Arkansas School-Age "LINKS"

ASU Childhood Services

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School-Age "LINKS" was compiled and formatted by ASU Childhood Services

In order to better compete with their international peers in the 21st century, American students will need to be better prepared to work in the growing fields of science, technology, engineering, and math. This brief written by the Afterschool Alliance in 2008 explains the ways in which afterschool can engage kids in these fields, collectively known as STEM.

Afterschool Programs: At the STEM of Learning

As the 20th century fades into history, it takes with it the old industrial economy in which plentiful manufacturing jobs offered millions of people without a college education a ticket to the middle class. The 21st century's information economy is creating more jobs that require not only a college education but also at least some expertise in the fields of science, technology, engineering and math, collectively known as STEM. In order to stay competitive in the global marketplace and provide our children with the best chance to succeed in life, we must get more students on the STEM path. All across the country, schools and communities are using the hours after school to do just that.

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ARKANSAS DEPARTMENT OF HUMAN SERVICES

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Afterschool Programs : At the STEM of Learning

Letting an Opportunity Pass

The U.S. Department of Labor is projecting that jobs requiring training in STEM will increase by 51 percent between 1998 and 2008, four times faster than overall job growth. By 2008, some six million job openings for scientists, engineers, and technicians will exist.[1] Unfortunately, American students are losing ground to their international peers when it comes to earning degrees and going into careers in those lucrative, burgeoning fields.

In 2005, roughly 29 percent of fourth- and eighth-grade students participating in the National Assessment of Educational Progress (NAEP) reached or exceeded the proficient level in science. Among 12th-graders, only 18 percent reached or exceeded proficient. In 2007, 39 percent of fourth grade participants and 32 percent of eighth-grade participants scored at or above proficient in math.[2]

- In 2006, 15-year-olds in the U.S. ranked 22nd in math and 19th in science among developed nations. Among these countries, the U.S. has the fourth largest gap between high- and low-income students.[3]
- Among high school graduates, the percentages of blacks and Hispanics ages 25 to 29 in 2000 who had completed bachelor's or higher degrees in science and engineering stood at 21 percent and 15 percent respectively, compared with 36 percent for whites.[4]
- Students on temporary visas earned 32 percent of all science and engineering doctorates awarded in the United States in 2003. Fifty-five percent of engineering doctorates and approximately 43 percent of U.S. doctorates in mathematics, computer sciences, and agricultural sciences were awarded to students on temporary visas.[5]

No one tells [students] or their parents that by failing to enroll in a rigorous, math-oriented college prep curriculum, they're effectively making a life decision to forgo the opportunity to pursue a career as a scientist or engineer.

— Education Sector, "Analysis and Perspectives: High Schools Failing to Prepare Many College-Bound Students for Science Careers"

A Matter of (Extra) Time

Both learners and teachers need more time—not to do more of the same, but to use all time in new, different, and better ways. The key to liberating learning lies in unlocking time.[6]

Combining STEM learning with the youth development expertise of afterschool professionals has the potential to revolutionize both fields by integrating each other's strengths. Afterschool programs are proven to teach the so-called "soft skills" of communication, problem solving, and teamwork, which young people need for any career. Making use of the hours after school for STEM activities gives students time to develop an interest in science, which is key to getting kids into STEM careers.

- Public Agenda's Reality Check 2006 finds that 45 percent of students would be "really unhappy if [they] ended up in a job or career that required doing a lot of math and science."[7]
- As youth get older they report significantly less interest and self-confidence in their science ability. Children ages 6-12 report a high level of interest and belief in their science abilities; by age 14, interest and self-confidence related to science drops off.[8]
- Interest in science careers among eighth-graders can be a better predictor than test performance in determining which students will pursue careers in science.[9]

- More than 90 percent of afterschool programs funded by 21st Century Community Learning Centers offer STEM activities, providing more time for children and youth to gain skills and build interest in the STEM fields.[10]

As a report from the Coalition for Science After School concluded: "After-school settings are optimal for providing engaging, hands-on STEM experiences, enabling students to apply, reinforce, and extend skills and concepts taught in school. And they are particularly conducive to project-based activities where a wide variety of children can participate in the design, construction, investigation, sense-making, and communication of science projects."[11]

Afterschool programs are also a positive addition to an education system that is seeking more options for delivering science learning experiences. Recent reports have found time for science limited in elementary classrooms.[12] Elementary teachers are rarely science experts and need more resources to offer quality science opportunities.[13] Several projects are finding success by inviting afterschool staff members to become part of the STEM education workforce. Curricula developed by NASA, the Educational Equity Center at The Academy for Educational Development, the Miami Museum of Science, the Intercultural Center for Research in Education, and several others is specifically designed and tested for use by the afterschool workforce. Other projects, including some funded by the National Science Foundation Academies for Young Scientists grants, are connecting pre-service teachers to afterschool to learn about science instruction that is youth-centered and open-ended.

