzed.
7. **SAFETY REQUIREMENTS**: None
8. **IMPOUND**: No
9. **THE COMPETITION**: Teams will demonstrate understanding of this content in any or all of the following ways:
 - a. Collect data with metric measuring devices (length, mass, or volume) and represent that data in a correctly labeled graph or data table.
 - b. Plot data points, make and interpret data tables, draw and interpret graphs, including what trends can be predicted from the data shown.
 - c. Make estimates of data between or beyond the data points given.
 - d. Calculate fractions or percentages based on charts, tables or data.
 - e. Calculate the mean, median, and mode for a set of data.
 - f. Distinguish between accuracy and precision and identify outliers in a set of data.
 - g. Identify types of questions (numerical, categorical, data that changes over time) when collecting data.
10. **SCORING**: Points will be awarded for the accuracy of responses. Ties will be broken by the accuracy or quality of answers to selected questions chosen by the event leader prior to the competition.
11. **EVENT RESOURCES**: <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

Describe It, Build It

1. **DESCRIPTION**: Technical writing skills are an important part of an engineer or scientist's ability to communicate precisely and clearly. This event will test a team's ability to communicate effectively by having one team member write a description of how to build a device and having his or her partner construct the device from raw materials using their partner's description.
2. **ESSENTIAL STANDARDS ALIGNMENT**: Science as Inquiry
3. **TEAM OF UP TO**: 2
4. **MAXIMUM TIME**: 60 min.
5. **TEAMS**: Teams must bring a writing instrument. No other resources are allowed.
6. **EVENT LEADERS**: Will provide paper and all necessary materials.
7. **SAFETY REQUIREMENTS**: None.
8. **IMPOUND**: No
9. **THE COMPETITION**: This event should occur in two rooms so that the builders are not in the same room as the describers while they are writing.
 - a. One team member (the describer) is shown an object (which may be abstract) built from, but not limited to, office & craft materials (e.g., straws, push pins, Styrofoam balls, paper cups, Popsicle sticks, paper, stickers, etc.) or commercial sets (e.g., K'nex, Tinker Toys, Legos, Lincoln Logs, etc.). The describer has 25 minutes to write a description of the object and how to build it. There will be no advantage to finishing early. The event leader will notify teams if the color of the pieces does not matter.
 - b. Only words and numbers may be used. Symbols, drawings and diagrams are not allowed, with the exception of common punctuation and editing symbols. Printable punctuation marks and/or editing symbols that can be produced on a standard QWERTY keyboard by pressing a single key or a single key in combination with the shift key may be used. These must be used in their normal context and not as symbols to form a key or code.
 - c. All abbreviations (not symbols) must be defined either at the beginning or when the abbreviation is first used. (e.g. rt = right)
 - d. The event leader will pass the description to the other team member (the builder) in the other room who will use the description to create the original object in 20 minutes. Time will be recorded if teams finish early and used as a tiebreaker.
10. **SCORING**:
 - a. The team that builds the object most like the original object wins.
 - b. Any improper use of symbols, codes or pictures of any kind (including use of words or letters as pictures or codes) will result in the team being placed in a second tier below devices without any writing violations.
 - c. Points will be given for each piece of material placed in the proper connection and location compared to the model according to a scoring rubric.
 - d. Pieces that are connected correctly beyond an incorrect connection will be counted in the score. No penalty will be assessed for parts that were not used.
 - e. The shortest time for the construction phase will be used as a tiebreaker, there is no benefit to finishing the writing portion early.
11. **EVENT RESOURCES**: <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

