



BOY SCOUTS OF AMERICA®

Baltimore Area Council
STEM In Scouting Day
at
Aberdeen Proving Ground

NOVA Award Prerequisites

The following pages contain the draft NOVA Award prerequisites for the Baltimore Area Council's "STEM in Scouting Day" to be held at Aberdeen Proving Ground on September 13, 2014. The prerequisites for each NOVA Award are in Bold and are highlighted in yellow. The NOVA Awards offered for the "STEM in Scouting Day" may be modified based on Scout pre-registration and Counselor availability. As NOVA Award Counselors are assigned, they will update the prerequisites based on resources and their planned course of instruction. NOVA Award Counselors will also be provided with the contact information for their pre-registered Scouts to communicate updated information about the class directly. Check back frequently for updates to the prerequisite list.

Questions on the list can be addressed initially to John Gillette: jgille4567@aol.com



Prepared. For Life.®

Shoot!

This module is designed to help you explore how science affects your life each day.

1. Choose A or B or C and complete ALL the requirements.

A. Watch about three hours total of science-related shows or documentaries that involve projectiles, aviation, weather, astronomy, or space technology. Then do the following:

- 1. Make a list of at least five questions or ideas from the show(s) you watched.**
- 2. Discuss two of the questions or ideas with your counselor.**

Some examples include—but are not limited to—shows found on PBS ("NOVA"), Discovery Channel, Science Channel, National Geographic Channel, TED Talks (online videos), and the History Channel. You may choose to watch a live performance or movie at a planetarium or science museum instead of watching a media production. You may watch online productions with your counselor's approval and under your parent's supervision.

B. Read (about three hours total) about projectiles, aviation, space, weather, astronomy, or aviation or space technology. Then do the following:

- 1. Make a list of at least two questions or ideas from each article.**
- 2. Discuss two of the questions or ideas with your counselor.**

Examples of magazines include—but are not limited to—Odyssey, Popular Mechanics, Popular Science, Science Illustrated, Discover, Air & Space, Popular Astronomy, Astronomy, Science News, Sky & Telescope, Natural History, Robot, Servo, Nuts and Volts, and Scientific American.

C. Do a combination of reading and watching (about three hours total). Then do the following:

- 1. Make a list of at least two questions or ideas from each article or show.**
 - 2. Discuss two of the questions or ideas with your counselor.**
- 2. Complete ONE merit badge from the following list. (Choose one that you have not already used toward another Nova award.) After completion, discuss with your counselor how the merit badge you earned uses science.**

Archery	Robotics
Astronomy	Shotgun Shooting
Athletics	Space Exploration
Aviation	Weather
Rifle Shooting	

3. Choose A or B and complete ALL the requirements.

A. Simulations. Find and use a projectile simulation applet on the Internet (with your parent's or guardian's permission). Then design and complete a hands-on experiment to demonstrate projectile motion.

- 1. Keep a record of the angle, time, and distance.**
- 2. Graph the results of your experiment. (Note: Using a high-speed camera or video camera may make the graphing easier, as will doing many repetitions using variable heights from which the projectile can be launched.)**

Helpful Links

Be sure you have your parent's or guardian's permission before using the Internet. Some of these websites require the use of Java runtime environments. If your computer does not support this program, you may not be able to visit those sites.

Projectile Motion Applets

Website: <http://www.mhhe.com/physsci/physical/giambattista/proj/projectile.html> 

Fowler's Physics Applets

Website:

http://galileoandstein.physics.virginia.edu/more_stuff/Applets/ProjectileMotion/enapplet.html 