Furthermore, afterschool programs' connections to community organizations such as museums and science centers can change attitudes about math and science. Students from underrepresented communities can gain the necessary skills to compete in formal science classrooms. Some afterschool programs are already making headway, giving students extra time to explore the STEM fields:

- Minneapolis and St. Paul's STUDIO 3D (Digital, Design, and Development) brings advanced computer technology projects to economically disadvantaged youth. Working with mentors, program youth participate in activities that use fundamental principles of math, geometry and engineering, such as 3-D digital animation, robotics, web design and computer programming. They have even used their skills to put some of their projects, complete with instructions, on a Studio 3D website. (www.smm.org/studio3d/projects.html)[14]
- Michigan's KLICK (Kids Learning in Computer Klub houses) serves middle school children throughout the state. KLICK students get to put their new computer knowledge to immediate use by engaging in projects that help their community. For example, one student developed and maintains the websites for the local 911 service and his own parents' dry cleaning business. Students also give computer lessons to community members and troubleshoot computers at their own schools.[15]
- Girls Inc. Operation SMART® (Science, Math and Relevant Technology), since the early 1980s, has engaged 617,000 girls and young women ages 6-18 in the hands-on, inquiry-based fun of exploring the natural world. Many science and math programs, both in and out of school, operate with girls as an afterthought. At over 1,000 Girls Incorporated® program sites in the United States and Canada, girls are front and center, getting comfortable with power tools and computers, and investigating insects and mechanical problems as they become scientists.

Girls work directly with scientists, engineers, and other professionals—archaeologists in Girls Dig ItSM, computer professionals in Eureka! ®, and environmental scientists and astronomers in Thinking SMARTSM. Evaluations conducted by Girls Inc. affiliates indicate that girls gain skills and confidence in doing math and science and are more likely to consider careers in these fields.[16] The scientists, engineers, and mathematicians among Girls Inc. "graduates" credit their days in Operation SMART with expanding their minds and their options.[17]

- The St. Louis Science Center launched the Youth Exploring Science (YES) program in 1997 to provide low-income, minority teens from community organizations with four years of opportunities to explore scientific concepts through inquiry-based experiences and then to teach others. As part of their teaching duties, YES teens facilitate science and mathematics activities in the community, including at other afterschool programs. YES teens start as volunteers but eventually become Science Center employees and earn wages. Of the 35 high school seniors in the 2006 program, 24 have been accepted into one or more colleges. One former student has graduated with a degree in biology from Grambling State University and hopes to go to medical school. Others have graduated with teaching degrees.[18]
- A recent evaluation of Kinetic City After School, a program managed by the American Association for the Advancement of Science, found significant increases in reading and writing proficiency along with science skills. Children participating in the program showed improvements not only in their knowledge of standards-based science content-- which is to be expected of a science program-- but also in their ability to read a seventh-grade level reading assignment, and compose a letter based on the information in the passage. The children also showed more interest in science careers, and were more likely to have engaged in science activities "just for fun."[19]

A Promising Remedy

Afterschool programs have proven to be effective supports for young people on a variety of fronts; including fostering healthy lifestyles, preventing drop-outs, boosting students' academic achievement and self-esteem, and helping young people find and develop their passions. As the public and parents become more concerned about today's students falling behind in math and science, they are realizing that the extra hours after school can be used to help our young people keep up and even excel. In fact, a recent poll found that 81 percent of Americans favor expanding afterschool programs as a means to increasing students' access to math and science education, even if this increases the per-pupil spending.[20]

Afterschool programs alone can not make up all the lost ground. They can and should, however, be part of a more comprehensive approach to giving more young people a chance to discover an interest in STEM, and an aptitude that could lead many -- especially those from underrepresented populations – to choose degrees and careers in the STEM fields.