Movers and Shakers

1. **DESCRIPTION:** Teams will be assessed on their knowledge of earthquakes and volcanoes and related land formations.
2. **ESSENTIAL STANDARDS ALIGNMENT:** 3.E.2
3. **TEAM OF UP TO:** 2
4. **MAXIMUM TIME:** 60 min.
5. **TEAMS:** Each team must bring writing instruments. No other resources are allowed.
6. **EVENT LEADERS:** Will provide a hands-on event with all necessary items, objects, materials, questions, and response sheets for participants to complete stations.
7. **SAFETY REQUIREMENTS:** None.
8. **IMPOUND:** No
9. **THE COMPETITION:** This event will be run in a station format using pictures, models, and diagrams. Teams rotate through stations that assess any or all of the following:
 - a. Features of earthquakes including what they are, where they can occur, why they occur (the underlying mechanism), and how they are measured.
 - b. Know how the following terms apply to earthquakes: tectonic plates, epicenter, fault, focus, foreshock, aftershock, seismograph and seismogram, P waves, S waves.
 - c. Features of volcanoes including what they are, parts of the world that have volcanoes, why they erupt (the underlying mechanism), and the impact of eruptions on both humans and the environment.
 - d. Know how the following terms apply to volcanoes: geysers, hot spots, hot springs, magma, lava, ash, mudslides, upper mantle, pyroclastic flow, pumice.
 - e. The different stages and types of volcanoes.
 - f. Locations of volcanic activity on earth, especially Hawaii, Yellowstone, and the Pacific Ring of Fire
 - g. How volcanoes and earthquakes are related.
 - h. What type of landmasses and rocks are formed from earthquakes and volcanic eruptions.
10. **SCORING:** Points will be awarded for the accuracy of responses. Ties will be broken by the accuracy or quality of answers to pre-selected questions chosen by the event leader.
11. **EVENT RESOURCES:** <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

Rock Star

1. **DESCRIPTION:** Teams will demonstrate their knowledge of rocks, minerals & the rock cycle.
2. **ESSENTIAL STANDARDS ALIGNMENT:** 3.E.2, 4.P.2
3. **TEAM OF UP TO:** 2
4. **MAXIMUM TIME:** 60 min.
5. **TEAMS:** Must bring writing instruments. Teams may bring 2 hand lenses and one 3-ring, 1” binder containing information in any form from any source. The materials must be 3-hole punched and inserted into the rings (sheet protectors are allowed). No actual samples may be used in the binder, but photographs and drawings are allowed.
6. **EVENT LEADERS:** Will provide a hands-on event with all necessary items, objects, materials, questions, and response sheets for participants to complete stations.
7. **SAFETY REQUIREMENTS:** Following the handling of rocks and minerals, students should wash their hands.
8. **IMPOUND:** No
9. **THE COMPETITION:** This event will be run in a station format. Teams will rotate through stations that assess any or all of the following topics:
 - a. Identification of specimens from the Official Rocks & Minerals List, provided below
 - b. Classification of rocks and minerals by their properties
 - c. Information about specimens on the list including uses and economic importance
 - d. Parts and processes of the Rock Cycle
10. **SCORING:** Points will be awarded for the accuracy of responses. Ties will be broken by the accuracy or quality of responses to pre-selected questions chosen by the event leader.
11. **EVENT RESOURCES:** <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

Rocks & Minerals List

Rocks:		Minerals:
Basalt	Obsidian	Calcite
Bituminous coal	Phyllite	Gypsum
Conglomerate	Pumice	Copper
Gneiss	Quartzite	Corundum
Granite	Sandstone	Feldspar (pink)
Limestone (chemical)	Scoria	Fluorite
Limestone (fossil)	Shale	Galena
Marble	Slate	Gold
		Graphite
		Pyrite
		Quartz (crystal)
		Talc

