



BOY SCOUTS OF AMERICA®

Baltimore Area Council **STEM In Scouting Day** at **Aberdeen Proving Ground**

Venturing 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.

NOTE: ALL VENTURERS MUST DO AN EXPLORATION WITHIN THEIR AWARD AREA PRIOR TO STEM DAY. REQUIREMENTS ARE LISTED IN THE LAST SECTION OF THIS DOCUMENT

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



Prepared. For Life.®

Launch!

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 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. The NASA website at www.nasa.gov has some short multimedia clips that involve projectiles, aviation, space, weather, astronomy, or aviation or space technology. 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. Choose ONE STEM field of interest from the following list. Complete ALL the requirements for a Venturing STEM exploration in that field. Venturing exploration topics. (If you have already completed a Venturing STEM exploration in one of these fields, please choose a different field for this award.) *[Requirements listed in last section of this document]*

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

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.

- 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> 

- Discuss with your counselor:
 - What a projectile is
 - What projectile motion is
 - The factors affecting the path of a projectile
 - The difference between forward velocity and acceleration due to gravity
- 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.)
 - Why are satellites usually launched toward the east, and what is a launch window?
 - 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?)
 - 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.

- During your visit, talk to a docent or person in charge about a science topic related to the site.
- Discuss your visit with your counselor.

B. Discover the latitude and longitude coordinates of your current position. Then do the following:

- 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 .)
- 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:

- Keep track of your experimental data for every attempt. Include the angle of launch and the distance projected.
- 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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Power Up

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. Choose ONE STEM field of interest from the following list. Complete ALL the requirements for a Venturing STEM exploration in that field. [Venturing exploration topics](#). (If you have already completed a Venturing STEM exploration in one of these fields, please choose a different field for this award.) *[Requirements listed in last section of this document]*

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 STEM explorations:

- 1. Tell your counselor the energy source(s) used in these STEM explorations.**
- 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.

Hang On!

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 <http://www.pbs.org/wqbh/nova/egypt/raising/lever.html> .

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.

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. Choose ONE STEM field of interest from the following list. Complete ALL the requirements for a Venturing STEM exploration in that field. Venturing exploration topics. (If you have already completed a Venturing STEM exploration in one of these fields, please choose a different field for this award.) [Requirements listed in last section of this document]

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

Composites can be found just about everywhere: in airplanes and sports cars, golf clubs and guitars, boats and baseball bats, bathtubs and circuit boards, and even bridges. Composites

make bicycles and skis lighter, kayaks and fishing poles stronger, houses warmer, and helmets tougher." Choose one of these items for your discussion to answer requirement 3c.

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 Links

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

Website: [http://www.constructionknowledge.net/general technical knowledge/general tech basic six simple machines.php](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 STEM exploration (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 STEM exploration
3. What you learned about motion from doing the STEM exploration

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.

Numbers Don't Lie

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 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. 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. Choose ONE STEM field of interest from the following list. Complete ALL the requirements for a Venturing STEM exploration in that field. Venturing exploration topics. (If you have already completed a Venturing STEM exploration in one of these

fields, please choose a different field for this award.) After completion, discuss with your counselor how the Venturing STEM exploration you completed uses mathematics. *[Requirements listed in last section of this document]*

American Business	Drafting	Personal	Surveying
Chess	Entrepreneurship	Management	Weather
Computers	Orienteering	Radio	

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.
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.

Helpful Links

"How to Calculate Your Horsepower": [wikiHow](#)

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

"Lab Power": [Haplosciences.net](#)

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

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
 - b. Punt—Number, 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 (with your parent's or guardian's permission) 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 (with your parent's or guardian's permission) 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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ALL VENTURERS MUST DO AN EXPLORATION WITHIN THEIR AWARD AREA PRIOR TO STEM DAY

Venturing STEM Explorations

The following requirements apply to any specific STEM field of interest chosen by a Venturer in the course of completing a Nova or Supernova award.

Safety Considerations

Discuss with your mentor the following safety issues in the field of interest you have chosen.

- The kinds of hazards (to humans, to the environment, to animals) that might occur while engaged in activities in this field
- Appropriate safety precautions to help minimize these risks
- Whether it is necessary to obtain training in safety protocols in this field
- The agencies or organizations that can provide such training
- What it would take to be a certified safety specialist or safety trainer in this field

Developing Knowledge

Do ONE of the following.

1. Visit a workplace in this field. Ask to see an example of the work that is done there, the different facilities, and the tools used. After your visit, discuss the following with your mentor:
 - A. How much work is done manually and how much work is done with the aid of technology
 - B. How much work is done by individuals and how much is done in cooperation with others
 - C. The ways in which the fields of science, technology, engineering, and/or mathematics are important to the work done in this business

Visitations will require advance planning by the Venturer with assistance from the counselor. The counselor should call ahead to make arrangements, and make plans to have appropriate supervision of all Venturers. The site will very likely have rules and instructions that must be followed. The counselor should help ensure that all the participants are aware of and follow those rules. This may include safety procedures and other instructions.

2. Using resources you find on your own such as at the library, on the Internet, or through visits to relevant places of learning, such as museums, learn more about this field. Then discuss the following with your counselor:
 - A. The historical development of this field
 - B. How tools and techniques have evolved over time
 - C. How modern tools and techniques have changed over time in this field and how its capacity for accomplishment has been affected
 - D. The ways in which science, technology, engineering, and/or mathematics are important to this field

Hands-On Experiences

In consultation with your counselor and, if necessary, a consultant who is a specialist in this field, identify four hands-on activities that are examples of work done in this field that you could carry out yourself. Each activity should engage your attention and efforts for approximately three

hours. Under the supervision of appropriate specialists and observing the highest standards of safety, carry out all four activities. Discuss with your counselor what you learned during each activity. Examples include—but are not limited to—conducting experiments, building models, designing tools, drawing plans, learning how to use tools, and serving as an assistant/apprentice to a specialist.

Career Exploration

Find out about three career opportunities in this field. Communicate to your counselor the training, education, and experience that are needed for each career.

Value and Impact

Using a combination of library research, Internet research (with your parent's or guardian's permission), and interviews with experts, find out how important the role of this field is in addressing the problems facing our modern world: a burgeoning worldwide population, stresses on the environment, ongoing issues of basic health and sustenance, or other concerns. How might knowledge, abilities, and capacity in this field bring about positive change on a significant scale? Create an oral or written report and present it to your counselor.