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UNIVERSITY OF ARKANSAS DIVISION OF AGRICULTURE

4-H Afterschool EXTRAORDINARY LEARNING OPPORTUNITIES

Flying Fighters

(15-19 years of age)

Are you ready to make and fly a fighter kite? The Nagasaki Hata is a popular Japanese fighter kite. By understanding where the center of gravity is and how to control its yaw, roll and pitch, you can make your kite execute a variety of acrobatic tricks. See what you can make your kite do as you perform several experiments and organize a kite-flying contest. Making a fighter kite with a friend or your helper is a way to double the fun. This kite requires a long tail because it is so unstable, but it's also highly maneuverable. After you build your fighter experiment flying it by using different size tails.

Specifications Rating:
With tail: novice
Without tail: expert
Wind:
Light to moderate
Line:
6-10 lb test (2.7-4.5 kg)

Activity: Build a Nagasaki Hata Fighter Kite and organize a kite flying contest.

Aerospace Skills: Building a fighter kite; experimenting with roll, pitch and yaw

Science Skills: Experimenting; building models

Materials: One 18" x 18" plastic sheet (kitchen garbage bag); one 21 ½" x 1/8" dowel; one 27 ½" x 1/8" dowel (match stick bamboo can be substituted); 43" kite line (10#-20# test); nylon reinforced tape; scissors; ruler

Nagasaki Hata Fighter Directions:

- Fold 18" x 18" plastic sheet in half. (Figure 1) Measure 4" down from top (Y) along the fold and draw a line to corner (X). Cut on line Y to X.
- Open plastic and lay shortest dowel (called a "spine" in kite terms) on fold. Tape to plastic at top and bottom (Figure 1) at points (W and Z).

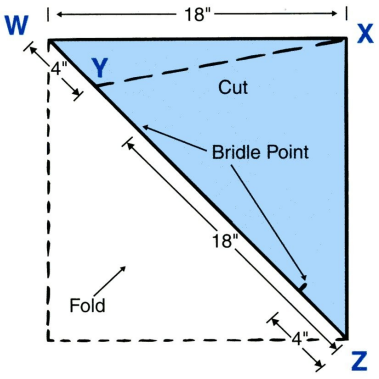


Figure 1

- Lay the longest dowel (called "strut" by kite flyers) on corner A and place toward tope of kite. Tape in place as shown. Bend strut and tape at point B. (Figure 2)
- Where both dowels cross (Figure 2, point C); punch holes on both sides and tie "bridle line" (kite string) around both dowels. Measure 4" up from the bottom of the spine – point D. (What is a spine? Look back to #2.) Repeat on other dowel end.

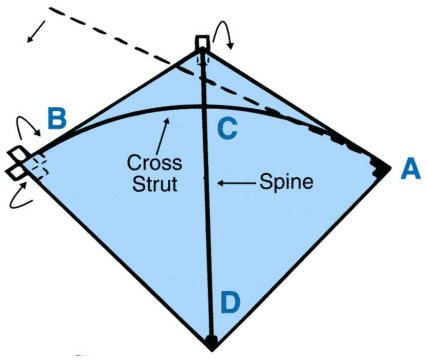


Figure 2

- Tie kite string in a loop ½" above center. (Figure 3). A tail can be added by tying a narrow strip of plastic to the dowel below point D.