Science Sketchers

1. **DESCRIPTION**: Team members will take turns drawing and guessing scientific terms or concepts from across all Essential Standards for Elementary Science.
2. **ESSENTIAL STANDARDS ALIGNMENT**: Vocabulary found throughout K-6 Science & Math Essential Standards
3. **TEAM OF UP TO**: 3
4. **MAXIMUM TIME**: 4 minutes per team.
5. **TEAMS**: Teams must be in groups of 2 or 3 in order to compete in this event. Teams should only bring a writing instrument with them to the competition.
6. **EVENT LEADERS**: Will provide stopwatch, 40 words printed on index cards, and score sheets.
7. **SAFETY REQUIREMENTS**: None.
8. **IMPOUND**: No
9. **THE COMPETITION**:
 - a. Teams will have 4 minutes to complete up to 40 terms.
 - b. All teams will receive the same terms in the same order. The terms will consist of one or two words coming ONLY from the list provided below.
 - c. Team members will alternate drawing and receiving clues. All team members must rotate turns on being the clue drawer and guesser. Teams may pick the initial order of rotation. This event requires a minimum of 2 team members to participate.
 - d. Timing begins when the judge shows the first team member the first term and ends when the team has correctly identified or passed the last term or when the 4-minute time period has expired, whichever occurs first.
 - e. No other team member may see the term. The sketcher will then draw pictures and visual clues. Letters of any alphabet or numbers of any kind are not allowed (it is the intent of this rule to prevent teams from inventing alphabets, codes, etc.). The following are acceptable symbols: arrows, a minus “-” to shorten a word, a plus “+” to lengthen a word (e.g., in response to “refract”, a “+” can be used to elicit the word “refraction”). No other symbols are permitted unless they represent the word(s) given, (e.g., a circle for the word sun in a solar eclipse).
 - f. Participants may not give visual clues with their hands or bodies except for event leader demonstrated clues such as nodding yes or no, or to acknowledge a desired response from team members.
 - g. The event leader will indicate when the correct term is given. Different forms of the term will not be accepted with the exception of plurals and singulars, which will be accepted interchangeably (e.g. calories or calorie would be accepted).
 - h. If a team violates any of the rules regarding the use of verbal or visual communication, the term in play at the time of the violation will be counted as a pass.
 - i. Any team member (person drawing or those guessing) may choose to pass on a term. Once the team passes on a term they may not return to it.
 - j. When the team has correctly identified or passed on the term, or if a violation occurs, the next team member will be given a new term until the team has gone through their set of terms or the time expires, whichever happens first.
10. **SCORING**:
 - a. One point will be awarded for each term correctly identified within the allotted time. The team correctly identifying the most terms will be declared the winner.
 - b. In the event of a tie, the first tiebreaker is the team with the longest string of consecutively correct words. The second tiebreaker will be the team who identifies the first word in the list passed by the other team. The third tiebreaker will be the team with the fewest words passed. The final tiebreaker is the shortest period of time to complete the list. If teams are unable to guess any of the words in 4 minutes, participation points

only will be given.

11. **EVENT RESOURCES:** <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

Science Sketchers Word List

Abdomen	Contract	Friction	Molecule	Rocket
Absorb	Crater	Fungus	Moon	Root
Acid rain	Cumulus Cloud	Galaxy	Motion	Rotation
Adapt	Current	Gas	Muscle	Saliva
Air pressure	Data Scientist	Geologist	Mutualism	Scale
Amphibian	Decay	Germinate	Neutron	Season
Angle	Decomposer	Global warming	Ocean	Sedimentary rock
Antenna	Degree	Gram	Omnivore	Seed
Arctic	Desert	Graph	Orbit	Shadow
Astronomer	Digestive system	Gravity	Organ	Skin
Atmosphere	Dissolve	Habitat	Organism	Soil
Atom	Eardrum	Heat	Oxygen	Solid
Balance	Earthquake	Herbivore	Parasite	Sound wave
Barometer	Eclipse	Humidity	Pendulum	Space
Biologist	Egg	Humus	Photosynthesis	Spinal cord
Bird	Electricity	Hurricane	Physicist	Spine
Blood	Electron	Ice	Planet	Star
Boil	Elevation	Igneous rock	Plastic	Static Electricity
Bone	Endoskeleton	Insect	Poison	Stem
Botanist	Energy	Insulate	Pole	Stomach
Calorie	Engineer	Jet stream	Pollen	Sugar
Camouflage	Entomologist	Joint	Pollution	Sun
Carnivore	Environment	Lake	Population	Sunrise
Cell	Equator	Leaf	Porous	Sunset
Charge	Erode	Light	Precipitation	Teeth
Chemist	Estimate	Lightning	Predator	Telescope
Chromosome	Estuary	Liquid	Prey	Temperature
Circuit	Evaporation	Magnet	Producer	Thermometer
Climate	Exercise	Mammal	Protein	Thunder
Clockwise	Exoskeleton	Map	Proton	Tornado
Cloud	Expand	Mass	Pull	Velocity
Cold front	Extinct	Matter	Quantity	Vibrate
Comet	Flight	Measure	Quartz	Vitamin
Compass	Float	Melt	Radiation	Volume
Compound	Flower	Metamorphic rock	Ramp	Waning Moon
Compression	Food web	Metamorphosis	Recycle	Warm front
Condensation	Force	Meteor	Repel	Waste
Conduction	Forest	Meter	Reptile	Water table
Constellation	Fossil	Mineral	Revolve	Waxing Moon
Consumer	Freeze	Mixture	River	Weather

