ELEMENTARY SCIENCE OLYMPIAD SIGNATURE EVENTS

Aerodynamics Aloft

How to use this Kit

The activities in this kit were designed to encourage hands-on learning and exploration for students in grades K-6, either at home or at school. Some students (grades 3-6) may be able to manage the activities on their own, and some students (grades K-2) will need an adult presence for part or all of the activities - you know your student best. No matter what, we hope that this kit helps to spark some curiosity in your student that grows into a lifelong love of science.

Tips on Supporting Your Student

- Skim through the materials and activities beforehand to get a sense of what support your student might need, as well as what common household items they may need for the activities. Ensure there are enough of these materials in case they make a mistake (which they will) or they want to extend the activity (which we hope they will).
- Encourage your student to work through mistakes and challenges without fixing things for them. You can say things like: "That's an interesting result. Is that what you expected?" or "What do you think will give you a different result next time?"
- Model not knowing all the answers. Science is all about exploration and experimentation. This is a wonderful opportunity to show your student that it's OK to not know an answer and to spend some time trying to figure it out.
- Help your child extend their learning beyond these activities by pointing out similar concepts in the real world, talking about careers that utilize the science concepts in the activity, and helping them find high-quality resources (books, websites, online videos) for further exploration.

Note: If you are a classroom teacher or an afterschool program provider, we have included recommendations for large and small group modifications and competition extensions.

About Science Olympiad

For more than 35 years, Science Olympiad has been dedicated to supporting science, technology, engineering and math (STEM) learning and teaching across the United States. As a non-profit organization, we support schools, teachers, and families through curriculum, science competitions, and learning opportunities for the elementary, middle and high school grades. We are helping to grow the next generation of STEM innovators, researchers and enthusiasts.

Elementary Science Olympiad is the perfect complement to any K-6 science program. Support your normal classroom routine with an all-building Science Olympiad Fun Day, or bring in experts and parent volunteers to run a Science Olympiad Fun Night. If you want to develop a feeder program, run a grades K-6 competitive tournament, just like the older kids, and with many of the same rules, just scaled down to size.

Find out more about the organization and how to start a program at your school at: soinc.org/programs/elementary.

Aerodynamics Aloft

Activity 1

Objective

- Participants will learn about the four forces of flight and will do a simple experiment to illustrate Bernoulli's principle of lift.

Notes for Parents & Teachers

- Practice the activity beforehand yourself so you can see where to hold the paper to get the best effect.

Set Up

- Cut white paper into 2"X11" strips. At least one per participant.

Materials

- Paper cut into 2"X11" strips of paper - 1 per participant
- Scissors

Procedures

Introduce students to the concepts of LIFT, THRUST, DRAG, and FLIGHT through this introductory activity. The parent/teacher can read the text below out loud to the students.

1. Have you ever watched the birds soar above you and wondered how they could stay afloat for so long without their wings getting tired? How about an airplane....how could such a heavy object defy the force of gravity and get so high up in the air so quickly?
2. Grasp one end of a strip of 2" X 10" paper and set it just against your chin, below your mouth. What do you think will happen to the paper? Will the paper go up or down?
3. Blow forcefully across the top of the paper-it should rise. Why does this happen?
4. A man named Bernoulli discovered that fast-moving air has less pressure than slow-moving air. You just saw what is called the "Bernoulli's principle" in action. When you blow hard across the top of the paper, the air is moved quickly. The paper rises because the pressure under the "wing" is greater, pushing the paper up. This is the force of LIFT that a plane uses to go up.
    a. If LIFT is the force that makes a plane go up, what force pulls on the plane to hold it on the earth? Answer: Gravity
    b. Wings give an airplane LIFT, but they don't drive it forward. THRUST is the force that does that. The airplane pushes against the air as the plane moves forward, creating a force we call DRAG. When THRUST overcomes DRAG and LIFT overcomes GRAVITY, the plane rises and we have FLIGHT.

Note: These same forces are at work if we are flying real planes or paper airplanes.

Modifications for Multiple Participants

- No modifications needed

Modifications if Event being done Competitively

- Won't be done competitively

Accommodations for Diverse Learners

- If the participant cannot hold the paper or appropriately blow on the paper, a partner or adult can model the activity for them.

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Activity 2

Objectives

- Participants will construct a basic paper airplane that will show Bernoulli's principle of lift in action.
- Participants will put into practice techniques of construction and throwing so that they will be better prepared to accurately hit a target.

Notes for Parents & Teachers

- Make sure you have a designated LARGE/LONG space for this activity. A gym or cafeteria or outside paved space on a windless day are great choices because you have the space needed to throw the planes, you can have a small area dedicated to building and adjusting airplanes and you can put tape on the floor.
  - If you have never experimented with paper airplanes before, know that this is a somewhat chaotic activity, especially if you have several participants. If you can have one LARGE space to do the making and flying, it will help. That way, participants can move between making planes, testing them, and adjusting them.
- Practice making and throwing a few of these planes beforehand so that YOU understand what's going on with them.
- Determine a "launching line" on the floor of your space. Lay down a strip of masking tape at one end of the hall/room/gym to mark this line.