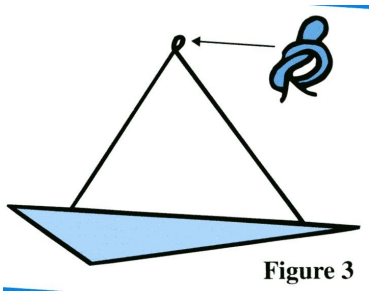


Figure 3

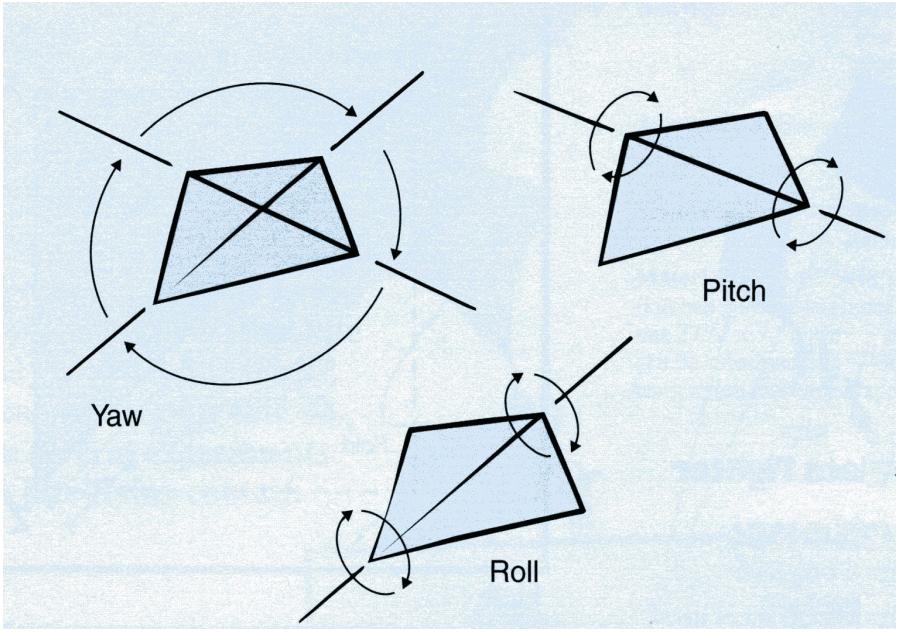
Kite Flying Tips

- When flying, a quick loosening of the tow line will cause the kite to become unstable and change its direction of flight. When the nose is pointed in the desired direction, placing tension on the kite will cause the kite to stabilize and continue on that flight path.

- If at any time the kite feels out of control as it dives toward the ground, do not pull on the tow line. If you do, the kite will increase speed and crash. To change direction, simply loosen the tow line from your hand until the kite changes direction. To maintain this new direction, just pull on the tow line once again. See for yourself!

	Action	Result
Quick loosening of the tow line		
Nose pointed in the desired direction, placing tension on the kite.		
Loosen the kite tow line from your hand		
Pull on the tow line after loosening it		

Source: University of Arkansas 4-H Afterschool Provider Curriculum 2010-2011



Use your kite to experiment with yaw, roll, pitch and center of gravity by doing the following:

1. Hold your kite away from you and balance it on one finger. What did you discover?

2. Use the diagram to try to roll your kite. How did you maneuver your kite?

3. Use the diagram to try to yaw your kite. How did you maneuver your kite?

4. Use the diagram to try to pitch your kite. How did you maneuver your kite?

Debriefing

Ground to Ground (Share)

- How did you make your kite?
- How did your kite fly?

Climb Out (Process)

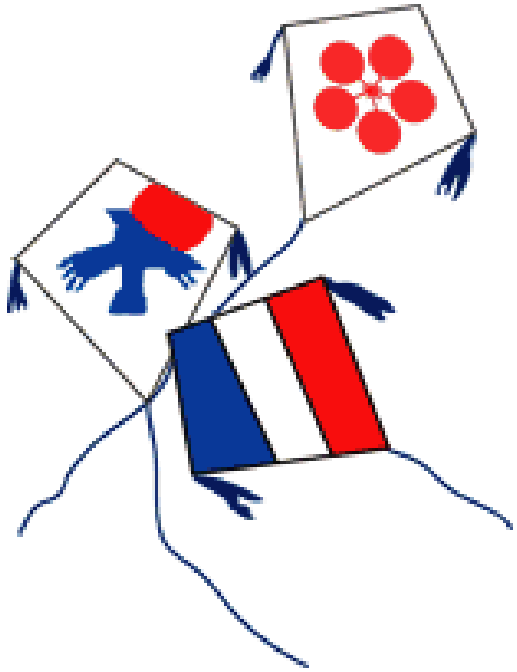
- How does a kite's center of gravity affect the way it flies?
- What are the benefits of a tail on a kite? How did your kite's tail help control yaw, pitch and roll?

Level Off (Generalize)

- How can making a model and making adjustments to it help you learn new things?
- What are some things you learned through the kite flying contest?

Cross Country (Apply)

- Describe ways that you learn through experimenting, and through contests.