Sky Quest

1. **DESCRIPTION:** Teams will be tested on their knowledge of the solar system. Topics include the sun, moon, planets, rotation and revolution, moon phases, seasons, space exploration missions and identification of constellations/stars/asterisms based on a provided list.
2. **ESSENTIAL STANDARDS ALIGNMENT:** 1.E.1, 3.E.1, 4.E.1, 6.E.1
3. **TEAM OF UP TO:** 2
4. **MAXIMUM TIME:** 60 min.
5. **TEAMS:** Must bring writing instruments. No other resources are allowed.
6. **EVENT LEADERS:** Will provide an event with all necessary items, objects, materials, questions, and response sheets for participants to complete the exam. Examples include but are not limited to reference charts, posters, and models for the event.
7. **SAFETY REQUIREMENTS:** None
8. **IMPOUND:** No
9. **THE COMPETITION:** This event will be run in a station format. Teams will rotate through stations that assess any or all of the following topics:
 - a. The Earth/Sun relationship including rotation and revolution, day/night, shadows, and seasons.
 - b. The Earth/Sun/Moon relationship including: phases and relative positions of all three bodies, tides, and both lunar and solar eclipses.
 - c. Identification and understanding of the planets in our solar system, how they relate to each other in size, order from the sun, physical properties, and what is unique about each one.
 - d. Space Exploration, including:
 - i. Robots, Probes, & Telescopes (Cassini, Dawn, Hubble Space Telescope, James Webb Space Telescope, Rovers on Mars (Sojourner, Spirit, Opportunity, Curiosity, Perseverance), Voyager 1 & 2)
 - ii. Human Spaceflight (Vostok 1, Freedom 7 & Friendship 7, Apollo 11, Space Shuttle program)
 - e. Identification of *Major Constellations, their Alpha stars & common Northern Hemisphere asterisms* from the list below.

Major Constellations and their Alpha star in parentheses, if noted:

Aquila (Altair)	Canis Major (Sirius)	Cygnus (Deneb)	Lyra (Vega)	Scorpius (Antares)
Aquarius	Canis Minor (Procyon)	Gemini (Castor and Pollux)	Orion (Betelgeuse)	Taurus (Aldebaran)
Aries	Cassiopeia	Hercules	Pegasus	Ursa Major
Bootes (Arcturus)	Corona Borealis	Leo (Regulus)	Perseus	Ursa Minor (Polaris)

Northern Hemisphere Asterisms:

Big & Little Dippers	Great Square of Pegasus	Orion's Belt	Summer Triangle	Winter Triangle
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10. **SCORING:** Points will be awarded for the accuracy of responses. Ties will be broken by the accuracy or quality of responses to pre-selected questions chosen by the event leader.
11. **EVENT RESOURCES:** <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

STEM Design Challenge

1. **DESCRIPTION:** Teams must build a putting device on site using only the materials and tools specified below. Teams will design and practice their putting device many times before arriving at the competition to be successful.
2. **ESSENTIAL STANDARDS ALIGNMENT:** 4.P.2, 5.P.1, Science as Inquiry
3. **TEAM OF UP TO:** 3
4. **MAXIMUM TIME:** **35 minutes to build**, up to 3 minutes to test.
5. **TEAMS:** Teams **MUST** bring the specified tools, string, tape, and their box full of K'nex materials. Teams may bring only 1 piece of paper no larger than 8.5" x 11" containing pictures, notes, or drawings to help them. No other resources are allowed.
6. **EVENT LEADERS:** Event leaders will provide the golf ball, sticky colored dots (or painter's tape), score sheets, unsharpened starter pencils, and any measuring devices needed. **This event must take place on low pile carpet.**
7. **SAFETY REQUIREMENTS:** None
8. **IMPOUND:** Yes. Teams must drop the challenge box off at the time and place specified by the tournament director. The box must be clearly labeled with the school/team name and team designation (Varsity, JV, etc.). Event leaders will inspect the boxes and their contents while in impound and remove any disallowed items.
9. **THE MATERIALS BOX:**
 - a. All materials and tools must be brought in a box with a lid; the outside dimensions of the box with lid in place can be no greater than 30.0 cm x 35.0 cm x 50.0 cm (example: a common 10 ream copy paper box with the lid on meets this requirement). With all materials and tools in the box, the lid must fit all the way on the box and close completely.
 - b. Teams may construct their own materials box or repurpose a box that is within the specified dimensions, made from any material. The materials box must not be used as a part of the device.
 - c. Varsity and JV teams from the same or different schools may not share the same materials box nor anything in the materials box.
 - d. **MATERIALS BOX:** Teams should make a reasonable effort to organize the supplies within the box neatly for efficient check-in and ease of inspection by the event leader(s). Teams may organize box supplies in clear plastic bags or other clear containers. The bags and containers must not be used as building materials. Teams may only bring the following in their materials box:
 - i. K'nex pieces. No K'nex motors or other electronic components may be used. No other brands or kinds of building materials may be used. **Pieces can't be preassembled in the box.** Event leaders will disassemble or remove any pieces not allowed by these rules.
 - ii. Rubber bands – any size, brand, or quantity.
 - iii. Tape - any kind you want.
 - iv. String – any size, brand, or quantity.
 - v. Tools – must not be used as part of the device. Teams may include scissors, ruler, a tape measure, and a stopwatch in the box.
 - e. Team members must complete the build of the device on site using only the materials in their box.
10. **THE CHALLENGE:**
 - a. Once teams enter the event area/room to compete, they may not leave the area or receive outside assistance, materials or communication until they are finished competing. Only participants and event leaders will be allowed in the event area/room while teams are competing. **Teams violating this rule will be disqualified.**
 - b. Teams are to design and build a putting device that will **putt a golf ball as close as possible to a target.**