Java Applets on Physics

Website: <http://www.walter-fendt.de/ph14e/projectile.htm> 

3. Discuss with your counselor:
 - a. What a projectile is
 - b. What projectile motion is
 - c. The factors affecting the path of a projectile
 - d. The difference between forward velocity and acceleration due to gravity
- B. Discover. Explain to your counselor the difference between escape velocity (not the game), orbital velocity, and terminal velocity. Then answer TWO of the following questions. (With your parent's or guardian's permission, you may explore websites to find this information.)**
 1. Why are satellites usually launched toward the east, and what is a launch window?
 2. What is the average terminal velocity of a skydiver? (What is the fastest you would go if you were to jump out of an airplane?)
 3. How fast does a bullet, baseball, airplane, or rocket have to travel in order to escape Earth's gravitational field? (What is Earth's escape velocity?)
4. Choose A or B and complete ALL the requirements.
 - A. Visit an observatory or a flight, aviation, or space museum.**
 1. During your visit, talk to a docent or person in charge about a science topic related to the site.
 2. Discuss your visit with your counselor.
 - B. Discover the latitude and longitude coordinates of your current position. Then do the following:**
 1. Find out what time a satellite will pass over your area. (A good resource to find the times for satellite passes is the Heavens Above website at www.heavens-above.com .)
 2. Watch the satellite using binoculars. Record the time of your viewing, the weather conditions, how long the satellite was visible, and the path of the satellite. Then discuss your viewing with your counselor.
5. Choose A or B or C and complete ALL the requirements.
 - A. Design and build a catapult that will launch a marshmallow a distance of 4 feet. Then do the following:
 1. Keep track of your experimental data for every attempt. Include the angle of launch and the distance projected.
 2. Make sure you apply the same force every time, perhaps by using a weight to launch the marshmallow. Discuss your design, data, and experiments—both successes and failures - with your counselor.
 - B. Design a pitching machine that will lob a softball into the strike zone. Answer the following questions, then discuss your design, data, and experiments - both successes and failures—with your counselor.**
 1. At what angle and velocity will your machine need to eject the softball in order for the ball to travel through the strike zone from the pitcher's mound?
 2. How much force will you need to apply in order to power the ball to the plate?

3. If you were to use a power supply for your machine, what power source would you choose and why?
- C. Design and build a marble run or roller coaster that includes an empty space where the marble has to jump from one part of the chute to the other. Do the following, then discuss your design, data, and experiments—both successes and failures—with your counselor.
1. Keep track of your experimental data for every attempt. Include the vertical angle between the two parts of the chute and the horizontal distance between the two parts of the chute.
 2. Experiment with different starting heights for the marble. How do the starting heights affect the velocity of the marble? How does the starting height affect the jump distance?
6. Discuss with your counselor how science affects your everyday life.
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Start Your Engines!

This module is designed to help you explore how technology affects your life each day.

1. Choose A or B or C and complete ALL the requirements.

A. Watch about three hours total of technology-related shows or documentaries that involves transportation or transportation technology. Then do the following:

- 1. Make a list of at least two questions or ideas from each show.**
2. Discuss two of the questions or ideas with your counselor.

Some examples include—but are not limited to—shows found on PBS ("NOVA"), Discovery Channel, Science Channel, National Geographic Channel, TED Talks (online videos), and the History Channel. You may choose to watch a live performance or movie at a planetarium or science museum instead of watching a media production. You may watch online productions with your counselor's approval and under your parent's supervision.

B. Read (about three hours total) about transportation or transportation technology. Then do the following:

- 1. Make a list of at least two questions or ideas from each article.**
2. Discuss two of the questions or ideas with your counselor.

Examples of magazines include—but are not limited to—Odyssey, Popular Mechanics, Popular Science, Science Illustrated, Discover, Air & Space, Popular Astronomy, Astronomy, Science News, Sky & Telescope, Natural History, Robot, Servo, Nuts and Volts, and Scientific American.

C. Do a combination of reading and watching (about three hours total). Then do the following:

- 1. Make a list of at least two questions or ideas from each article or show.**
 2. Discuss two of the questions or ideas with your counselor.
2. **Complete ONE merit badge from the following list. (Choose one that you have not already used toward another Nova award.) After completion, discuss with your counselor how the merit badge you earned uses technology.**

Automotive Maintenance	Farm Mechanics
Aviation	Motorboating
Canoeing	Nuclear Science
Cycling	Railroading
Drafting	Small - Boat Sailing
Electricity	Space Exploration
Energy	Truck Transportation

3. Do ALL of the following.
 - A. Using the requirements from the above list of merit badges:
 1. Tell your counselor the energy source(s) used in these merit badges.
 2. Discuss the pros and cons of each energy source with your counselor.
 - B. Make a list of sources of energy that may be possible to use in transportation.
 - C. With your counselor:
 1. Discuss alternative sources of energy.
 2. Discuss the pros and cons of using alternative energy sources.

4. Design and build a working model vehicle (not from a kit).

- A. Make drawings and specifications of your model vehicle before you begin to build.**

B. Include one of the following energy sources to power your vehicle (do not use gasoline or other combustible fuel source): solar power, wind power, or battery power.

C. Test your model. Then answer the following questions:

- 1. How well did it perform?**
- 2. Did it move as well as you thought it would?**
- 3. Did you encounter problems? How can these problems be corrected?**

D. Discuss with your counselor:

1. Any difficulties you encountered in designing and building your model
 2. Why you chose a particular energy source
 3. Whether your model met your specifications
 4. How you would modify your design to make it better
5. Discuss with your counselor how technology affects your everyday life.
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Whoosh!