Aerospace FACTS

Japanese Kite Flying

Kite flying, as practiced by the Japanese, is a highly competitive and often dangerous sport. Before a battle, kite warriors coat their flying lines with glue and bits of powdered glass. Sometimes curved steel blades are fastened to the tails. The object of the flight is to entangle an opponent's line and cut it down. Once a kite has fallen, the victor claims it as his own.

Solo Flight

The traditional colors of the Nagasaki Hata are red, white and blue. The designs are usually very simple, sometimes nothing more than three bold diagonal stripes. Decorate your kite to look like a traditional fighting kite or create a design of your own.

Find the center of gravity on a model rocket, airplane or kite. Demonstrate the design elements that stabilize a kite, airplane or rocket when they are affected by air turbulence.

UNIVERSITY OF ARKANSAS DIVISION OF AGRICULTURE

4-H Afterschool EXTRAORDINARY LEARNING OPPORTUNITIES

Wonderful Wings

(6-9 years of age)

Hummingbirds, robins, eagles, gliders, jets, helicopters and airplanes. What do all of these have in common? In this activity you will discover how birds and airplanes are alike.

Blast Off!

1. Color the birds and the airplanes on the following pages.
2. Cut out the fourteen picture boxes.
3. Arrange the boxes in order with the birds facing up.
4. Staple the boxes together on the top left corner. **Helper note:** Be sure edges are trimmed evenly.
5. Flip through the pictures and watch the bird take off, fly and land.
6. Turn your booklet over, flip through the airplane pictures and watch an airplane take off, fly and land.
7. Then draw and color a picture of your favorite airplane and bird.

Debriefing

Ground to Ground (Share)

- What did you see when you flipped through the cards?
- Share with your helper how the bird took off, flew and landed compared to the airplane.

Climb Out (Process)

- How do the feet, tail, wing and light weight body of a bird compare to the parts of an airplane?

Level Off (Generalize)

- How can comparing two things help you learn about them?

Cross Country (Apply)

- How can comparing things help you do something else in your life, like:
  - Decide which bike to buy?
  - Choose a meal at a restaurant?
  - Decide if you would rather have a dog or a cat for a pet?

- Pilots must have licenses to fly, just like drivers have licenses to drive. When people pass the tests to get their pilot's licenses, we say they have earned their "wings."
- A special department of government called the Federal Aviation Administration sets the rules for pilots. It also works hard to make sure flying is safe for everyone.

- Visit an aviary, zoo or your back yard feeder and watch how different birds take off, fly and land.
- Take a discovery airplane flight through the Young Eagle's Program.

Source: University of Arkansas 4-H Afterschool Provider Curriculum

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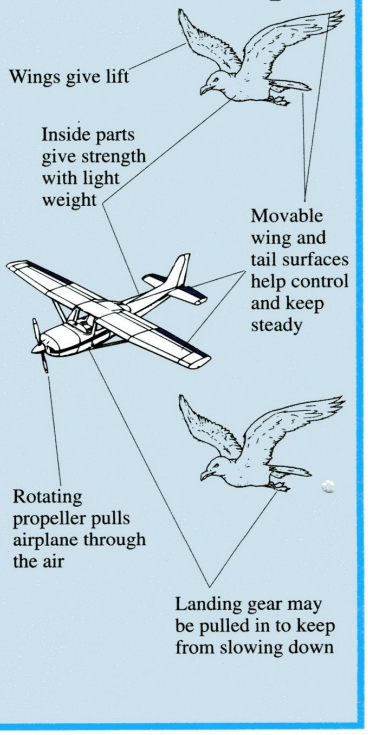
How Birds and Aircraft Fly



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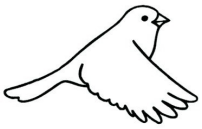

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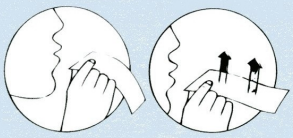
How Airplanes Fly

You can try this experiment to see how the wings of an airplane lift in moving air.

1. Hold one end of a sheet of paper close to your lips. Let the other end flop. Blow hard across the top.



2. The paper lifts because air is moving faster over the top of it. This lowers the pressure or weight of air above the paper. Because the air pressure underneath is greater, it lifts the paper.

