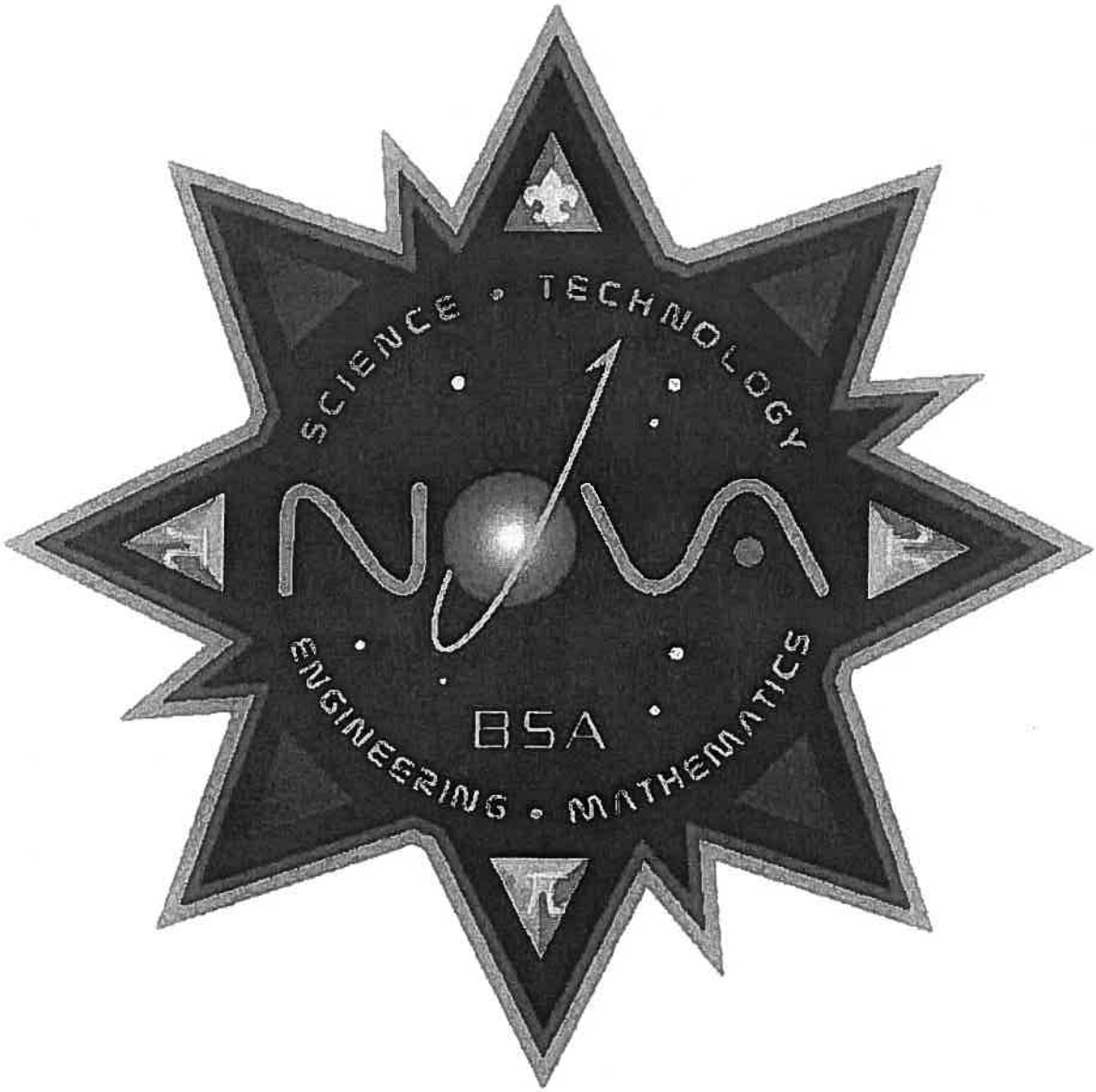
BOY SCOUTS OF AMERICA

NOVA REQUIREMENTS



Exxon Mobil | Program Impact

Dear Unit Leader:

The Boy Scouts of America and ExxonMobil Corporation have joined together to initiate a program that encourages active interest by youth in the fields of science, technology, engineering and mathematics (STEM). Circle Ten Council is one of the pilot councils for the program and we are asking that your unit consider participating in the program. The BSA STEM initiative is designed to bring a Scouting focus to skills that are relevant and needed in our competitive world and will provide opportunities for youth at all levels of Scouting to develop an enhanced interest in Science, Technology, Engineering and Mathematics and recognize youth STEM achievement.

Enclosed you will find the following information a packet containing information on the program, requirements, counselor guides and more information.

Since this in in the testing phase, changes will be made to the program as we find what works and what does not. However, once a Scout begins work on an award, he will work under those requirements regardless of any subsequent changes.

This is an exciting program and provides great opportunities for Scouts to enhance their knowledge in these important areas, have fun doing it and being recognized for their accomplishments. It is not necessary that all members of your unit participate. If interested, please contact Scott Ferguson at scott.ferguson@scouting.org or at 214-902-6777. We will also follow up in the near future to answer any questions and help you get started.

Sincerely,

Rob McCullough
Council STEM Chair

Scott Ferguson
Director of Support Services

STEM - NOVA Award Program: The **NOVA** Award program consists of individual activity elements in various **STEM** (Science, Technology, Engineering, and Mathematics) topics structured for either Cub Scouts or Boy Scouts/Venturers. These topics are designed to encourage participation and to increase interest in **STEM** by making it relevant and fun.

Current Topics available for the Cub Scout NOVA Award:
SCIENCE EVERYWHERE (Science)
SWING! (Motion – Engineering)
TECH TALK (Technology)
DESIGNED TO CRUNCH (Mathematics)

Current Topics available for the Boy Scout and Venturing NOVA Award:
SHOOT! Projectiles & Space (Science)
WHOOSH! (Motion – Engineering)
START YOUR ENGINES (Transportation Tech)
DESIGNED TO CRUNCH (Mathematics)

The **NOVA** Award will be a distinctive pocket patch with a separate pin-on device awarded for each individual topic completed by the youth. If a youth completes a significant number (to be determined) of the available **STEM** topics, then he/she will be presented with a Certificate and Bronze Medal.

STEM – SUPERNOVA Award Program:
The **SUPERNOVA** Award program is similar to the BSA Hornaday Award Program. The basic requirements are to earn certain Academic Pins (Cub Scouts), Activity Badges (Webelos) and Merit Badges (Boy Scouts) plus complete various other more rigorous **STEM** related requirements. The Venturing requirements are based on more independent achievement and teaching activities. **SUPERNOVA** is designed to encourage and recognize more in-depth achievement in **STEM**.

Cub Scout
o Cub Scout: Luiz Walter Alvarez Award -Certificate and Bronze Medal on neck ribbon
o Webelos: Charles Townes Award - Certificate and Bronze Medal on neck ribbon

Boy Scout
o Basic: Bernard Harris Award - Certificate and Bronze Pocket Medal
o Intermediate: Thomas Edison Award - Certificate and Silver Pocket Medal
o Advanced: Albert Einstein Award - Certificate and Gold Pocket Medal

Venturing
Sally Ride Award - Certificate and Bronze Pocket Medal

What is the Boy Scouts of America Science, Technology, Engineering and Math (STEM) Initiative?

A partnership with ExxonMobil: ExxonMobil Corporation has an ongoing commitment to support a variety of programs that encourage active interest by youth in the fields of science, technology, engineering and mathematics (STEM). EOM has generously agreed to fund the development of such a program within Scouting through a special multi-year grant. The BSA STEM initiative is designed to bring a Scouting focus to skills that are relevant and needed in our competitive world, increasing the value of Scouting to families and communities as it supports the development of these critical skills in our youth. The BSA STEM initiative will provide opportunities for youth at all levels of Scouting to develop an enhanced interest in Science, Technology, Engineering and Mathematics and recognize youth STEM achievement.

Honorary Chairman and National Spokesperson: Dr. Bernard Harris, entrepreneur and former Boy Scout and NASA space shuttle astronaut has agreed to serve in this capacity on an active and engaged basis through 2013.

A new series of youth awards and adult recognitions: To be called NOVA and SUPERNOVA, these awards are designed to increase interest in science, technology, engineering and mathematics among Cub Scouts, Webelos, Boy Scouts and Venturers and to recognize achievement and superior achievement in these areas. Adults will be recognized for promoting the BSA STEM initiative and for mentoring youth to earn the NOVA and SUPERNOVA awards.

Other Components of the BSA STEM Initiative:
- Design and introduce potential new Cub Scout activity pins and Boy Scout merit badges or modifications to existing merit badges to incorporate skills in science, technology, engineering and mathematics.
- Develop specialized programs that a den, troop, crew or post might use to learn more about science, technology, engineering and mathematics. Some of these programs would connect with another aspect of Scouting. For example: Pinewood Derby, various merit badges.
- Develop partnerships with non-Scouting entities who could offer specialized programs in some aspect of science, technology, engineering and mathematics to our Scouting youth.
- Develop a framework by which a council might offer a "STEM" summer camp or day camp.
- Create council sponsored merit badge universities that offer STEM related merit badges.
- Develop and implement appropriate adult and youth leader training in conducting specialized science, technology, and engineering and mathematics events.
- Investigate the possibility of specialized science, technology, engineering and mathematics programs at our existing and future national high adventure bases.
For example: Philmont STEM Trek, SeaBase STEM Adventure, Summit STEM Experience.
- Include STEM exhibits, displays and/or competition at the 2013 Summit National Jamboree.
- Increase the sponsorship of Exploring Posts by companies whose core business is based on some application of STEM. For example: engineering companies and research labs.
- Investigate developing some type of award (or grant) for teachers who participate in these new Scouting STEM programs. This could possibly recruit new volunteers or even Enhance our relationship with the public school systems in our councils.
- Develop a Scouting STEM scholarship program.
- Bottom line: To make it "cool" (and also rewarding) to be a Scout who is interested in Doing science, technology, engineering and mathematics.

STEM/Nova Participation Sign-Up

Yes, we would like tp participate.

UNIT TYPE (Please check)

Pack _____ Troop _____ Crew _____

UNIT NUMBER _____

CONTACT

Name _____

Address _____

City, ST Zip _____

Ph # _____

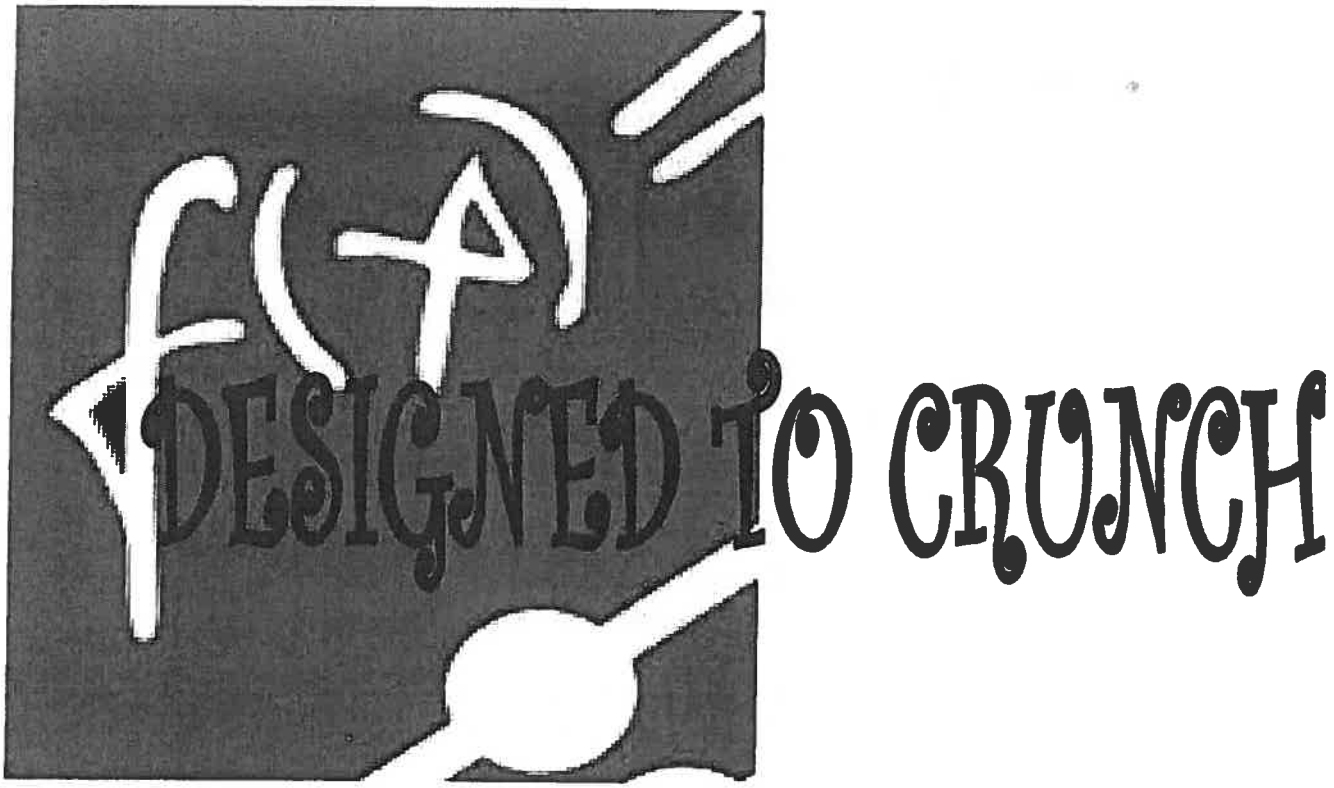
EMAIL _____

Number of Scouts that might potentially participate _____

Return to Scott Ferguson

Fax: 214-902-6789
Email: scott.ferguson@scouting,.org
Address: 8605 Harry Hines, Dallas, TX 75235