This module is designed to help you explore how engineering affects your life each day.

1. **Choose A or B or C and complete ALL the requirements.**
 - A. **Watch about three hours total of engineering-related shows or documentaries that involve motion or motion-inspired technology. Then do the following:**
 1. **Make a list of at least two questions or ideas from each show.**
 2. Discuss two of the questions or ideas with your counselor.

Some examples include—but are not limited to—shows found on PBS ("NOVA"), Discovery Channel, Science Channel, National Geographic Channel, TED Talks (online videos), and the History Channel. You may choose to watch a live performance or movie at a planetarium or science museum instead of watching a media production. You may watch online productions with your counselor's approval and under your parent's supervision. One example is the NOVA Lever an Obelisk page on ancient Egypt and the use of levers, available at www.pbs.org/wgbh/nova/egypt/raising/lever.html.

Examples of magazines include—but are not limited to—Odyssey, Popular Mechanics, Popular Science, Science Illustrated, Discover, Air & Space, Popular Astronomy, Astronomy, Science News, Sky & Telescope, Natural History, Robot, Servo, Nuts and Volts, and Scientific American.

- B. **Read (about three hours total) about motion or motion-inspired technology. Then do the following:**
 1. **Make a list of at least two questions or ideas from each article.**
 2. Discuss two of the questions or ideas with your counselor.
 - C. **Do a combination of reading and watching (about three hours total). Then do the following:**
 1. **Make a list of at least two questions or ideas from each article or show.**
 2. Discuss two of the questions or ideas with your counselor.
2. **Choose ONE merit badge from the following list. (Choose one you have not already used for another Nova award.) After completion, discuss with your counselor how the merit badge you earned uses engineering.**

Archery	Inventing
Aviation	Model Design and Building
Composite Materials	Railroading
Drafting	Rifle Shooting
Electronics	Robotics
Engineering	Shotgun Shooting

3. **Do ALL of the following:**
 - A. **Make a list or drawing of the six simple machines.**
 - B. Be able to tell your counselor the name of each machine and how each machine works.

Helpful Link

"Six Simple Machines": [ConstructionKnowledge.net](http://www.constructionknowledge.net)
Website:
http://www.constructionknowledge.net/general_technical_knowledge/general_tech_basic_six_simple_machines.php

- C. Discuss the following with your counselor:
1. The simple machines that were involved with the motion in your chosen merit badge (Hint: Look at the moving parts of an engine to find simple machines.)
 2. The energy source causing the motion for the subject of your merit badge
 3. What you learned about motion from earning your merit badge
4. Choose A or B and complete ALL the requirements.
- A. Visit an amusement park. Then discuss the following with your counselor:**
- 1. The simple machines present in at least two of the rides**
 - 2. The forces involved in the motion of any two rides**
- B. Visit a playground. Then discuss the following with your counselor:
1. The simple machines present in the playground equipment
 2. The forces involved in the motion of any two playground fixtures
5. Do the following:
- A. On your own, design one of the following and include a drawing or sketch: an amusement park ride OR a playground fixture OR a method of transportation.**
- B. Discuss with your counselor:
1. The simple machines present in your design
 2. The energy source powering the motion of your creation
6. Discuss with your counselor how engineering affects your everyday life.
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Designed to Crunch!

This module is designed to help you explore how math affects your life each day.

1. Choose A or B or C or D and complete ALL the requirements.
 - A. Watch about three hours total math-related shows or documentaries that involve scientific models and modeling, physics, sports equipment design, bridge building, or cryptography. Then do the following:
 1. Make a list of at least five questions or ideas from the show(s) you watched.
 2. Discuss two of the questions or ideas with your counselor

Some examples include—but are not limited to—shows found on PBS ("NOVA"), Discovery Channel, Science Channel, National Geographic Channel, TED Talks (online videos), and the History Channel. You may choose to watch a live performance or movie at a planetarium or science museum instead of watching a media production. You may watch online productions with your counselor's approval and under your parent's supervision.

- B. Research (about three hours total) several websites (with your parent's or guardian's permission) that discuss and explain cryptography or the discoveries of people who worked extensively with cryptography. Then do the following:
 1. List and record the URLs of the websites you visited and the major topics covered on the websites you visited. (You may use the copy and paste function—eliminate the words—if you include your sources.)
 2. Discuss with your counselor how cryptography is used in the military and in everyday life and how a cryptographer uses mathematics.