- c. The event leader will set the target distance between 50.0 cm and 75.0 cm from the center front of the putting area **after all challenge boxes have been impounded and the building period is about to start**. The putting area is a 1.5 m wide x 1.5 m long rectangle marked with blue painter's tape that is parallel to the target which will be a sticky colored dot or painter's tape in the shape of an X. The target distance will be set at only 5.0 cm increments (either 50.0, 55.0, 60.0, 65.0, 70.0, or 75.0 cm). See Figure 1 below.



Figure 1

- d. The entire device, **while in the resting position**, must fit in an imaginary box that is **1.00 m wide by 1.00 m long by 1.00 m high** in any orientation on the floor. This will be measured after teams place their device in the putting area.
- e. The putting machine **must be free standing** and cannot be attached to a table, floor or any other support. Remember, it will have to be moved and placed in the putting area.
- f. Team members will **NOT** be allowed to stand on anything to construct the device or release the putting arm.
- g. **IMPORTANT: The putting device, once put in putting position, must be activated so that no significant energy is contributed to the putt (for example, a team member using his/her hand to push the putting arm to putt the ball). The putting device must be “triggered” using an unsharpened pencil (provided by the Event Leader) to trip a switch, lever or string that releases the putting arm so that the lowest most part of the putting arm strikes the golf ball causing it to roll across the carpet towards the target. No human putting allowed.**
- h. Teams will be given **35 minutes** to build and practice with their putting devices. Event leaders are encouraged to have multiple putting areas and targets so that multiple teams can set up and putt as soon as event leaders are ready. The number of putting areas you need is based on the number of teams you expect to compete. It is suggested to have at least 2 putting areas for every ten teams competing.
- i. After 35 minutes, time is called and teams are no longer allowed to touch their putting device until called by the event leader(s) to make their official two putts. When called by the event leader(s), teams must place their device at a location they select in the putting area. While in resting position, event leaders inspect the device using the provided score sheet.
- j. **Each team will have 3 minutes to set up, adjust and calibrate their device and to putt a maximum of two putts.** Inspection and measurement time by the event leaders will not be included in the allotted time.
- k. To putt, teams will place a golf ball on the floor in a position where it will be struck by the swing of the putting arm. The ball may be placed anywhere as long as the device, in its resting position, remains in the putting area. The putting arm and other parts of the device may extend outside the putting area while in putting position or after the device is triggered (for example the putting arm can swing outside of the putting area).
- l. When given a signal from the event leader, one team member will trigger the putting device with the unsharpened starter pencil.
- m. If the team tries to trigger the device and it does not go through a putting motion, it does not count as one of the team's two putts and the team must be allowed to adjust/reset the device if time allows. If it does go through the motion and it misses the ball then the accuracy score is equal to the target distance so that their score for that putt is 0.
- n. After each putt, the Event Leader will indicate to the team when they may approach the golf ball and target to assess how they may calibrate or adjust their device (for the second putt).

11. **SCORING:**

- The highest score between the two putts will be used.
- Putt Score = TD - AS
- Target Distance (TD) = distance set by event supervisor (see 10.c. above)
- Accuracy Score (AS) = measured straight line distance, in cm (to the .1 cm), from center of the target to the closest edge of the golf ball.