Cub Scouts



1. Watch or read. Choose a, b, or c and complete all the requirements:
    a. Watch an episode or episodes (about an hour total) of NOVA or other media production* that involve math or physics (math and physics are in almost every kind of invention – cars, airplanes, telescopes. Math also includes cryptology).
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Read one long or two short magazine articles** that show(s) how scientists use math.
        i. Make a list of at least two questions or ideas from the article(s)
        ii. Discuss the ideas and questions with your counselor
    c. Do a combination of reading and watching
        i. Make a list of at least two questions or ideas from the article or production
        ii. Discuss the ideas and questions with your counselor
2. Complete the Mathematics pin
3. Calculate. Choose two options from a, b, and c and complete all the requirements for those options. Keep your work to show your counselor – the necessary information to make your calculations may be found in a book or on the internet. (You may work with a parent or your counselor on these calculations.)
    a. Choose two places and calculate how much you would weigh there.
        i. On the sun or the moon
        ii. On Jupiter or Pluto

iii. On a planet that you choose

b. The height of (Do one)
   i. A tree
   ii. Your house
   iii. A building of your choice
c. The volume of air in your bedroom (Volume=length x width x height. Make sure your measurements have the same units – all feet or all inches.)

4. Design – Secret Codes
   a. Look up, then tell your counselor
      i. About Cryptography
      ii. At least three ways secret codes or ciphers are made
      iii. How secret codes and ciphers relate to mathematics
   b. Design a secret code or cipher
      i. Write a message in your code/cipher
      ii. Share your code/cipher with your counselor

Links – to start your study

1. Calculations
   a. Weight on other planets
      i. http://www.essortment.com/all/weightonplan_rvrp.htm
      ii. http://www.intrepidmuseum.org/Education/Teacher-Resources/documents/Space_9-12Post.aspx
   b. Height of trees or other tall things
      i. http://www.associatedcontent.com/article/5588962/how_to_calculate_the_height_of_a_tree.html
   c. Volume of a room
      i. http://www.ehow.com/how_2266390_calculate-volume-room.html
2. Secret Codes
   a. http://www.nsa.gov/kids/
   b. http://www.cerias.purdue.edu/education/k-12/teaching_resources/lessons_presentations/cryptology.html
   c. http://nrich.maths.org/2197
   d. http://www.wikihow.com/Create-Secret-Codes-and-Ciphers

*(Some media examples are the Discovery Channel, Science Channel, National Geographic, and the History Channel.)

**(Examples of magazine sources include Odyssey, Know : the Science Magazine for Curious Kids, Kids Discover, National Geographic Kids, Owl or OWLkids Online. You may wish to look at an article from Popular Mechanics or Popular Science with one of your parents.)

1. Watch or read. Choose a, b, or c and complete all the requirements:
    a. Watch an episode or episodes (about an hour total) of NOVA or other media production* that involve math or physics (math and physics are in almost every kind of invention – cars, airplanes, telescopes. Math also includes cryptology).
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Read one long or two short magazine articles** that show(s) how scientists use math.
        i. Make a list of at least two questions or ideas from the article(s)
        ii. Discuss the ideas and questions with your counselor
    c. Do a combination of reading and watching
        i. Make a list of at least two questions or ideas from the article or production
        ii. Discuss the ideas and questions with your counselor
2. Complete the Mathematics pin

3. **Calculate. Choose two options from a, b, and c and complete all the requirements for those options. Keep your work to show your counselor – the necessary information to make your calculations may be found in a book or on the internet. (You may work with a parent or your counselor on these calculations.)**

   a. **Choose two places and calculate how much you would weigh there.**

Earth's gravity is the standard, so it is set at 1, one gravity. When astronauts and pilots talk about pulling g's, they are referring to how much gravity they are experiencing related to Earth's gravity. On earth, we are pulling 1g. If a pilot is pulling 2g's, it is as if he weighs twice as much as he normally weighs. In outer space, our bodies are not affected strongly by gravity; there are 0g's, and we feel weightless. Other solar bodies have different gravities. Weight on another planet or the moon is calculated by multiplying an earth weight by the fraction of the gravity on the other planet or moon.

i. **On the sun or the moon**

Earth weight (in pounds) X 28 *(27.97)* = **Sun** weight
Earth weight (in pounds) X 0.166 = **Moon** weight

ii. **On Jupiter or Pluto**

Earth weight (in pounds) X 2.36 = **Jupiter** weight

Pluto is no longer considered a planet because it is so small. Pluto is now considered a planetoid. A human would weigh less on Pluto than on Earth's moon. Earth weight (in pounds) X 0.059 = **Pluto** weight

iii. **On a planet that you choose**

Earth weight (in pounds) X 0.378 = **Mercury** weight
Earth weight (in pounds) X 0.907 = **Venus** weight
Earth weight (in pounds) X 1.000 = **Earth** weight
Earth weight (in pounds) X 0.377 = **Mars** weight
Earth weight (in pounds) X 2.36 = **Jupiter** weight
Earth weight (in pounds) X 0.016 = **Saturn** weight
Earth weight (in pounds) X 0.889 = **Uranus** weight
Earth weight (in pounds) X 1.12 = **Neptune** weight

b. **The height of (Do one)**

http://www.associatedcontent.com/article/5588962/how_to_calculate_the_height_of_a_tree.html

i. **A tree**
ii. **Your house**
iii. **A building of your choice**

Step 1:

On a sunny day, choose a tree that casts a clear shadow. Trees and other tall objects that stand by themselves are easiest to work with.

Step 2:
Hold a ruler perpendicular to the ground, right next to the tree.

Step 3:
Measure the shadow of the ruler, and record the measurement. Call this measurement "A."
Step 4:
Measure the shadow of the tree. Call the tree shadow measurement "B."
Step 5:
Multiply measurement "B" by 12. Then divide that answer by measurement "A." This answer is the height of the tree in inches.

c. **The volume of air in your bedroom (Volume=length x width x height. Make sure your measurements have the same units – all feet or all inches.)** The answer will be in cubic feet or cubic inches. (ft^3 or in^3)

4. **Design – Secret Codes**
   a. **Look up, then tell your counselor**
      i. **About Cryptography**

The first recorded use of cryptography, the practice and study of hiding information, was when Julius Caesar used a substituted letter code to hide information. Cryptography has been very useful during wars, transmitting information without revealing it to the enemy (unless the code is broken). The major use of cryptography today is with computers, especially in finance and electronic data transmissions. ATM cards, computer passwords, PIN and TIN numbers depend on cryptography.

ii. **At least three ways secret codes or ciphers are made**

A code is a symbol or signal used to represent or communicate something else. A cipher is a way to make a secret message by changing or rearranging the letters in the message. Codes replace words, phrases, or sentence with groups of letters or numbers; ciphers rearrange or substitute letters. Examples of codes and ciphers include, but are not limited to:

- Transposition ciphers - rearrange the letters in a word.
- Book Code/Dictionary Code – Use two of the same book (dictionaries work best). For each word in the code, give the page number, (column number for a dictionary), row number, and word number. Usually it is best to use two or three digits for each coded word, using zeros as place holders.
- Letter shifts – shift every letter in the alphabet a set number of places.
- Number substitutions - Assign every letter a number. This can be combined with letter shift
- Keyboard ciphers – using a keyboard, shift a set number of places.
- Date shift ciphers - http://www.wikihow.com/Create-Secret-Codes-and-Ciphers
- Stacked ciphers – combine two or more codes and or ciphers

iii. How secret codes and ciphers relate to mathematics

Many ciphers can be broken by using frequency analyses, for example, the letter e is the most frequently used letter in the English language. Ciphers are pairs of algorithms, rules or set of rules to solve a problem, to encrypt and decrypt information. Since the early 20th century, cryptography is makes a much more extensive use of mathematics, including information theory, computational complexity, statistics, number theory, and abstract algebra.

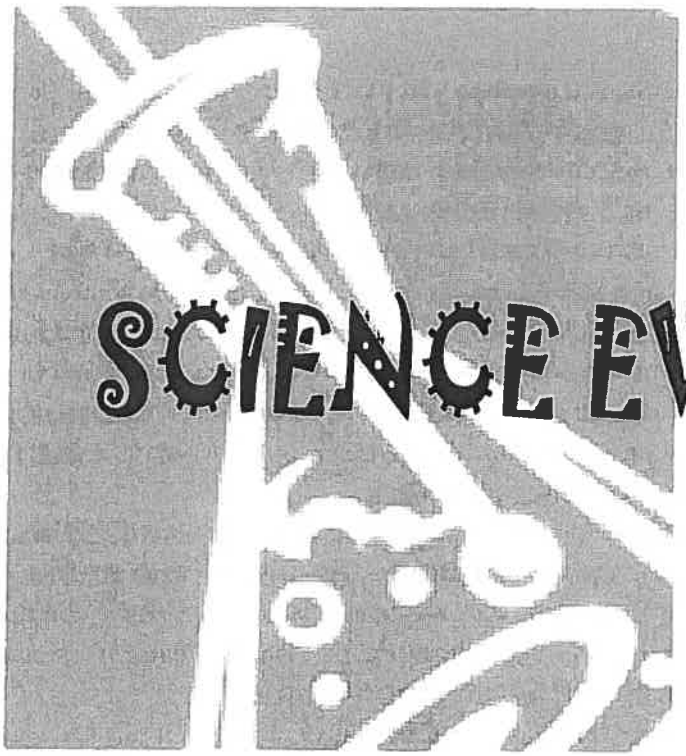
b. Design a secret code or cipher
    i. Write a message in your code/cipher
    ii. Share your code/cipher with your counselor

Links – to start your study

1. Calculations
    a. Weight on other planets
        i. http://www.essortment.com/all/weightonplan_rvrp.htm
        ii. http://www.intrepidmuseum.org/Education/Teacher-Resources/documents/Space_9-12Post.aspx
    b. Height of trees or other tall things
        i. http://www.associatedcontent.com/article/5588962/how_to_calculate_the_height_of_a_tree.html
    c. Volume of a room
        i. http://www.ehow.com/how_2266390_calculate-volume-room.html
2. Secret Codes
    a. http://www.nsa.gov/kids/
    b. http://www.cerias.purdue.edu/education/k-12/teaching_resources/lessons_presentations/cryptology.html
    c. http://nrich.maths.org/2197
    d. http://www.wikihow.com/Create-Secret-Codes-and-Ciphers

*(Some media examples are the Discovery Channel, Science Channel, National Geographic, and the History Channel.)

**(Examples of magazine sources include Odyssey, Know : the Science Magazine for Curious Kids, Kids Discover, National Geographic Kids, Owl or OWLkids Online. You may wish to look at an article from Popular Mechanics or Popular Science with one of your parents.)