Notes for Teachers

- Make sure you have reserved a large space, such as the gym or lunch room, for this activity.
- This is a great event to invite parent/guardian help into your classroom. Many hands will be needed to help with the folding, throwing and adjusting.
- Have students write their names on their planes.

Set Up

- Make a target for this activity. A large piece of paper or poster board with a large black dot in the center will do the trick. You can place the target at a distance of 5 meters to start out with. As the throwing gets more precise, move the target out farther.
- Beginning at the starting line, and using a tape measure, make a line at every meter from 1-15 meters. This will reduce the need to measure the distance thrown each time.

Materials

- Lots of 8 1/2" X 11" paper (scratch paper, as long as it isn't wrinkled, is great!)
- Masking tape
- Metric Tape Measure
- Copies of attached worksheets for each participant:
  - Aerodynamics Aloft Flight Log
  - Aerodynamics Aloft Troubleshooting Sheet
  - Aerodynamics Aloft Airplane Construction Directions

Procedures

1. Following the steps on the worksheet, participants should make the airplane.
2. Launch paper plane toward the target. Ask participants: "How close did you get to the target? What should you do differently next time?"
3. The parent/teacher can suggest options for modifications:
    a. Does it make a difference if you:
        i. Hold the plane in a different spot while launching?
        ii. Change the amount of force while launching?
        iii. Change the plane construction: stabilizers, add/subtract weight, use different paper
        iv. Adjust the stabilizers?
        v. Add/subtract weight with more tape/less tape/no tape?
        vi. What does paper of differing weight do to the airplane?
        vii. Check out the Troubleshooting page for more information.
4. Change the position of the target once you get really good at hitting the target in its current position.

Note: After a few launches, the nose of your plane will be pretty beat up. Just make another one (or 2)! Use our directions, come up with your own design or do some research.

Modifications for Multiple Participants

- If multiple participants are making planes, be sure to label their planes with their names.
- Participants should only touch their airplanes and no one else's so that no one accidentally damages someone's airplane.
- Participants should always throw in the same direction for safety. Participants should never be walking toward those who are throwing airplanes. At no time should participants be throwing airplanes at other participants.
- If you have a large space, all participants can throw at one time, retrieve their planes, then return to the Launching Line via the sides of the area.
- If you only have a hallway, participants might throw in small groups, retrieve their planes, and return before the next volley.

Modifications if Event Being Done Competitively

- Participants will be given a partner.
    - Each participant gets to make their own airplane.
    - Practice with your airplane and, if necessary, make several airplanes, adjusting and modifying as needed. Pick the best airplane to use during the competition.
- Participants will line up at the Launching Line. Each participant will take his/her turn at throwing 1 plane toward the target.
- Parent/Teacher will measure the distance from the center dot on the target to the SPOT THE PLANE FIRST LANDS. (If doing this activity at school, parent "spotters" would be good for this.) Use the large metric tape measure to get an exact measurement. Record this number on the Aerodynamics Aloft Flight Log.
- As the worksheet indicates, the "score" will consist of the two team members' distances added together. The team with the lowest score will be the winner during the actual competition.

Accommodations for Diverse Learners

- Tactile lines may be made to assist with folding. These may be bold lines, textured lines using thin dried lines made from glue, lines made with texture using pin size holes or pre-folded lines that have been unfolded for the participant to refold.
- A partner may do the folding while directions are rephrased by the participant. If gross motor impacts throwing ability, allow a partner to launch the plane or an adult may provide hand over hand support to assist the participant launching the plane.

Next Generation Science Standards Addressed

The Next Generation Science Standards (NGSS) associated with the lesson are included to represent the specific learning outcomes that students are working towards during the course of this lesson. Teachers use these standards to guide their instructional planning and selection of learning activities. In particular, these standards help teachers determine the specific science content is developmentally appropriate for a student as well as how it should be sequenced over the course of a student's time in school.

For parents and guardians, this information is provided so you can see some of the "big ideas" that your student is working towards in this lesson. Additionally, these standards show you how the different topics in science combine to help inform your collective understanding of issues. We have selected the NGSS as our reference for all Elementary Science Olympiad Signature Events because they represent the best national thinking around science learning for K-12 students. Also, many states have either adopted the NGSS as their state science standards or revised their state science standards to reflect information contained in the NGSS. If you would like to learn more about the NGSS, you can find additional information, including which states have officially adopted the NGSS, at nextgenscience.org.