- e. Teams will be ranked into tiers based on adherence to the challenge instructions. Within each tier, teams will be ranked based on their highest accuracy score.
 - i. Tier 1: Teams with no violations.
 - ii. Tier 2: Teams whose device violates any part of sections 9 or 10. Some examples are: If the device is higher than 1 meter; If a team member touches the lever arm to make a putt; If a team impounds their box or any materials late.
- f. Tiebreaker:
 - i. Score of second putt.

12. **RESOURCES**: <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

STEM Design Challenge Score Sheet

School Name: _____ Team (Circle One): Varsity JV1 JV2 JV3

Student Names: _____

- | | YES | NO |
|--|-------|-------|
| 1. The box was impounded on time and the box is clearly labeled with the school/team name and designation. | _____ | _____ |
| 2. All materials and tools fit in a box that is no greater than 30.0 cm x 35.0 cm x 50.0 cm, including the lid, which fits all the way on the box and closes completely.
NOTE: Any materials or tools that are not on the approved list will be removed before the competition and given back to the team at a later time. Any pre - assembled materials will be taken apart by the event leaders before the event. No penalty will be assessed for this. | _____ | _____ |
| 3. The entire device fits inside an imaginary cube 1m wide by 1m long by 1 m high in resting position. | _____ | _____ |
| 4. The structure is free-standing and not attached to a table, floor, or any other support. | _____ | _____ |
| 5. The device is triggered using an unsharpened pencil and no energy added. | _____ | _____ |

Teams with a “no” checked above will be placed in Tier #2.

Tier = _____

Putt #1 Score = $\frac{\text{_____ (cm)}}{\text{TD}} - \frac{\text{_____ (cm)}}{\text{AS}} = \text{_____}$

Putt #2 Score = $\frac{\text{_____ (cm)}}{\text{TD}} - \frac{\text{_____ (cm)}}{\text{AS}} = \text{_____}$

Tier* (Circle one): 1 2 DQ

Final Rank: _____

***Note:** Ties broken by the highest score for the second putt.
DQ would only be used in the case of a sportsmanship issue or receiving outside assistance.

Super Sleuths

1. **DESCRIPTION:** Given a mystery scenario, evidence, and a list of possible suspects, teams will be expected to perform a series of tests to draw specific conclusions about the scenario and suspects. The test results along with other evidence will be used to solve the mystery of the scenario.
2. **ESSENTIAL STANDARDS ALIGNMENT:** 3.P.2, 4.P.2, Science as Inquiry
3. **TEAM OF UP TO:** 2
4. **MAXIMUM TIME:** 60 min.
5. **TEAMS:** Teams may bring only specified items and goggles. No other items are allowed. The event supervisors will check the kits, and confiscate non-allowed items. **Students not bringing these items will be at a disadvantage.**
 - a. Spot plates, cups, or any containers in which teams can perform the tests
 - b. Droppers, popsicle sticks, spatulas, plastic spoons, tongs, and/or forceps for handling materials
 - c. pH test strips or pH paper
 - d. A ruler
 - e. A wash bottle or dropper bottle of distilled water (don't use tap water for this)
 - f. Hand lens (aka magnifying glass)
 - g. Paper towels
 - h. A disposable cup for solid waste
 - i. Writing instruments
 - j. Safety gear – see rule #7.
 - k. Teams may bring one 8.5" x 11" two-sided page of notes containing information in any form from any source.
6. **EVENT LEADERS:** Event leaders will provide evidence at a central location or pre-organized bags of evidence for each team along with the following:
 - a. Iodine reagent (KI solution) Note: ***Be sure to check with parents about Iodine allergies before assigning students to this event.***
 - b. Vinegar
 - c. Isopropyl (rubbing) alcohol
 - d. A waste containerThe event leader may provide additional equipment such as microscopes or special demos as the test calls for; instructions on additional equipment will be given if deemed necessary. Flame tests are not permitted.
7. **SAFETY REQUIREMENTS:** Students must wear the following or they cannot participate:
 - a. Closed-toed shoes
 - b. Safety goggles (indirect vent goggles)
 - c. Long hair must be tied back
 - d. Optional: aprons, gloves, and lab coatsStudents who unsafely remove their safety goggles or are observed handling any of the material or equipment in a hazardous/unsafe manner (e.g., tasting chemicals or flushing solids down a drain) will be disqualified from the event.
8. **IMPOUND:** No
9. **THE COMPETITION:** Teams will be given a scenario that introduces a crime, suspects, and sources of evidence. Teams will perform tests on the evidence to identify the perpetrator of the crime and write up their analysis of the crime.