SCIENCE EVERYWHERE

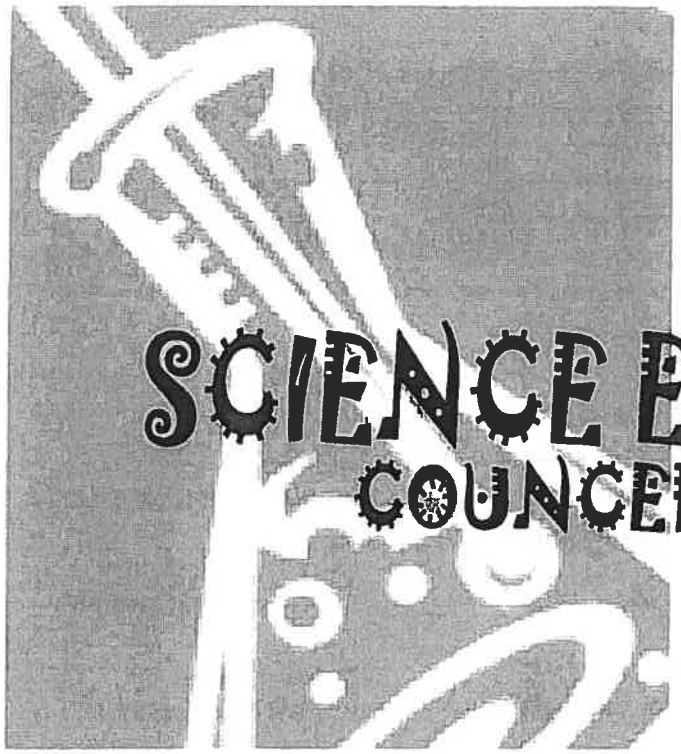
1. Watch or read. Choose a, b, or c and complete all the requirements:
    a. Watch an episode or episodes (about an hour total) of NOVA or other media production* about animals, rockets, tornadoes and hurricanes, the environment, or anything science related.
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Read one long or two short magazine articles** about animals, rockets, tornadoes and hurricanes, or the environment.
        i. Make a list of at least two questions or ideas from the article(s)
        ii. Discuss the ideas and questions with your counselor
    c. Do a combination of reading and watching
        i. Make a list of at least two questions or ideas from the article or production
        ii. Discuss the ideas and questions with your counselor
2. Complete one belt loop or pin from the following list. (Choose one that you do not have.)

Astronomy
Collecting
Geography
Geology
Map & Compass
Nutrition
Pet Care
Photography
Science
Weather
Wildlife Conservation

3. Act like a scientist!
    a. With your counselor, choose a question you would like to investigate.
        Examples (you may get other ideas from your belt loop activities):
        1. Why do rockets have fins? Is there any connection between the feathers on arrows and fins on rockets?
        2. Why do some cars have spoilers? How do spoilers work?
        3. Where does water from the creek in your neighborhood go? Does your stream flow to the Atlantic or the Pacific Ocean? (You may wish to use Google maps to follow the streams and rivers to the ocean. Keep track of the names of the streams, lakes, and rivers connecting your stream to the ocean. A fun book to read is *Paddle to the Sea* by Holling C. Holling.)
        4. Is the stream in your neighborhood or park polluted? (You can do a stream sample to investigate what kinds of things are living in the water and under the rocks – some things live in polluted water, others can only live in clean water. You can discover if a stream is polluted by investigating what lives there.)
    b. With a parent or your counselor, use the scientific method to investigate your question. (You may do this section with another Cub Scout if you wish, but you need to do and record your own work.)
        Keep records of your question, what information you found, how you investigated, and what you found out about your question.
    c. Discuss your investigation and findings with your counselor.
4. Visit
    a. Visit a place where science is being done, used, or explained.
        i. Examples:
            1. Zoo
            2. Aquarium
            3. Water treatment plant
            4. Observatory
            5. Science museum
            6. Weather Station
            7. Fish Hatchery
    b. Talk to someone in charge about science.
    c. Discuss with your counselor the science done, used, or explained at the place you visited.

*(Some media examples are the Discovery Channel, Science Channel, National Geographic, and the History Channel.)

**(Examples of magazine sources include Odyssey, Know : the Science Magazine for Curious Kids, Kids Discover, National Geographic Kids, Owl or OWLkids Online. You may wish to look at an article from Popular Mechanics or Popular Science with one of your parents.)



SCIENCE EVERYWHERE
COUNCELOR EDITION

1. Watch or read. Choose a, b, or c and complete all the requirements:
    a. Watch an episode or episodes (about an hour total) of NOVA or other media production* about animals, rockets, tornadoes and hurricanes, the environment, or anything science related.
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Read one long or two short magazine articles** about animals, rockets, tornadoes and hurricanes, the environment, or anything science related.
        i. Make a list of at least two questions or ideas from the article(s)
        ii. Discuss the ideas and questions with your counselor
    c. Do a combination of reading and watching
        i. Make a list of at least two questions or ideas from the article or production
        ii. Discuss the ideas and questions with your counselor
2. Complete one belt loop or pin from the following list. (Choose one that you do not have.)

Astronomy	Pet Care
Collecting	Photography
Geography	Science
Geology	Weather
Map & Compass	Wildlife Conservation
Nutrition	

3. Act like a scientist!
   a. With your counselor, choose a question you would like to investigate.
      Examples (you may get other ideas from your belt loop activities):
      1. Why do rockets have fins? Is there any connection between the feathers on arrows and fins on rockets?

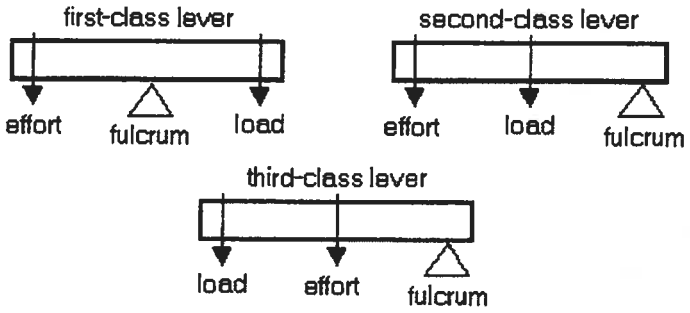
Arrow feathers and rocket fins serve the same purpose – they provide aerodynamic stability during flight through the atmosphere

      2. Why do some cars have spoilers? How do spoilers work?

In theory, spoilers on cars use Bernoulli's principle in the opposite way that an airplane does. An airplane wing is designed for the air to flow faster over the top than under the bottom, thus creating lift. A spoiler on a regular car is supposed to force the air to move more quickly under the spoiler than over the top, thus pushing the car down to give the drive wheels more traction and increase stability. The faster the cargoes, the faster the air moves under the spoiler, the more anti-lift is generated, which provides more stability. Without a spoiler, the only way to increase stability would be to increase the weight of the car, but increasing the weight of the car increases its inertia, causing problems at corners and turns. Designers of spoilers have to balance the anti-lift with the drag created by using a spoiler.
http://www.physlink.com/education/askexperts/ae496.cfm

      3. Where does water from the creek in your neighborhood go? Does your stream flow to the Atlantic or the Pacific Ocean? (You may wish to use Google maps to follow the streams and rivers to the ocean. Keep track of the names of the streams, lakes, and rivers connecting your stream to the ocean. A fun book to read is *Paddle to the Sea* by Holling C. Holling.)
      4. Is the stream in your neighborhood or park polluted? (You can do a stream sample to investigate what kinds of things are living in the water and under the rocks – some things live in polluted water, others can only live in clean water. You can discover if a stream is polluted by investigating what lives there.)

3. Levers
   a. **Make a list or drawing of the three types of levers**
      (a lever is one kind of simple machine; there are three classes of levers.)



Click here for more information

   b. **Be able to tell your counselor**
      i. **The class of each lever**
      ii. **How it works.**

A lever is a rigid bar that turns around a fulcrum (a fixed point). The force, a push or a pull, which is applied to the lever is called the effort. The farther the effort is from the fulcrum, the easier it is to use the lever. What the lever moves is called the load or the resistance. Levers can change the direction of motion, make it easier to move something, or cause something to move a greater distance. There are three classes of levers.

Class 1 lever - First Class lever. The fulcrum is located between the effort and the load. The direction the load moves is opposite to the direction of the effort. Depending on where the fulcrum is placed, a first class lever can either make the load move more easily or move a greater distance. Examples of first class levers include seesaws, crowbars, scissors, and pliers.

Class 2 lever - Second Class lever. The fulcrum is at one end, the effort is at the other end, and the load is in the middle. The effort and the load move in the same direction. A Class 2 lever makes an object easier to move. Examples of second class levers include catapults, screwdrivers, nutcrackers, staplers, and wheelbarrows.

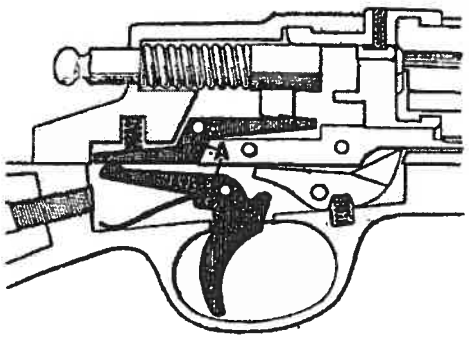
Class 3 lever - Third Class lever. The fulcrum is at one end. The effort is applied between the fulcrum and the load. The effort and the load move in the same direction. A third class lever makes an object harder to move, but moves the object through a much greater distance than the effort force moves. Because the load end moves faster than the effort (it has to travel farther during the same time length) the load gains speed. Many sporting activities use Class 3 levers. Class 3 levers include bats, rackets, paddles, clubs, clubs, fishing poles, and brooms.

http://www.fi.edu/pieces/knox/automaton/lever.htm

c. With your counselor, discuss

i. The type of lever involved with the motion in your chosen Pin

All the Cub Scout pins for this award use third class levers except BB Gun shooting. BB guns use a first class lever for the trigger.



The fulcrum (pivot point) is between the effort (applied by the trigger finger) and where the pressure (the load or resistance) is applied to the spring.

http://en.wikipedia.org/wiki/File:Trigger_mechanism_bf_1923.jpg

ii. What you learned about levers and motion from doing your Pin

iii. Why we use levers

Levers can be used to:

- Make things easier to move – small force applied over a large distance results in a large force moving a small distance. (First Class levers where the applied force is farther away from the fulcrum than the resultant force and Second Class levers.)
- Change the direction of the applied force. (First Class levers)
- Increase the distance an object moves - a large force applied over a small distance yields small force moving a large distance. (Third Class levers and First Class levers where the fulcrum is closer to the applied force than is the resultant force.)

4. Visit –
   a. A playground
      i. Discuss with your counselor what playground or sports equipment uses levers

   Seesaws – first class
   Swings – second class levers
   Sandbox shovels – third class
   Bats, clubs, rackets, paddles, and fishing poles are third class levers.
   Playgrounds have other simple machines, including incline planes (slides) and wheel and axles (merry-go-rounds).

5. Design
   a. Design, including a drawing or sketch, one of the following
      i. A new playground fixture that uses a lever
      ii. A new game or sport using a lever

Many states have stream studies based on macro-invertebrate identification and populations. Some states use data collected by volunteers for incorporation into stream quality reports. Check the internet or with your state's Natural Resource Department for more information.
An on-line guide to macro-invertebrate stream quality organisms for Ohio.
http://rol.freenet.columbus.oh.us/PDF_guide.pdf
University of Virginia Stream Study Guide http://people.virginia.edu/~sos-iwla/Stream-Study/StreamStudyHomePage/StreamStudy.HTML
Maryland Stream Study http://www.dnr.state.md.us/streams/pubs/freshwater.html
California information http://www.krisweb.com/aqualife/insect.htm
Washington information http://www.bgsd.k12.wa.us/hml/jr_cam/macros/resources.html

b. With a parent or your counselor, use the scientific method to investigate your question. (You may do this section with another Cub Scout if you wish, but you need to do and record your own work.)

Keep records of your question, what information you found, how you investigated, and what you found out about your question.

Scientific Method:

- Problem or Question – what are you trying to find out?
- Information – what do you already know about the problem?
- Hypothesis – what do you think is the answer to your question?
- Procedure or Experimental set-up – how will you find the answer to your question and test your hypothesis?
- Data and Analysis – what did you find out by doing your experiment? This includes charts, graphs, and any results
- Conclusion – what did you find to be the answer to your question? If you did not find the answer, why not? How could you find out or expand on the answer(s) you discovered? Communicate your findings.

c. Discuss your investigation and findings with your counselor.

4. Visit
   a. Visit a place where science is being done, used, or explained.
      i. Examples:
         1. Zoo
         2. Aquarium
         3. Water treatment plant
         4. Observatory
         5. Science museum
         6. Weather Station
         7. Fish Hatchery
   b. Talk to someone in charge about science.
   c. Discuss with your counselor the science done, used, or explained at the place you visited.

*(Some media examples are the Discovery Channel, Science Channel, National Geographic, and the History Channel.)

**(Examples of magazine sources include Odyssey, Know : the Science Magazine for Curious Kids, Kids Discover, National Geographic Kids, Owl or OWLkids Online. You may wish to look at an article from Popular Mechanics or Popular Science with one of your parents.)