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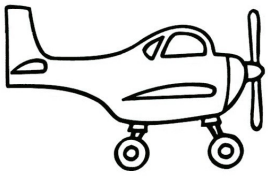

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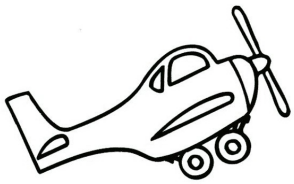

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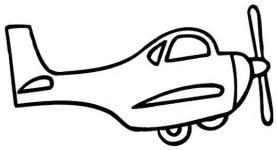

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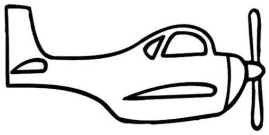

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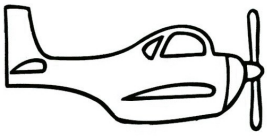

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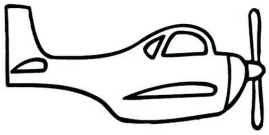

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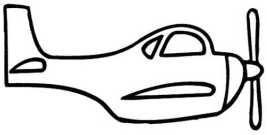

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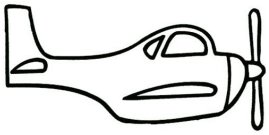

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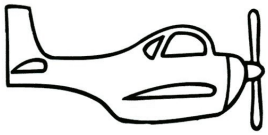

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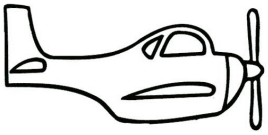

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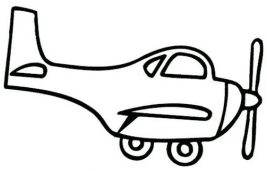

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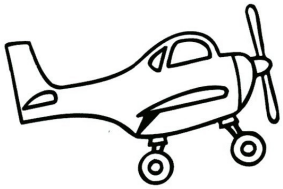

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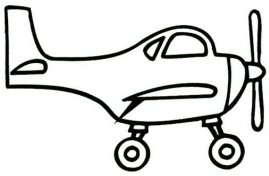

STEM Resources in the Natural State

Wanting to extend your STEM learning experiences to outside of your afterschool program? Consider the following science-related venues or resources in Arkansas that can assist you in engaging students in a variety of STEM related experiences:

In Little Rock:

- Central Arkansas Library System - http://cals.org/
- C.A. Vines Arkansas 4H Center - http://arkansas4hcenter.org/
- Heifer Ranch - http://www.heifer.org/site/c.edJRKQNiFiG/b.201557/
- Little Rock Zoo - http://littlerockzoo.org/
- Museum of Discovery - (closed for renovations until January 2012) http://amod.org/
- Pinnacle Mountain State Park - http://www.arkansasstateparks.com/pinnaclemountain/
- Witt Stephens Jr. Central Arkansas Nature Center - http://centralarkansasnaturecenter.com/

In Hot Springs:

- Garvan Woodland Gardens - http://garvangardens.org/
- Mid-America Science Museum - http://midamericamuseum.org/
- Ron Coleman Mining http://colemanquartz.com/

In Northwest Arkansas:

- Botanical Garden of the Ozarks - http://bgozarks.org/
- Hobbs State Park - Conservation Area - http://www.arkansasstateparks.com/hobbsstateparkconservationarea/
- Ozark Natural Science Center - http://onsc.us/
- University of Arkansas Discovery Zone - http://cmase.uark.edu/

Elsewhere:

- Arkadelphia: Henderson State University Planetarium - http://www.hsu.edu/interior2.aspx?id=759
- Jonesboro: Arkansas State University Museum - http://www2.astate.edu/museum/
- Pine Bluff: Arts & Science Center for Southeast Arkansas - http://artssciencecenter.org/
- Texarkana: Texarkana Museums System - http://texarkanamuseums.org/
- Statewide: The State Parks of Arkansas - http://www.arkansasstateparks.com/
- Arkansas Regional Robotics Hubs - http://asta.ar.gov/educators_Robotics.html
- Arkansas Natural Heritage Commission - http://www.naturalheritage.com/site-map/default.aspx?aspxerrorpath=/resources/education/natural_diversity/default.aspx
- Statewide: 4H Afterschool - http://www.kidsarus.org/4h_program.htm
- Arkansas Department of Education—Science Frameworks - http://arkansased.org/educators/curriculum/frameworks.html#science