a. **Crime Scene Chemical Evidence:**

- i. Powders: Teams will be asked to identify up to 5 of the following powders. There will be no mixtures of powders: Alka Seltzer, baking soda, calcium carbonate, citric acid, cornstarch, sugar, flour, gypsum, non-iodized table salt, powdered milk, sodium acetate, sodium carbonate, vitamin C, yeast.
- ii. General Knowledge: Teams will be expected to answer questions about the tests they perform, chemical and physical properties of the powders, and proper lab procedure. Example questions:
 1. If the pH of a substance is 3.5, is it acidic or basic?
 2. What does it mean if a powder turns black in the presence of iodine?
 3. What is the chemical name and chemical formula of table salt?
 4. What is the proper method to smell a chemical?

b. **Crime Scene Physical Evidence:**

- i. Paper Chromatography: Students will set up and analyze evidence from paper chromatography (ink pens, juices, markers, etc). Students should understand the basic principle of paper chromatography and be able to make predictions about the crime scene based on chromatographs. No calculations are expected to be performed. Water chromatography only.
- ii. Hair and fibers: Teams will be asked to compare known fiber/hair samples to samples found on the suspects and at the crime scene. Hair fibers will only include human, dog, and cat. Fibers will be limited to: cotton, nylon, polyester, & wool.
- iii. Toolmarks: Teams will be asked to analyze scratches, marks, indentations, etc. found at the crime scene and compare them to objects (such as tools) found near the scene or in possession of the suspects.

- c. **Analysis of the Crime:** Students will answer questions about which pieces of evidence implicate which suspect and why the suspect was chosen as the culprit, and also why the other suspects were not chosen. They will also answer any other crime scene analysis questions posed by the event supervisor.

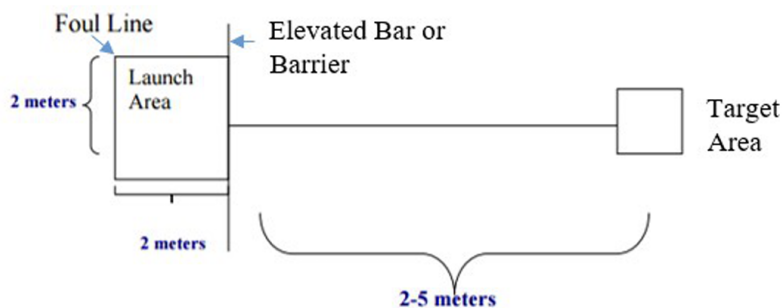
10. **SCORING:** The team with the highest score wins. Time will not be used for scoring. The score will be composed of the following elements (percentages given are approximate):

- a. Analysis of chemical evidence 50%, analysis of physical evidence 30%, and analysis of the crime 20%.
- b. Tiebreaker: The highest score on the chemical evidence analysis will break ties.
- c. A 10% penalty may be given if the area is not cleaned up as designated.

11. **EVENT RESOURCES:** <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

Trajectory

1. **DESCRIPTION:** Teams will bring with them a device constructed out of specified materials to protect a raw egg from breaking when tossed over a bar or barrier and allowed to fall to the floor or pavement. The goal is to keep the egg from cracking or breaking during its impact with the floor or pavement.
2. **ESSENTIAL STANDARDS ALIGNMENT:** Science as Inquiry
3. **TEAM OF UP TO:** 2
4. **MAXIMUM TIME:** 10 min.
5. **TEAMS:** Teams must bring egg protection devices and safety glasses.
6. **EVENT LEADERS:** Must provide score sheets, scales or a balance, paper towels, tarps, raw Grade A Large chicken eggs that have been massed ahead of time, plastic bags for the eggs, and all materials needed for the event. Event leaders will write the mass of the eggs ahead of time on each egg with a permanent marker.
7. **SAFETY REQUIREMENTS:** Teams must wear safety glasses throughout the event.
8. **IMPOUND:** None
9. **THE COMPETITION:** This event should occur in a large room or outdoors.
 - a. Teams build ahead of time an egg-protecting device using the following specifications
 - i. The device dimensions must not exceed 30 cm in any direction.
 - ii. The device (including the egg) must not exceed 500 grams. The mass will be used as a tiebreaker.
 - iii. The device may only be made out of the following materials:
 - Cups, plates, or bowls made from paper or Styrofoam, Rubber bands, Paper of any kind (recycling used homework sheets is encouraged!), Paper or plastic straws with or without wrappers, Cotton balls, Natural or synthetic fiberfill (i.e. Poly-fil), Packing peanuts, Bubble wrap, Plastic bags (baggies or plastic grocery bags), Tape (any kind), Standard cardboard tubes from toilet paper or paper towels.
 - iv. The device may not contain anything that would aid it in adhering to the target.
 - v. The device may not have anything that would aid in slowing the free fall (e.g., parachutes, streamers, etc.)
 - b. The target area will be approximately 60 cm x 60 cm with a target in the center of the area. Teams will set up in a 2.00 m x 2.00 m launch area that has a 3-meter high bar or barrier at the front of the launch area (see picture below. Teams will toss the egg-containing device over the bar/barrier. The target distance will be between 2.00 and 5.00 meters marked on the half meter. So, the target could be 2.50 m, 3.00 m, 3.50 m, 4.00 m, 4.50 m, or 5.00 m. The distance will remain the same for all teams.