1. Watch or read. Choose a, b, or c and complete all the requirements::
    a. Watch an episode or episodes (about an hour total) of NOVA or other media production* that involves motion or machines.
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Read one long or two short magazine articles** that show(s) how motion or machines is/are measured, used, created.
        i. Make a list of at least two questions or ideas from the article(s)
        ii. Discuss the ideas and questions with your counselor
    c. Do a combination of reading and watching
        i. Make a list of at least two questions or ideas from the article or production
        ii. Discuss the ideas and questions with your counselor
2. Complete a Belt loop or Pin from the following list. (Choose one that you do not have.)

Badminton	Golf
Baseball	Hockey
BB Gun Shooting	Softball
Fishing	Table Tennis
	Tennis

3. Levers
    a. Make a list or drawing of the three types of levers
        (a lever is one kind of simple machine)
    b. Be able to tell your counselor
        i. The class of each lever
        ii. How it works.
    c. With your counselor, discuss
        i. The type of lever involved with the motion in your chosen Pin
        ii. What you learned about levers and motion from doing your Pin
        iii. Why we use levers
4. Visit –
    a. A playground
        i. Discuss with your counselor what playground or sports equipment uses levers
5. Design
    a. Design, including a drawing or sketch, one of the following
        i. A new playground fixture that uses a lever
        ii. A new game or sport using a lever
    b. Discuss with your counselor
        i. How the lever in your design will move something

*(Some media examples are the Discovery Channel, Science Channel, National Geographic, and the History Channel.)

**(Examples of magazine sources include Odyssey, Know : the Science Magazine for Curious Kids, Kids Discover, National Geographic Kids, Owl or OWLkids Online. You may wish to look at an article from Popular Mechanics or Popular Science with one of your parents.)

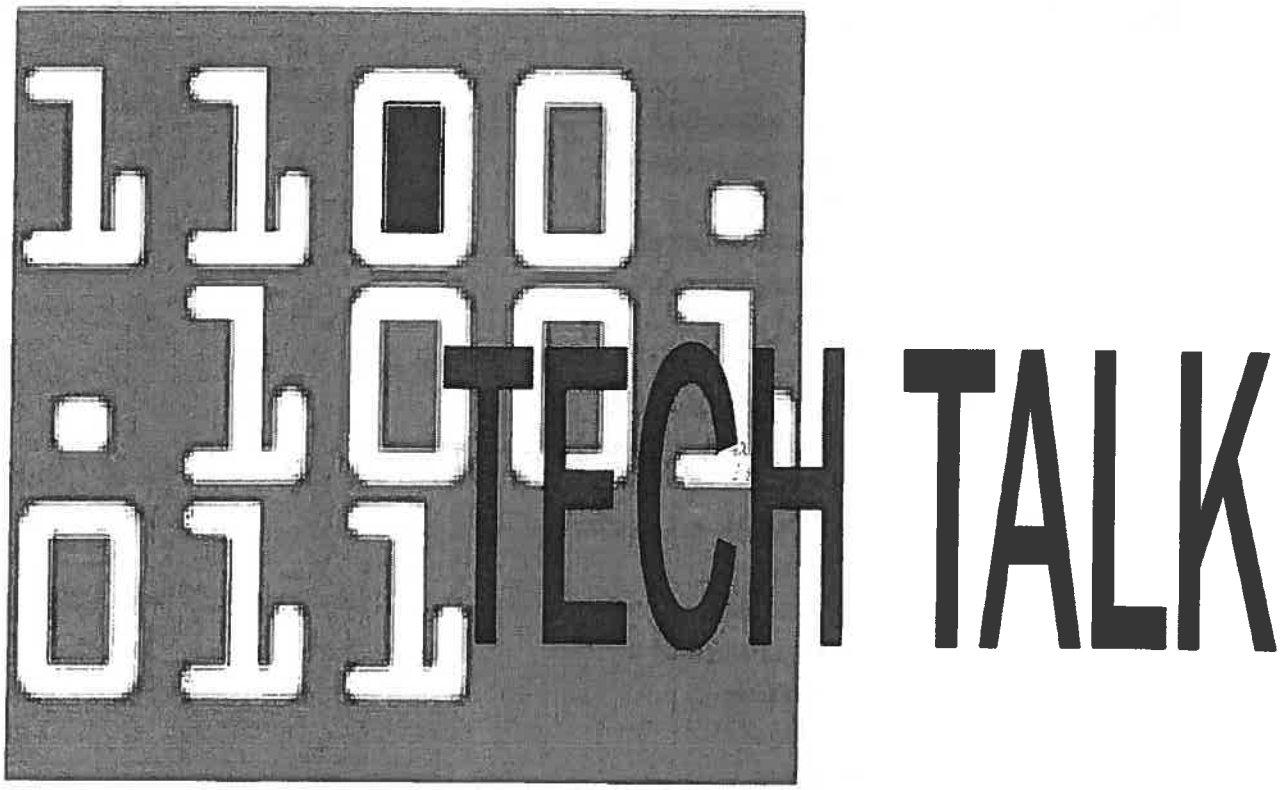
1. Watch or read. Choose a, b, or c and complete all the requirements:
    a. Watch an episode or episodes (about an hour total) of NOVA or other media production* that involves motion or machines.
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Read one long or two short magazine articles** that show(s) how motion or machines is/are measured, used, created or how machines work. (How does a gun work?)
        i. Make a list of at least two questions or ideas from the article(s)
        ii. Discuss the ideas and questions with your counselor
    c. Do a combination of reading and watching
        i. Make a list of at least two questions or ideas from the article or production
        ii. Discuss the ideas and questions with your counselor
2. Complete a Belt loop or Pin from the following list. (Choose one that you do not have.)

Badminton	Golf
Baseball	Hockey
BB Gun Shooting	Softball
Fishing	Table Tennis
	Tennis

b. Discuss with your counselor
    i. How the lever in your design will move something

*(Some media examples are the Discovery Channel, Science Channel, National Geographic, and the History Channel.)

**(Examples of magazine sources include Odyssey, Know : the Science Magazine for Curious Kids, Kids Discover, National Geographic Kids, Owl or OWLkids Online. You may wish to look at an article from Popular Mechanics or Popular Science with one of your parents.)



1. Look up a definition of Technology and discuss it with your counselor.
2. Watch or read. Choose a, b, or c and complete all the requirements:
    a. Watch an episode or episodes (about an hour total) of NOVA or other media production* that involves technology or how technology is used.
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Read one long or two short magazine articles** that talk about technology or how it is used.
        i. Make a list of at least two questions or ideas from the article(s)
        ii. Discuss the ideas and questions with your counselor
    c. Do a combination of reading and watching
        i. Make a list of at least two questions or ideas from the article or production
        ii. Discuss the ideas and questions with your counselor

3. Complete a belt loop or pin from the following list. (Choose one that you do not have.)

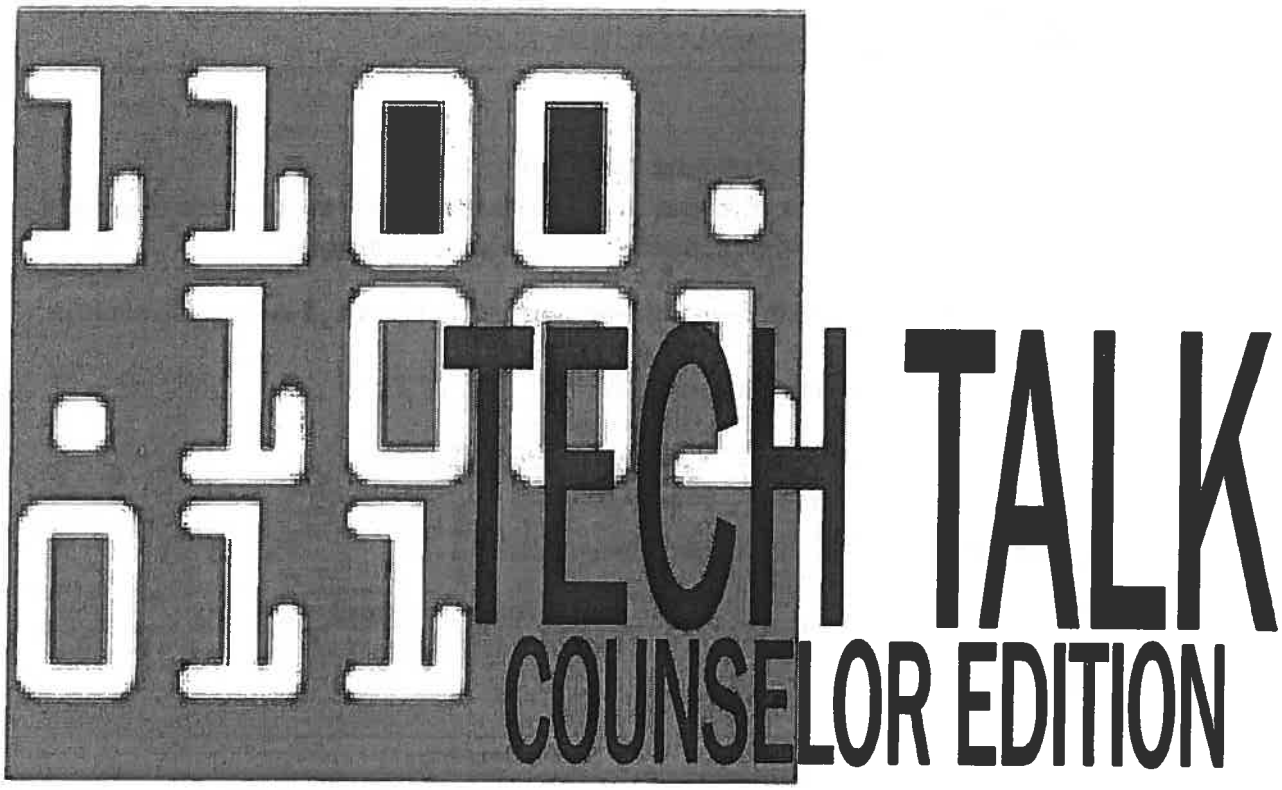
Astronomy	Map and Compass
BB Gun Shooting	Music
Bicycling	Photography
Bowling	Snow Ski and Board Sports
Computers	Video Games

4. What technology is used in your belt loop or pin?
    a. How do you think this technology
        i. Was invented?
        ii. Could be made better?
    b. Discuss your ideas with your counselor
5. Discuss with your counselor, then
    a. Visit a place of your choice that uses technology and
    b. Talk to someone in charge about
        i. The technologies used where you are visiting
        ii. Why they use these technologies

    Places you might like to visit may include
    - An amusement park
    - A police or fire station
    - A radio or television station
    - A newspaper office
    - A factory or store
6. Discuss with your counselor
    a. how technology is used in
        i. Communication (radio, TV, newspapers and magazines)
        ii. Business
        iii. Construction
        iv. Sports
        v. Entertainment
    b. Why technology is important

*(Some media examples are the Discovery Channel, Science Channel, National Geographic, and the History Channel.)

**(Examples of magazine sources include Odyssey, Know : the Science Magazine for Curious Kids, Kids Discover, National Geographic Kids, Owl or OWLkids Online. You may wish to look at an article from Popular Mechanics or Popular Science with one of your parents.)



1. **Look up a definition of Technology and discuss it with your counselor.**

   Technology is the process by which humans modify nature to meet their needs and wants; it is a product of engineering and science.
   http://www.members.nae.edu/nae/techlithome.nsf/weblinks/KGRG-55A3ER?OpenDocument
   Sometimes people refer to something as "high tech" or "low tech". "High tech" refers to the most currently advanced technology, but high tech becomes low tech with longevity and familiarity and as old technologies are replaced.

2. **Watch or read. Choose a, b, or c and complete all the requirements:**
   a. **Watch an episode or episodes (about an hour total) of NOVA or other media production* that involves technology or how technology is used.**

      Many boys will watch episodes on airplanes, space flight, computers, and other "high tech" products.

      i. **Make a list of at least two questions or ideas from each production**
      ii. **Discuss the ideas and questions with your counselor**

   b. **Read one long or two short magazine articles** that talk about technology or how it is used.**

      i. **Make a list of at least two questions or ideas from the article(s)**
      ii. **Discuss the ideas and questions with your counselor**

c. Do a combination of reading and watching
   i. Make a list of at least two questions or ideas from the article or production
   ii. Discuss the ideas and questions with your counselor

3. Complete a belt loop or pin from the following list. (Choose one that you do not have.)

Astronomy	Map and Compass
BB Gun Shooting	Music
Bicycling	Photography
Bowling	Snow Ski and Board Sports
Computers	Video Games

4. What technology is used in your belt loop or pin?

Astronomy	**Map and Compass**
Telescopes, Binoculars, Maps	Maps, Compasses
BB Gun Shooting	**Music**
Gun	Musical instruments, Tape recorders
Bicycling	**Photography**
Bicycle, Safety equipment, Protective gear	Cameras, Light meters
Bowling	**Snow Ski and Board Sports**
Pin re-setter, Ball return equipment, Scoring equipment	Skis and poles, Snow boards, Cold weather gear, Ski lifts
Computers	**Video Games**
Computers	Game systems, Monitors

   a. How do you think this technology
      i. Was invented?
      ii. Could be made better?
   b. Discuss your ideas with your counselor
5. Discuss with your counselor, then
   a. Visit a place of your choice that uses technology and
   b. Talk to someone in charge about
      i. The technologies used where you are visiting
      ii. Why they use these technologies

   Places you might like to visit may include

   - An amusement park
     Computers, rides, entry gates, camera monitors ...
   - A police or fire station
     Computers, vehicles, rescue equipment, sirens, jaws of life, fingerprint ink, handcuffs, hoses...
   - A radio or television station
     Computers, printers, broadcast equipment, fax machines, telephones...