Helpful Link

"The Mathematics of Cryptology": University of Massachusetts

Website: <http://www.math.umass.edu/~gunnells/talks/crypt.pdf> 

- C. Read at least three articles (about three hours total) about physics, math, modeling, or cryptography. You may wish to read about how technology and engineering are changing sports equipment, how and why triangles are used in construction, bridge building, engineering, climate and/or weather models, how banks keep information secure, or about the stock market. Then do the following:
 1. Make a list of at least two questions or ideas from each article.
 2. Discuss two of the questions or ideas with your counselor.

Examples of magazines include—but are not limited to—Odyssey, Popular Mechanics, Popular Science, Science Illustrated, Discover, Air & Space, Popular Astronomy, Astronomy, Science News, Sky & Telescope, Natural History, Robot, Servo, Nuts and Volts, and Scientific American.

- D. Do a combination of reading, watching, or researching (about three hours total). Then do the following:
 1. Make a list of at least two questions or ideas from each article, website, or show.
 2. Discuss two of the questions or questions with your counselor.
2. Complete ONE merit badge from the following list. (Choose one that you have not already used toward another Nova award.) After completion, discuss with your counselor how the merit badge you earned uses mathematics.

Chess	Personal Management
Computers	Radio
Drafting	Surveying
Entrepreneurship	Weather

3. Choose TWO from A or B or C or D or E and complete ALL the requirements. (Write down your data and calculations to support your explanation to your counselor. You may use a spreadsheet. Do not use someone else's data or calculations.)

A. Calculate your horsepower when you run up a flight of stairs.

Helpful Links

"How to Calculate Your Horsepower": wikiHow

Website: <http://www.wikihow.com/Calculate-Your-Horsepower> 

Haplosciences.net

Website: <http://onlinephys.com/labpower1.html> 

1. How does your horsepower compare to the power of a horse?
2. How does your horsepower compare to the horsepower of your favorite car?

Share your calculations with your counselor, and discuss what you learned about horsepower.

B. Attend at least two track, cross-country, or swim meets.

1. For each meet, time at least three racers. (Time the same racers at each meet.)
2. Calculate the average speed of the racers you timed. (Make sure you write down your data and calculations.)
3. Compare the average speeds of your racers to each other, to the official time, and to their times at the two meets you attended.

Share your calculations with your counselor, and discuss your conclusions about the racers' strengths and weaknesses.

C. Attend a soccer, baseball, softball, or basketball game. Choose two players and keep track of their efforts during the game. (Make sure you write down your data and calculations.) Calculate their statistics using the following as examples:

1. Soccer—Goals, assists, corner kicks, keeper saves, fouls, offsides
2. Baseball or softball—Batting average, runs batted in, fielding statistics, pitching statistics
3. Basketball—Points, baskets attempted, rebounds, steals, turnovers, and blocked shots

Share your calculations with your counselor, and discuss your conclusions about the players' strengths and weaknesses.

D. Attend a football game or watch one on TV. (This is a fun activity to do with a parent or friend!) Keep track of the efforts of your favorite team during the game. (Make sure you write down your data and calculations.) Calculate your team's statistics using the following as examples:

1. Kicks/punts
 - a. Kickoff—Kick return yards

- c. Field goals—Attempted, percent completed, yards
 - d. Extra point—Attempted, percent completed
2. Offense
 - a. Number of first downs
 - b. Forward passes—Attempted, percent completed, total length of passes, longest pass, number and length of passes caught by each receiver, yardage gained by each receiver after catching a pass
 - c. Running plays—Number, yards gained or lost for each run, longest run from scrimmage line, total yards gained or lost, and number of touchdowns
 3. Defense—Number of quarterback sacks, interceptions turnovers, and safeties

Share your calculations with your counselor, and discuss your conclusions about your team's strengths and weaknesses.

E. How starry are your nights? Participate in a star count to find out. This may be done alone but is more fun with a group. Afterward, share your results with your counselor.

1. Visit NASA's Student Observation Network website at www.nasa.gov/audience/foreducators/son/energy/starcount/  for instructions on performing a star count.
 2. Do a star count on five clear nights at the same time each night.
 3. Report your results on NASA's Student Observation Network website and see how your data compares to others.
4. Do ALL of the following.
 - A. Investigate your calculator and explore the different functions.**
 - B. Discuss the functions, abilities, and limitations of your calculator with your counselor. Talk about how these affect what you can and cannot do with a calculator. (See your counselor for some ideas to consider.)
 5. Discuss with your counselor how math affects your everyday life.
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