- c. Once teams enter the launch area to compete, they may not leave the area or receive outside assistance, materials, or communication until they are finished competing. Only team members, event leaders and event assistants will be allowed in the event area while teams are competing. Teams violating this rule will be disqualified.
- d. Teams will have 5 minutes to load the egg, contained within a plastic bag, into the device and seal the device. Teams should bring their own tape or other material needed to seal the device after loading the egg.
- e. Teams must use eggs and plastic bags provided by the event leader and will be allowed to inspect and select their own egg from a carton of available eggs. Once the team chooses an egg, it is their responsibility to handle it carefully and keep it from breaking. If the egg is broken while loading the device or before tossing the device, event leaders may or may not be able to provide a second egg.
- f. The event leader will inspect and record the mass of the device to the nearest 0.1 g after it has the egg and sealed bag loaded. No additional materials may be added unless they were included in the mass recorded.
- g. The event leader will indicate when it is OK for teams to toss the device. Teams must stand behind the front of the launch area, one member will toss the egg-containing device over the elevated bar or barrier that is 3 meters high and as close to the target as possible. The device must go over the bar/barrier without touching it and land on the hard surface below (floor or ground). The tossing team members body parts may not extend beyond the launch area at any time during the toss. If a team does not clear the bar, the team may try tossing again without repairing the device.
- h. Once the egg-containing device lands, the event leader will measure the distance (point to point) from the target center to the furthest piece/part of the egg-containing device. Measurement is to the .01 meter.
- i. Following measurement, event leaders will request a team member to pick up the team's device and remove the egg to show if it survived. Breakage is defined as being cracked or broken enough to leave a wet mark on a paper towel. If the egg cracked or is broken, then the team is placed in Tier 2. Eggs that break upon removal before being verified as unbroken by an event leader will be scored as broken.

10. **SCORING:**

- a. Devices will first be ranked in tiers according to the following guidelines.
 - i. Tier 1 = Devices with eggs that survive and with NO competition violations
 - ii. Tier 2 = Devices with eggs that break or with competition violations
- b. Within each tier, devices will be ranked by distance to the target. In the event of a tie, the lightest egg-containing device wins.

11. **EVENT RESOURCES:** <https://ncscienceolympiad.ncsu.edu/resources/elementary/>

Trajectory Score Sheet

School Name: _____ Team (Circle One): Varsity JV1 JV2 JV3

Student Names: _____

- | | YES | NO |
|---|------------|-----------|
| 1. Device dimensions are 30 cm or less in any direction. | _____ | _____ |
| 2. Device mass (with egg) is 500 grams or less (Mass = _____) | _____ | _____ |
| 3. Device only used allowed materials | _____ | _____ |
| 4. Device is free of any adhesives that would aid in adhering to target | _____ | _____ |
| 5. Device is free of parachute or streamers,
or anything that would aid in slowing the free fall | _____ | _____ |
| 6. Device determined to be safe | _____ | _____ |

Teams with a “no” checked above will be placed in Tier #2. **Tier =** _____

- | | | |
|---|-----|-------|
| 7. Distance (point to point) from the target center to the furthest piece/part of the egg-containing device. Measurement is to the .01 meter. | | _____ |
| 8. Did the egg break or crack (circle one) | YES | NO |

Tier (Circle one): 1 2 DQ **Final Rank:** _____

Note: SHORTEST DISTANCE within each Tier wins. Rank event from smallest measurement to largest within each Tier. In the event of a tie, the lightest egg-containing device wins. DQ would only be used in the case of a sportsmanship issue.