- A newspaper office
  Computers, printers, rollers, folding machines, telephones, tape recorders, voice recognition…
- A factory or store
  Computers. cash registers, scanning equipment. lights, machinery, vehicles…

6. Discuss with your counselor
   a. how technology is used in
      i. Communication (radio, TV, newspapers and magazines)
      ii. Business
      iii. Construction
      iv. Sports
      v. Entertainment
   b. Why technology is important
      Technology is important because it is how human modify nature to meet their needs and wants; it is how we make our surroundings more comfortable, make our work easier, communicate, conduct business, travel…

*(Some media examples are the Discovery Channel, Science Channel, National Geographic, and the History Channel.)
**(Examples of magazine sources include Odyssey, Know : the Science Magazine for Curious Kids, Kids Discover, National Geographic Kids, Owl or OWLkids Online. You may wish to look at an article from Popular Mechanics or Popular Science with one of your parents.)

SUPERNOVA
Cub Scouts
Webelos

Cub Scout SUPERNOVA Award

Purpose: To recognize superior achievement by a Cub Scout in the field of Science, Technology, Engineering and Mathematics **(STEM)**.

Basic Requirements:

- Cub Scout member of a Wolf or Bear Den.
- Must select a Council approved "mentor" who is a registered Scouter and NOT the parent or unit leader of the candidate.
- Final approval must be by the District NOVA Award Committee or Advancement Committee.

Cub Scout Academic Areas and other guidelines approved for Cub Scout SUPERNOVA Award:

- SCIENCE and MATHEMATICS – these must be earned for the Cub Scout SUPERNOVA Award
- ASTRONOMY, COMPUTERS, GEOLOGY, and WEATHER – these are classified as the **"Science"** academic areas and some of these must be earned for the Cub Scout SUPERNOVA Award.
- All experiments or projects should be conducted using the highest level of safety protocol and always under the supervision of a qualified, responsible adult.

Dr. Luiz Walter Alvarez SUPERNOVA Award (the Cub Scout SUPERNOVA award):

- Earn the SCIENCE and MATHEMATICS academic pins, and at least three of the four academic pins from the "Science" academic area list.
- Research facts about Dr. Luiz Walter Alvarez from resources in your school library or on the internet (with you parent's permission and guidance) and report your findings to your mentor.
- Research facts about three other famous scientists, engineers or mathematicians approved by your mentor and report on them to your mentor either verbally or in writing.
- Talk with your teacher(s) at school (or your parents if you are home-schooled) about your interest in earning the SUPERNOVA award and ask them to give you their views on the importance of math and science in your education. Report what you find out to your mentor.
- Participate in a science fair in your classroom or school or do a special science project approved by your teacher. Report on this activity to your mentor.
- Write a 300 word essay on a career that is heavily involved with science, technology, engineering or mathematics and submit it to your mentor for approval OR visit a person who works in a STEM related career, talk with them and report on this visit to your mentor.
- Learn the Scientific Method and report orally on it to your Mentor (or NOVA Committee) using a combination of explanation and demonstration.
- Participate in a **NOVA** or other **STEM** related program in your Cub Scout den or pack meeting which is conducted by a Boy Scout or Venturer who is working on his or her SUPERNOVA award.
- **Submit an application to the District NOVA or Advancement Committee for approval.**

Cub Scout SUPERNOVA Award Recognition Materials: Certificate and Cloth Badge.

Webelos Scout SUPERNOVA Award

Purpose: To recognize superior achievement by a Webelos Scout in the field of Science, Technology, Engineering and Mathematics **(STEM)**.

Basic Requirements:

- Webelos Scout.
- Must select a Council approved "mentor" who is a registered Scouter and NOT the parent or unit leader of the candidate.
- If the candidate earned the Cub Scout SUPERNOVA award, similar requirements must be repeated while the candidate is a Webelos Scout.
- Final approval must be by the District NOVA Award Committee or Advancement Committee.

Webelos Activity Badges and other guidelines approved for the Webelos Scout SUPERNOVA Award:

- SCHOLAR, SCIENTIST, FORESTER, GEOLOGIST, NATURALIST, and ENGINEER – these are classified as the **"Science"** Webelos Activity Badges and ALL of these must be earned for the Webelos Scout SUPERNOVA Award.
- All experiments or projects should be conducted using the highest level of safety protocol and always under the supervision of a qualified, responsible adult.

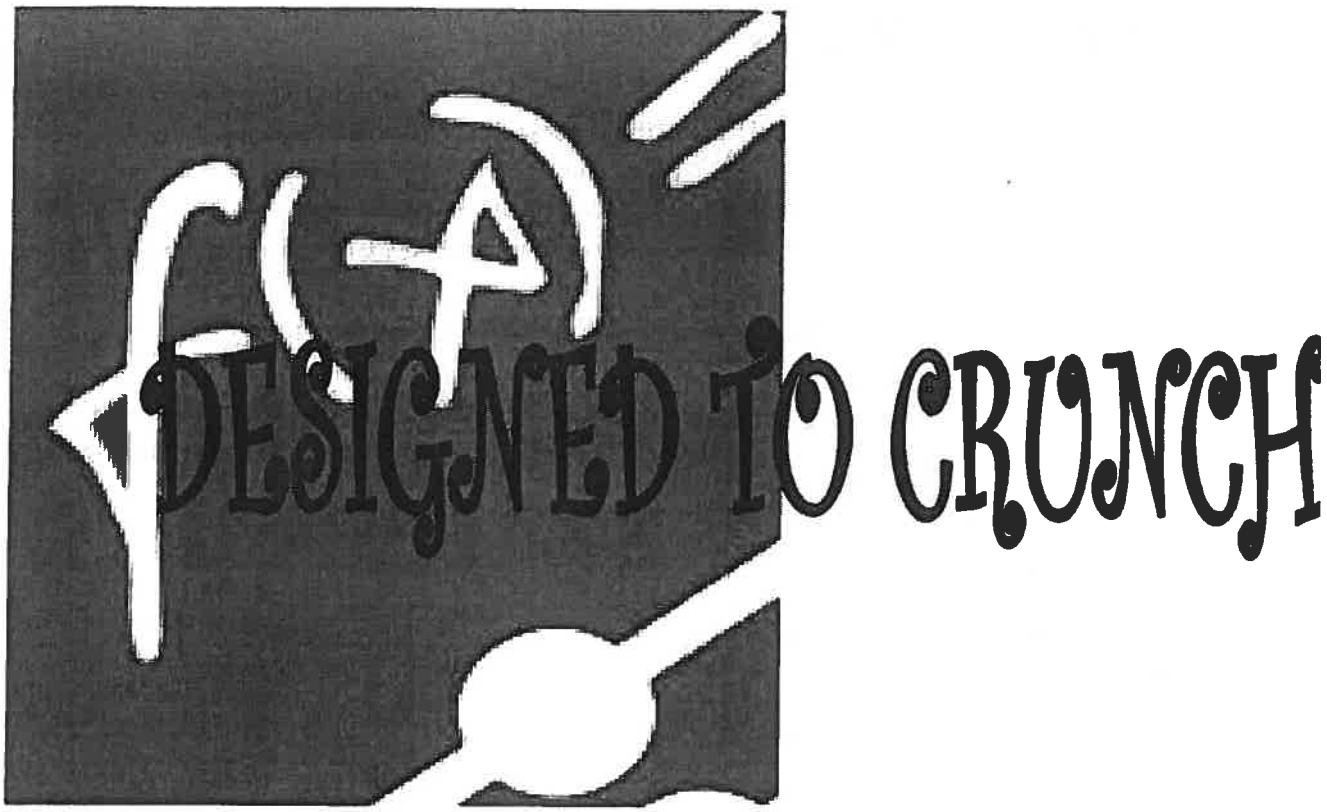
Dr. Charles Townes SUPERNOVA Award (the Webelos Scout SUPERNOVA award):

- Earn ALL six Webelos activity badges from the **"Science"** activity badge list.
- Research facts about Dr. Charles Townes from resources in your school library or on the internet (with you parent's permission and guidance) and report your findings to your mentor.
- Research facts about five other famous scientists, engineers or mathematicians approved by your mentor and report on them to your mentor either verbally or in writing.
- Talk with your teacher(s) at school (or your parents if you are home-schooled) about your interest in earning the Webelos SUPERNOVA award and ask them to give you their views on the importance of math and science in your education. Report what you find out to your mentor.
- Participate in a science fair in your classroom or school or do a special science project approved by your teacher. Report on this activity to your mentor.
- Write a 500 word essay on a career that is heavily involved with science, technology, engineering or mathematics and submit it to your mentor for approval OR visit a person who works in a STEM related career, talk with them and report on this visit to your mentor.
- Conduct an experiment which illustrates the Scientific Method and under the direct supervision of your Mentor and prepare an appropriate report on this for your District NOVA Committee.
- Participate in a **NOVA** or **STEM** related program in your Cub Scout den or pack meeting which is conducted by a Boy Scout or Venturer who is working on his or her SUPERNOVA award.
- **Submit an application to the District NOVA or Advancement Committee for approval.**

Webelos Scout SUPERNOVA Award Recognition Materials: Certificate, Cloth Badge and Medal on ribbon.

Revised Presentation Materials
Stardate 2010.11.12

Boy Scouts



1. Watch or Research, choose option a, b, c, or d and complete all the requirements:
    a. Watch 3 episodes of NOVA or other media production that involve scientific models and modeling, math, physics, sports equipment design, bridge building, or Cryptography. (Examples of media productions include Discovery Channel, Science Channel, National Geographic, and the History Channel)
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Research several on-line sites that discuss and explain Cryptography or the discoveries of people who extensively worked with cryptography
        i. List and record (you may use the copy and paste function if you include your sources)
            1. The URLs of the sites you visited
            2. Major topics covered on the sites you visited
            3. How cryptography is used in the military and in everyday life
        ii. Discuss with your counselor how a cryptographer uses mathematics (a sample site - http://www.math.umass.edu/~gunnells/talks/crypt.pdf)
    c. Read at least three articles about physics, math, modeling, or cryptography. You may wish to read about how technology and engineering are changing sports equipment, why and how triangles are used in building, bridge building, engineering, climate and/or weather models, how banks keep information secure, or about the stock market. (Examples of magazine sources include Popular Mechanics, Popular Science, Science Illustrated, Discover Magazine, Professional Motor Mechanic, Odyssey, and Scientific American.)

i. Make a list of at least two questions or ideas from each article
ii. Discuss the ideas and questions with your counselor

d. Do a combination of reading, watching, or researching
i. Make a list of at least two questions or ideas from each article, site, or production
ii. Discuss the ideas and questions with your counselor

2. Merit badge
a. Complete ONE merit badge from the following list. (If you have already completed one of these merit badges, please complete a different merit badge for this award.)

American Business
Architecture
Drafting
Entrepreneurship
Inventing
Landscape Architecture
Model Design and Building
Orienteering
Photography
Pioneering
Plumbing
Pottery
Radio
Salesmanship
Space Exploration
Surveying
Traffic Safety
Truck Transportation
Weather
Woodworking

b. Discuss with your counselor how the merit badge you completed uses mathematics

3. Calculate - choose TWO. (Write down your data and calculations to support your explanation to your counselor. Do not use someone else's data or calculations.):
a. Your horsepower when you run up a flight of stairs
i. How does your horsepower compare to the power of a horse?
http://www.wikihow.com/Calculate-Your-Horsepower
http://onlinephys.com/labpower1.html
ii. How does your horsepower compare to the horsepower of your favorite car?

b. Attend at least two track, cross-country, or swim meets.
i. For each meet, time at least three racers (Time the same racers at each meet.)
ii. Calculate the average speed of the racers you timed. (Make sure you write down your data and calculations.)
iii. Compare the average speeds of your racers
1. To each other
2. To their times at the two meets you attended.
iv. Show your calculations to your counselor.

c. Attend a baseball, softball, or basketball game.
i. Choose two players
ii. Keep track of their efforts during the game. (Make sure you write down your data and calculations.)