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- Energy: 4-PS3-1
- Engineering Design: K-2-ETS1-1, 2, & 3; 3-5-ETS1-1, 2, & 3
- Forces and Interactions: MS-PS2-2
- Motion and Stability: Forces and Interactions: 3-PS2-1; 5-PS2-1

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Flight Log

Name:

Participant	Flight 1	Flight 2	Total Score

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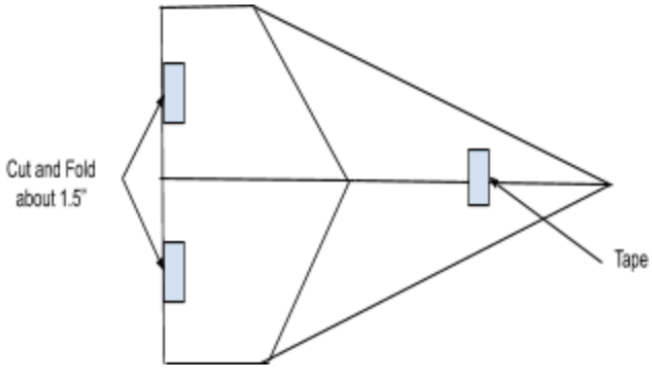
Troubleshooting Sheet

Construction Hints

- Fold carefully to make sure the left and right sides of the airplane are exactly equal.
- Make your creases sharp by running your finger or a ruler across the fold.
- If your plane is not flying straight enough, adjust the "stabilizers" by folding them up or down. *For an even flight, they need to be folded exactly the same!*
- If your plane is curving in flight, inspect the nose of the plane. If it is bent, it may need to be straightened out.
- Sometimes putting a little tape on the nose helps to add weight and helps the plane fly farther and/or straighter.
- Remember that a plane will get "beat up" after a few tests. At this point, you need to make a new plane.
- You can change your plane design by cutting little flaps in the wings. (See diagram.) By folding the flaps up and down, the plane will change its flight pattern. But be careful! A little change goes a long way.



Flying Hints

- Practice holding the plane about one-third of the distance from the nose when throwing.
- "Follow through" by extending your arm all the way as you release the plane.

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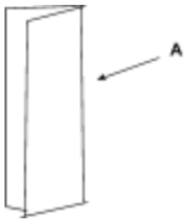
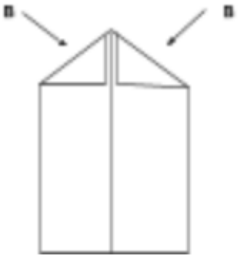
Airplane Construction Guidelines

Use any good paper (recycled paper is good!) to make your airplanes. Be sure to put your name on your plane if more than one person is throwing.

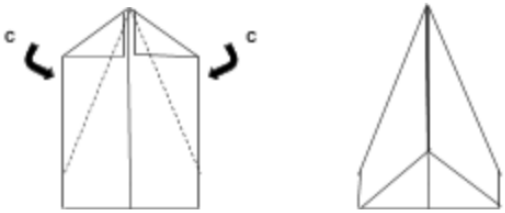
Fold the paper in half lengthwise ("hotdog") on line A, creasing it sharply along the fold.



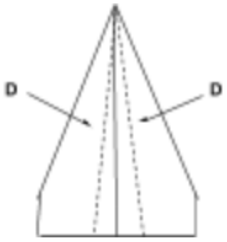
Open up the paper and fold the corners down (B) toward the center as shown.



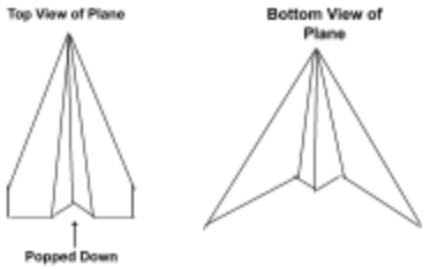
Fold the sides down again, toward the center, matching up the solid dark lines (C). Crease the folds sharply.



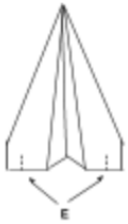
Turn the airplane over. One by one, fold the sides over the middle (D) to an arbitrary point that is symmetrical with the other side, causing the middle spine to pop up.



Here is what your plane should look like from the top & back, and from the bottom, with the middle spine popping up.



Fold up and in on the dotted lines (E) to create "stabilizers". Pinch the body of the plane together. Use a piece of tape to help the plane hold this position.

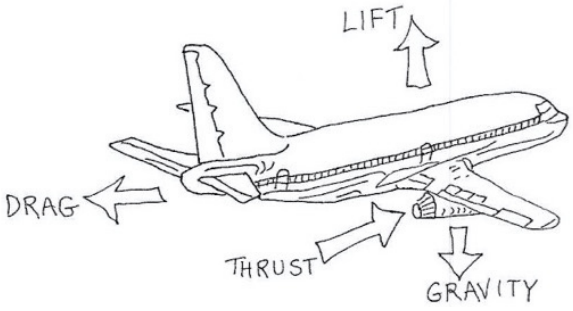


*Hold the plane about one third from the nose when launching.

*Use the biggest open space you can find, or one decided on by your teacher.

*When you're on your own, you can make more planes like this and change the angle of launch to see what happens.

The Forces of Flight



FLIGHT is attained when THRUST overcomes DRAG and LIFT overcomes GRAVITY.