1. Calculate their statistics – examples:
    a. Baseball or softball
        i. Batting average
        ii. Runs Batted In
        iii. Fielding statistics
        iv. Pitching statistics
    b. Basketball
        i. Points
        ii. Baskets attempted
        iii. Rebounds
        iv. Steals and Takeaways
        v. Turnovers

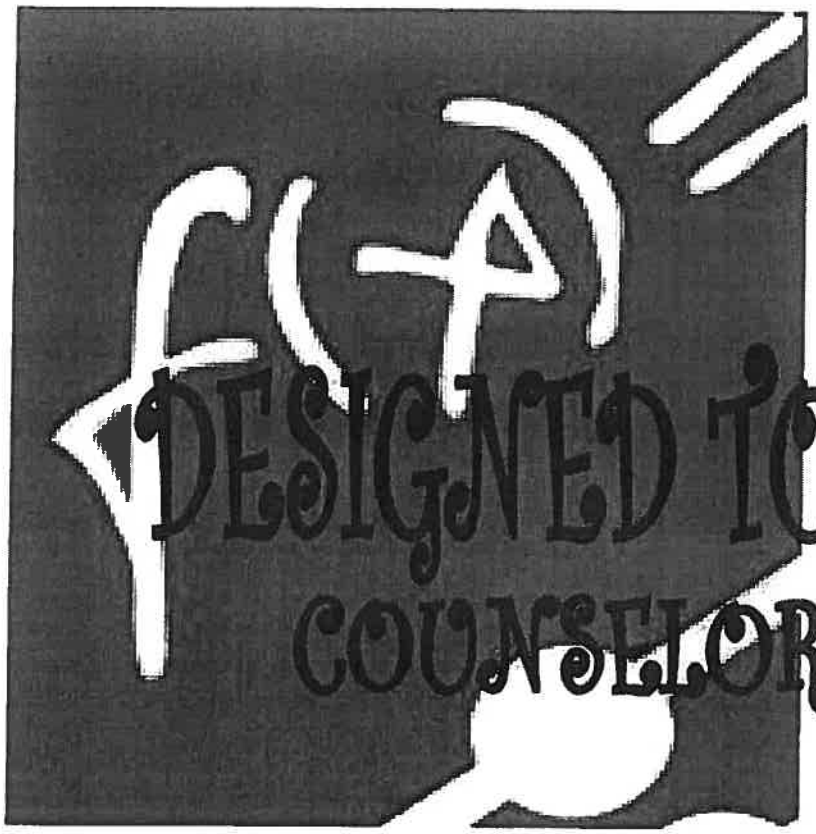
iii. Show your calculations to your counselor.

d. Attend a football game or watch on TV. (Fun to do with a parent or friend!)
    i. Keep track of the efforts of your team during the game. (Make sure you write down your data and calculations.) – examples:
        1. Kick/Punt teams
            a. Kickoff
                i. Kick return yards
            b. Punt
                i. Number of punts
                ii. Yards of each punt
            c. Field goals
                i. Attempted
                ii. Percent completed
                iii. Yards of each kick
            d. Extra point
                i. Attempted
                ii. Percent completed
        2. Offense
            a. Number of first downs
            b. Forward passes
                i. Attempted
                ii. Percent completed
                iii. Length
                    1. Longest
                    2. Length of all passes
                iv. Receivers
                    1. Number of passes caught
                    2. Length of passes caught
                    3. Yards run after catching a pass
            c. Running plays
                i. Number of running plays
                ii. Yards gained or lost
                    1. Each run
                    2. Longest run from scrimmage line
                    3. Total yards gained
            d. Number of touchdowns

3. Defense
    a. Number of quarterback sacks
    b. Number of interceptions
    c. Number of turnovers
    d. Number of safeties

ii. Show your calculations to your counselor.

4. Calculator (scientific or graphing)
    a. Investigate your calculator – 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.)



1. Watch or Research, choose option a, b, c, or d and complete all the requirements:
    a. Watch 3 episodes of NOVA or other media production that involve scientific models and modeling, math, physics, sports equipment design, bridge building, or Cryptography. (Examples of media productions include Discovery Channel, Science Channel, National Geographic, and the History Channel)
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Research several on-line sites that discuss and explain Cryptography or the discoveries of people who extensively worked with cryptography
        i. List and record (you may use the copy and paste function if you include your sources)
            1. The URLs of the sites you visited
            2. Major topics covered on the sites you visited
            3. How cryptography is used in the military and in everyday life
        ii. Discuss with your counselor how a cryptographer uses mathematics (a sample site - http://www.math.umass.edu/~gunnells/talks/crypt.pdf)
    c. Read at least three articles about physics, math, modeling, or cryptography. You may wish to read about how technology and engineering are changing sports equipment, why and how triangles are used in building, bridge building, engineering, climate and/or weather models, how banks keep information secure,

or about the stock market. (Examples of magazine sources include Popular Mechanics, Popular Science, Science Illustrated, Discover Magazine, Professional Motor Mechanic, Odyssey, and Scientific American.)
   i. Make a list of at least two questions or ideas from each article
   ii. Discuss the ideas and questions with your counselor

d. Do a combination of reading, watching, or researching
   i. Make a list of at least two questions or ideas from each article, site, or production
   ii. Discuss the ideas and questions with your counselor

2. Merit badge
   a. Complete ONE merit badge from the following list. (If you have already completed one of these merit badges, please complete a different merit badge for this award.)

American Business	Plumbing
Architecture	Pottery
Drafting	Radio
Entrepreneurship	Salesmanship
Inventing	Space Exploration
Landscape Architecture	Surveying
Model Design and Building	Traffic Safety
Orienteering	Truck Transportation
Photography	Weather
Pioneering	Woodworking

   b. Discuss with your counselor how the merit badge you completed uses mathematics

3. Calculate - choose TWO. (Write down your data and calculations to support your explanation to your counselor. Do not use someone else's data or calculations.):
   a. Your horsepower when you run up a flight of stairs

From http://www.wikihow.com/Calculate-Your-Horsepower Or use http://onlinephys.com/labpower1.html

- **Find out how much you weigh in kilograms and write it down** (your weight in pounds multiplied by 0.454)
- **Find a stair, ladder or something similar** (as long as it gets you upwards)
- **Measure HEIGHT (not length) of the stairs (or whatever you use) to the ending point at the top and write it down,** this can be done by multiplying the height of one stair by the number of stairs (you don't care about how LONG the stairs are)
- **Start off with a running start towards the stairs, once you step to the first step, start the timer, once both feet are on the top step, stop it**. Now you have all the numbers needed.
- **Calculate the Power (P) with the formula**: mah/t (m*9.80*h)/t, where m = mass (your weight) in kilograms, h = height of staircase in meters. 9.80 is the acceleration caused by Earth's gravity and t = time in seconds. The number you get is in Watts, which is equal to

Joules per second (J/s) and Newton meters per second (Nm/s). If you don't divide by time, you will calculate the energy needed to climb the stairs. (Work = mah, Power = mah/t. Work, and/or energy, is measured in Newton meters or Joules, Power is measured in Joules/second or Watts).

- **Divide the number of Watts by 745.6 to get the number in horsepower.**
    - i. How does your horsepower compare to the power of a horse?
    - ii. How does your horsepower compare to the horsepower of your favorite car? http://www.wikihow.com/Calculate-Your-Horsepower http://onlinephys.com/labpower1.html
        1. Horsepower is a unit of power. One horsepower equals 33,000 ft-lbs of work per minute, or 745.6 watts. James Watt, who invented steam engines, based his unit of power on how much weight a real horse could pull from a coal mine in one minute. (Good information http://www.web-cars.com/math/horsepower.html)
        2. Most car information packets and on-line sites list the horsepower of the car.

b. Attend at least two track, cross-country, or swim meets.
    - i. For each meet, time at least three racers (Time the same racers at each meet.)
    - ii. Calculate the average speed of the racers you timed. (Make sure you write down your data and calculations.)
        1. Average speed = Distance / Time
    - iii. Compare the average speeds of your racers
        1. To each other
        2. To their times at the two meets you attended.
    - iv. Show your calculations to your counselor.

c. Attend a baseball, softball, or basketball game.
    - i. Choose two players
    - ii. Keep track of their efforts during the game. (Make sure you write down your data and calculations.)
        1. Calculate their statistics – examples:
            - a. Baseball or softball
                - i. Batting average
                - ii. Runs Batted In
                - iii. Fielding statistics
                - iv. Pitching statistics
            - b. Basketball
                - i. Points
                - ii. Baskets attempted
                - iii. Rebounds
                - iv. Steals and Takeaways
                - v. Turnovers
    - iii. Show your calculations to your counselor.

d. Attend a football game or watch on TV. (Fun to do with a parent or friend!)
    - i. Keep track of the efforts of your team during the game. (Make sure you write down your data and calculations.) – examples:

1. Kick/Punt teams
    a. Kickoff
        i. Kick return yards
    b. Punt
        i. Number of punts
        ii. Yards of each punt
    c. Field goals
        i. Attempted
        ii. Percent completed
        iii. Yards of each kick
    d. Extra point
        i. Attempted
        ii. Percent completed
2. Offense
    a. Number of first downs
    b. Forward passes
        i. Attempted
        ii. Percent completed
        iii. Length
            1. Longest
            2. Length of all passes
        iv. Receivers
            1. Number of passes caught
            2. Length of passes caught
            3. Yards run after catching a pass
    c. Running plays
        i. Number of running plays
        ii. Yards gained or lost
            1. Each run
            2. Longest run from scrimmage line
            3. Total yards gained
    d. Number of touchdowns
3. Defense
    a. Number of quarterback sacks
    b. Number of interceptions
    c. Number of turnovers
    d. Number of safeties

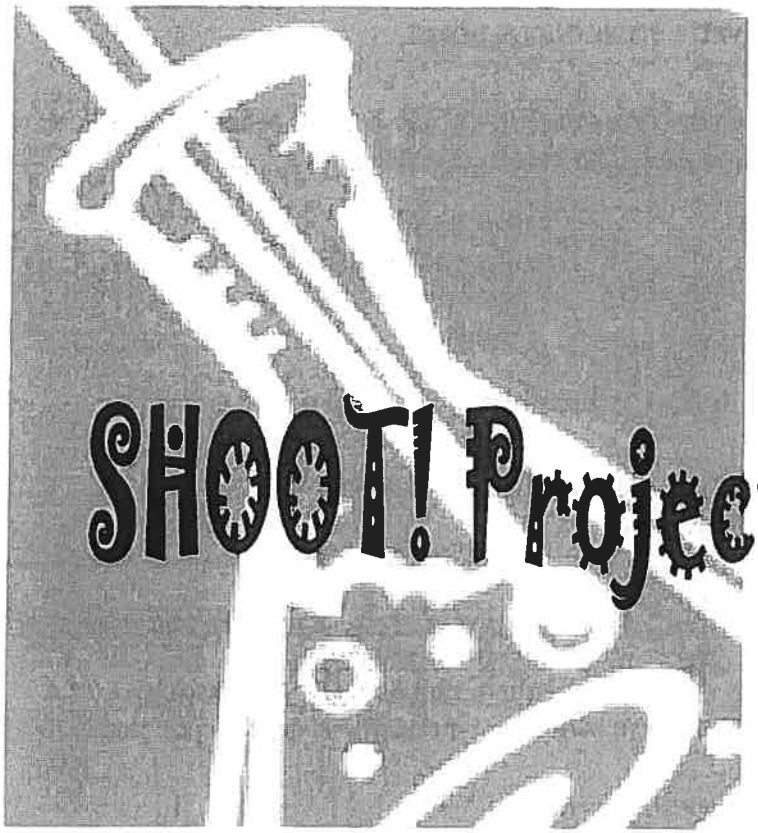
ii. Show your calculations to your counselor.

4. Calculator (scientific or graphing)
    a. Investigate your calculator – 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.)

[redacted] [DESIGNED TO CRUNCH COUNSELOR EDITION]

For Requirement 4 of Designed to Crunch, are some ideas for your Scout to consider. Pick a few or think of others.

- How can you add fractions, using your calculator, and get an answer in fraction form?
- How can you perform repeated calculations efficiently?
- How many digits in a numerical answer can your calculator show you? What if the answer to your calculation has more digits than your calculator can show you? Can you figure out how many digits your answer has? Can you figure out the hidden digits?
- How can you enter, store, recall, and use a list of data to perform data analysis calculations?
- For a calculator with graphing capabilities, how can you display a graph? Will a graphing calculator always show the *entire* graph or must it sometimes show only a portion of the graph? If it shows only a portion of a graph, how can you be certain that the portion you are viewing shows the features you want to see?
- For numerical calculations, when does your calculator give *exact* answers and when does it give *approximate* answers? What is the difference? How can you tell? Does it matter?
- If your calculator defaults to giving you an approximate answer, but you need an exact answer, what do you do?
- If an approximate answer will do, how might your calculator's internal calculation limitations affect the accuracy of the approximation?
- For a calculator with graphing capabilities, how might pixel limitations affect its depiction of a graph?
- Is the calculator always right? Why or why not? How might you tell? What might cause a calculator to give you an incorrect answer? (For a graphing calculator, what might cause the calculator to give you an incorrect graph, or *no* graph, or a graph that cannot be readily interpreted?)
- Are there numerical calculations that calculators *can't* do? If possible, give an example.



SHOOT! Projectiles & Space

1. Watch or research. Choose option a, b, or c and complete all the requirements:
    a. Watch 3 episodes/hours of NOVA, NASA, or other media productions (examples include Discovery Channel, Science Channel, National Geographic, and the History Channel. NASA also has some short multimedia clips) that involve projectiles, aviation, space, weather, astronomy, or aviation and/or space technology.
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Read at least three articles about projectiles, aviation, space, weather, astronomy, or aviation and/or space technology. (Examples of magazine sources include Odyssey, Popular Mechanics, Popular Science, Science Illustrated, Discover Magazine, Air and Space, Popular Astronomy, Astronomy Magazine, Science News, Sky and Telescope, Natural History, and Scientific American).
        i. Make a list of at least two questions or ideas from each article
        ii. Discuss the ideas and questions with your counselor
    c. Do a combination of reading and watching
        i. Make a list of at least two questions or ideas from each article or production
        ii. Discuss the ideas and questions with your counselor

2. Complete a merit badge from the following list. (If you have already completed one of these merit badges, please complete a different merit badge for this award.)

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

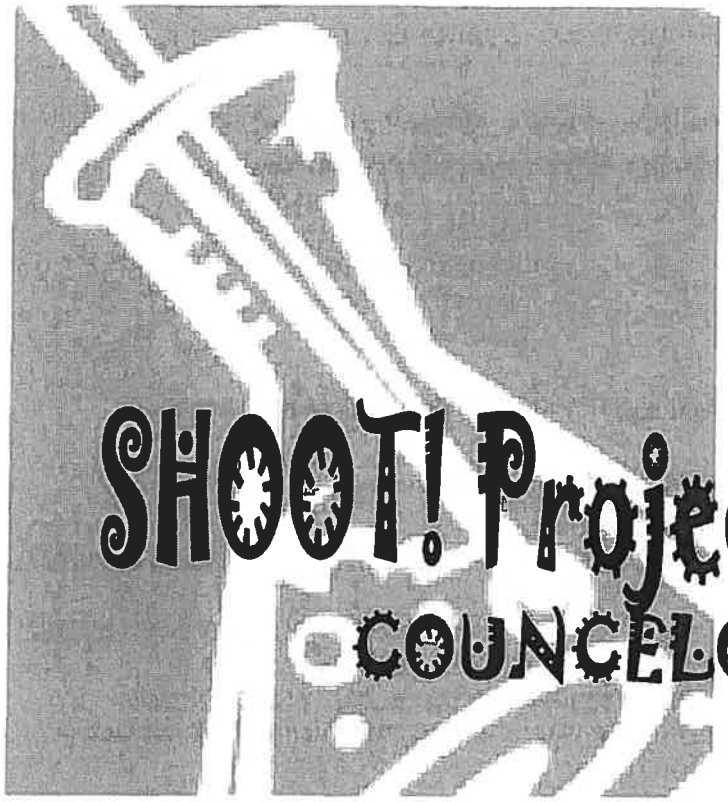
3. Projectile Motion – choose option a or b and complete all the requirements.
    a. Simulations -
        i. Find and use a projectile simulation applet on the internet.
            Possible links:
                a. http://www.mhhe.com/physsci/physical/giambattista/proj/projectile.html
                b. http://galileoandeinstein.physics.virginia.edu/more_stuff/Applets/ProjectileMotion/enapplet.html
                c. http://www.walter-fendt.de/ph14e/projectile.htm
        ii. Design and complete a hands-on experiment to demonstrate projectile motion.
            1. Keep a record of the
                a. Angle
                b. Time
                c. 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 for where the projectile can land.)
        iii. Explain to your counselor
            1. the definition of
                a. a projectile and
                b. projectile motion.
            2. Discuss the factors affecting the path of a projectile.
            3. Discuss the difference between forward velocity and acceleration due to gravity.
    b. Discover-
        i. Explain to your counselor the difference between escape velocity (not the game), orbital velocity, and terminal velocity.
        ii. Do two of the following (you may wish to explore internet sites 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. Visit or view. Choose one and complete all the requirements.
    a. Visit
        i. Choose one
            1. An observatory
            2. A flight, aviation, or space museum
        ii. Talk to a docent or person in charge about a science topic related to the site.
        iii. Discuss your visit with your counselor.
    b. View
        i. Discover your latitude and longitude coordinates.
        ii. Find the time for a satellite to pass over your area. (A good resource to find the times for satellite passes is http://www.heavens-above.com/)
        iii. Watch the satellite using binoculars.
        iv. Record
            1. The time of your viewing
            2. The weather conditions
            3. How long the satellite was visible
            4. The path of the satellite
        v. Discuss your viewing with your counselor.
5. Hands-ON! Choose a, b, or c and complete all the requirements.
    a. Design and build a catapult that will launch a marshmallow a distance of four feet.
        i. Keep track of your experimental data
            1. Angle of launch
            2. Distance projected
        ii. Make sure you apply the same force every time - perhaps you could use a weight to launch the marshmallow.
        iii. Discuss your design, data, and experiments, both failures and successes, with your counselor.
    b. Design a pitching machine that will lob a softball into the strike zone.
        i. 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?
        ii. How much force you will need to apply in order to power the ball over the distance to the plate?

iii. If you were to use a power supply on your machine, what would be your power source and why?
iv. Discuss your design, data, and experiments, both failures and successes, with your counselor.

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.
   i. Keep track of your experimental data for every try. Include:
      1. Vertical angle between the two parts of the chute
      2. Horizontal distance between the two parts of the chute
   ii. Experiment with different heights to start the marble.
      1. How do the start heights affect the velocity of the marble?
      2. Does a higher start height allow a greater jump distance?
   iii. Discuss your design, data, and experiments, both failures and successes, with your counselor.



SHOOT! Projectiles & Space

COUNCELOR EDITION

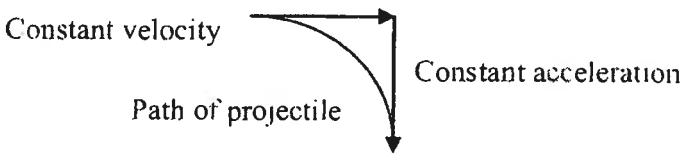
1. Watch or research. Choose option a, b, or c and complete all the requirements:
    a. Watch 3 episodes/hours of NOVA, NASA, or other media productions (examples include Discovery Channel, Science Channel, National Geographic, and the History Channel. NASA also has some short multimedia clips) that involve projectiles, aviation, space, weather, astronomy, or aviation and/or space technology.
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Read at least three articles about projectiles, aviation, space, weather, astronomy, or aviation and/or space technology. (Examples of magazine sources include Odyssey, Popular Mechanics, Popular Science, Science Illustrated, Discover Magazine, Air and Space, Popular Astronomy, Astronomy Magazine, Science News, Sky and Telescope, Natural History, and Scientific American).
        i. Make a list of at least two questions or ideas from each article
        ii. Discuss the ideas and questions with your counselor
    c. Do a combination of reading and watching
        i. Make a list of at least two questions or ideas from each article or production
        ii. Discuss the ideas and questions with your counselor

2. Complete a merit badge from the following list. (If you have already completed one of these merit badges, please complete a different merit badge for this award.)

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

3. Projectile Motion – choose option a or b and complete all the requirements.
    a. Simulations -
        i. Find and use a projectile simulation applet on the internet.
            Possible links:
                a. http://www.mhhe.com/physsci/physical/giambattista/proj/projectile.html
                b. http://galileoandeinstein.physics.virginia.edu/more_stuff/Applets/ProjectileMotion/enapplet.html
                c. http://www.walter-fendt.de/ph14e/projectile.htm
        ii. Design and complete a hands-on experiment to demonstrate projectile motion.
            1. Keep a record of the
                a. Angle
                b. Time
                c. 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 for where the projectile can land.)
        iii. Explain to your counselor
            1. the definition of
                a. a projectile
                Projectile
                - an object that is fired, launched, or thrown, but which cannot propel itself
                -a self-propelled missile, like a rocket
                b. projectile motion
                Projectile motion is the curved path taken by an object that is fired, launched, or thrown.
                http://www.ncsec.org/cadre2/team1_2/pm.htm
            2. Discuss the factors affecting the path of a projectile.
            When an object is fired, launched, or thrown, it is given **horizontal velocity**. (Velocity is the same as speed, but it is speed in a given direction.) Once the object is launched, no additional horizontal velocity giving force is applied. Newton's

First Law of Motion states that a body at rest stays at rest and a body in motion stays in motion unless acted upon by an outside force. If gravity did not act on the projectile's path. the object would continue to move in the direction it was launched
Once the object has been launched, the only force acting upon it is the **force of gravity**, which accelerates the object toward the earth.
(http://www.regentsprep.org/regents/physics/phys01/accgravi/index.htmm
http://www.physicsclassroom.com/class/1dkin/u1l5b.cfm
Projectile motion is caused by the force of gravity giving vertical acceleration to an object that has horizontal velocity. (If an object is thrown straight up in the air, the force of gravity slows it down, it comes momentarily to a complete stop, then accelerates downward.) An object which has been launched will continue to move in the direction it was thrown at the speed with which it was thrown (except for being slowed down by friction with the air air resistance), but it will begin to accelerate toward the earth, moving faster toward the earth all the time. The combination of constant horizontal velocity and increasing downward velocity due to the acceleration of gravity is what gives a projectile its curved path.



http://www.physicsclassroom.com/class/vectors/u3l2a.cfm

3. **Discuss the difference between forward velocity and acceleration due to gravity.**
Forward velocity is the speed horizontal to the earth given to a projectile. If the projectile is thrown parallel to the earth, all of its original speed will be its forward velocity. If an object is thrown at an angle to the earth. the forward velocity is that portion of the velocity that is parallel to the earth. (Determining forward velocity can be done by separating the velocity into horizontal and vertical components - like on a triangle - using vector resolution http://www.physicsclassroom.com/class/vectors/u3l1e.cfm#trig and http://www.physicsclassroom.com/class/vectors/u3l2d.cfm.)
Forward velocity has a constant speed.

Acceleration due to gravity slows things down that are moving upwards and speeds things up that are moving downwards. At most locations on earth, the acceleration of gravity (9.80 m/s^2 or ~32.174 ft/s^2). will cause an object to fall 9.8 meters/second faster every second. An object starting with no vertical motion will be falling toward earth at the rate of 9.8m/s at the end of one second and at the rate of 19. 6m/s at the end of two seconds. Acceleration due to gravity is constantly changing the vertical speed/velocity of an object.

b. Discover-

i. **Explain to your counselor the difference between escape velocity (not the game), orbital velocity, and terminal velocity.**

Escape Velocity is the speed at which an object will be able to escape the gravity of the earth, moon, or other body. An object must travel fast enough that it will not fall back to the surface. **Escape velocity from the earth is 11.2 km/s or 25038.72 mph.** http://hyperphysics.phy-astr.gsu.edu/hbase/vesc.html Escape velocity is proportional to the square root of the ratio between the mass of the larger body and the distance of the smaller object from the center of the larger body.
http://science.howstuffworks.com/framed.htm?parent=satellite.htm&url=http://www.kidsplanet.com/ce5/CE017285.html

http://www.qrg.northwestern.edu/projects/vss/docs/space-environment/2-whats-escape-velocity.html

Orbital Velocity - An object goes into orbit (achieves **orbital velocity**) when its horizontal velocity balances the acceleration of gravity at that location in space. An object that has orbital velocity continues to fall toward the earth as it travels away from the earth, giving the object a circular path around the earth. The object continually falls around the earth due to the combination of horizontal velocity and acceleration due to gravity.

Terminal velocity - The point at which the acceleration of gravity on an object matches the air resistance of the object. Terminal velocity is affected by the weight of the object and the orientation of the object. (The more surface area that is horizontal to the earth, the lower the terminal velocity. Skydivers who perform aerial displays use this fact. The first divers to jump lie flat to increase their air resistance while later divers streamline dive to catch them in the air.)

NOTE: If it were not for air resistance, all objects, regardless of mass, size, or any other factor, would fall at the SAME velocity.

Watch – Astronauts David Scott and Jim Irwin do Galileo's experiment on the moon http://er.jsc.nasa.gov/seh/feather.html

ii. Do two of the following (you may wish to explore internet sites to find this information). http://science.howstuffworks.com/satellite3.htm

1. **Why are satellites usually launched toward the east and what is a launch window?**

   When satellites are launched to the east, the spin of the earth effectively adds to their velocity, making escape velocity easier to obtain and requiring less fuel. Not all spacecraft are launched toward the east; launch direction depends also on the final orbit and purpose of the satellite.

   http://www.braeunig.us/space/orbmech.htm

   http://www.eumetsat.int/Home/Main/Satellites/SatelliteProgrammesOverview/SP_20100427133512861?l=en

   In order for a spacecraft to rendezvous with another spacecraft or other object in space, the launch must occur at a time when the orbits of the two will overlap in the future. A **launch window** describes a time period in which a mission must be launched in order to match orbits.

   http://www.esa.int/esaSC/SEMO49YO4HD_index_0.html

   "The perfect launch window requires the coincidence of orbits and their inclinations, precession, weather and lighting."http://www.npr.org/templates/story/story.php?storyId=4749663

   http://www.nasa.gov/audience/forstudents/brainbites/nonflash/bb_home_launchwindow.html

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?)**

   Terminal Velocity is when the acceleration due to gravity is matched by the air resistance (or resistance of whatever fluid the object is travelling through). When the acceleration of gravity is balanced by air resistance, the object continues to fall, but it does not increase its velocity.

   "A person has a terminal velocity of about 200 mph when balled up and about 125 mph with arms and feet fully extended to catch the wind." 49-89 m/s

   http://hypertextbook.com/facts/JianHuang.shtml

   Also check:

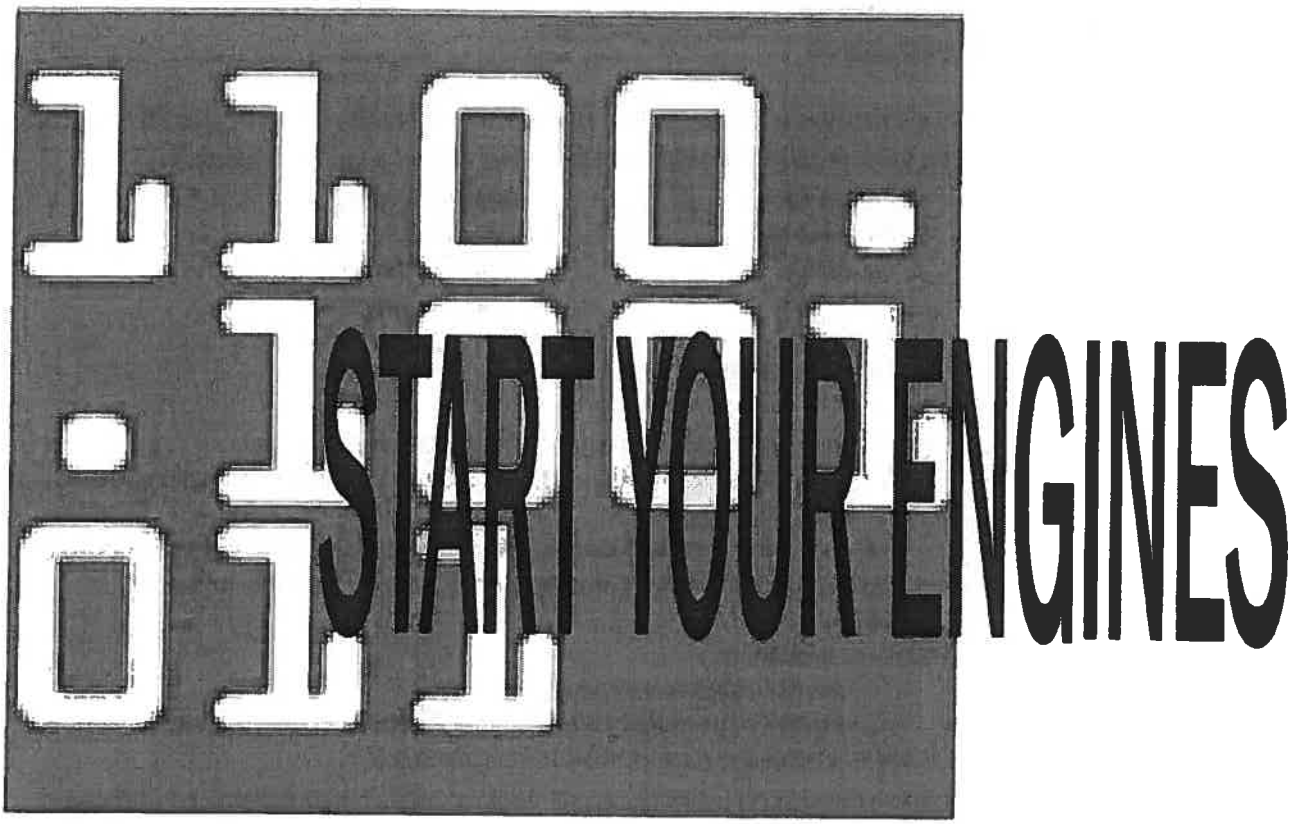
   http://exploration.grc.nasa.gov/education/rocket/termvr.html

3. **How fast a bullet, baseball, airplane, or rocket would have to 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?) Escape velocity from the earth is 11.2 km/s or 25038.72 mph.

4. Visit or view. Choose one and complete all the requirements.
    a. Visit
        i. Choose one
            1. An observatory
            2. A flight, aviation, or space museum
        ii. Talk to a docent or person in charge about a science topic related to the site.
        iii. Discuss your visit with your counselor.
    b. View
        i. Discover your latitude and longitude coordinates.
        ii. Find the time for a satellite to pass over your area. (A good resource to find the times for satellite passes is http://www.heavens-above.com/)
        iii. Watch the satellite using binoculars.
        iv. Record
            1. The time of your viewing
            2. The weather conditions
            3. How long the satellite was visible
            4. The path of the satellite
        v. Discuss your viewing with your counselor.
5. Hands-ON! Choose a, b, or c and complete all the requirements.
    a. Design and build a catapult that will launch a marshmallow a distance of four feet.
        i. Keep track of your experimental data
            1. Angle of launch
            2. Distance projected
        ii. Make sure you apply the same force every time - perhaps you could use a weight to launch the marshmallow.
        iii. Discuss your design, data, and experiments, both failures and successes, with your counselor.
    b. Design a pitching machine that will lob a softball into the strike zone.
        i. 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?
        ii. How much force you will need to apply in order to power the ball over the distance to the plate?
        iii. If you were to use a power supply on your machine, what would be your power source and why?
        iv. Discuss your design, data, and experiments, both failures and successes, with your counselor.

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. http://www.ehow.com/how_6352569_make-toy-marble-run.html
   i. Keep track of your experimental data for every try. Include:
      1. Vertical angle between the two parts of the chute
      2. Horizontal distance between the two parts of the chute
   ii. Experiment with different heights to start the marble.
      1. How do the start heights affect the velocity of the marble?
      2. Does a higher start height allow a greater jump distance?
   iii. Discuss your design, data, and experiments, both failures and successes, with your counselor.

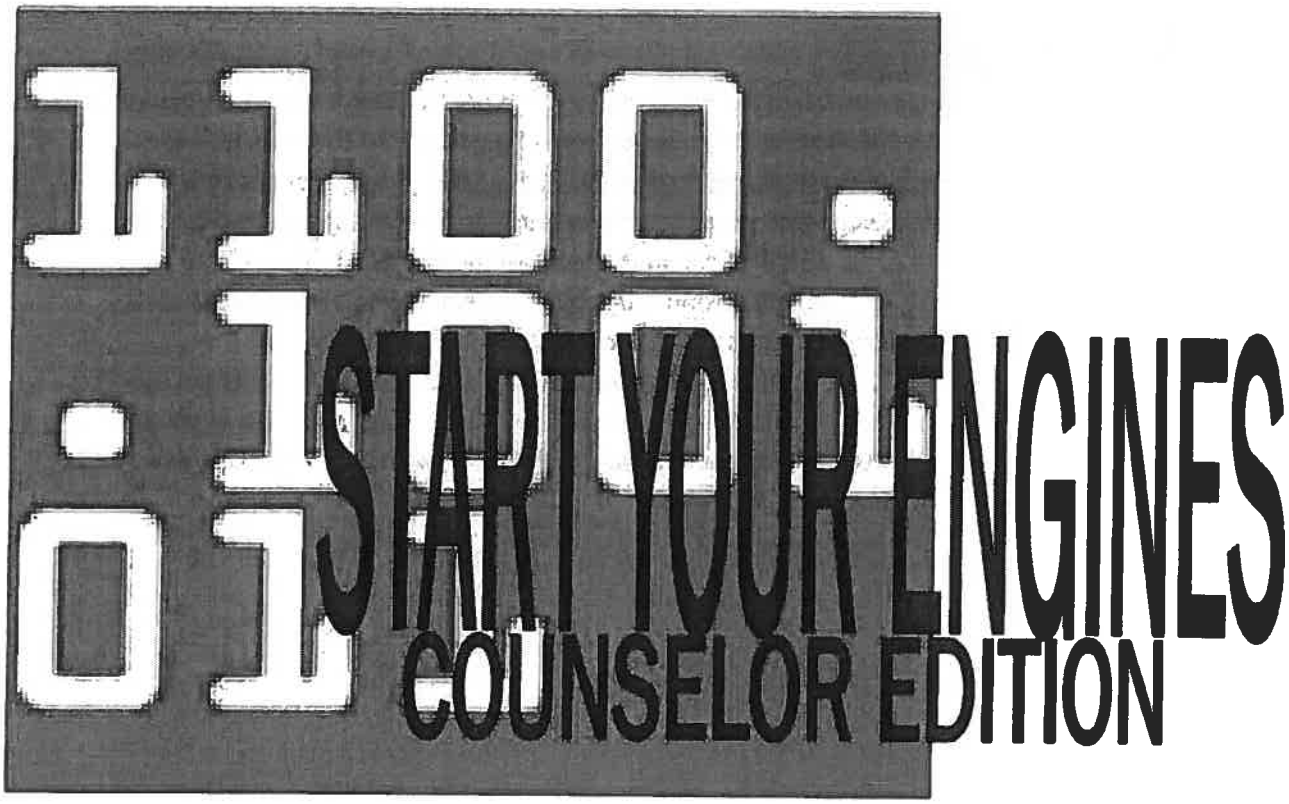


1. Watch or Research. Choose option a, b, or c and complete all the requirements:
    a. Watch 3 episodes/hours of NOVA or other media productions (examples include Discovery Channel, Science Channel, National Geographic, and the History Channel) that involve transportation or transportation technology.
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Read at least three articles about transportation or transportation technology. (Examples of magazine sources include Popular Mechanics, Popular Science, Science Illustrated, Discover Magazine, Professional Motor Mechanic, Odyssey, and Scientific American).
        i. Make a list of at least two questions or ideas from each article
        ii. Discuss the ideas and questions with your counselor
    c. Do a combination of reading and watching
        i. Make a list of at least two questions or ideas from each article or production
        ii. Discuss the ideas and questions with your counselor

2. Complete a merit badge from the following list. (If you have already completed one of these merit badges, please complete a different merit badge for this award.)

Automotive Maintenance	Motor Boating
Aviation	Railroading
Canoeing	Small-Boat Sailing
Cycling	Space Exploration
Farm Mechanics	Truck Transportation

3. Energy Sources
    a. Using the requirements from the above list of merit badges,
        i. Tell your counselor the energy source(s) for the types of transportation in the listed merit badges
        ii. Discuss the pros and cons of each energy source with your counselor
    b. Make a list of other sources of energy that may be possible to use in transportation
    c. With your counselor
        i. Discuss alternative sources of energy
        ii. 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 an energy source to power your vehicle
        i. Solar power
        ii. Wind power
        iii. Battery power
        iv. (Do not use gasoline or other combustible fuel source)
    c. Test your model
        i. How well did it perform?
        ii. Did it move as well as you thought it would?
        iii. Did you encounter problems? How can these problems be corrected?
    d. Discuss with your counselor
        i. What difficulties you encountered in designing and building your model
        ii. Why you chose your energy source
        iii. If your model met your specifications
        iv. How you would modify your design to make it better



1. Watch or Research. Choose option a, b, or c and complete all the requirements:
    a. Watch 3 episodes/hours of NOVA or other media productions (examples include Discovery Channel, Science Channel, National Geographic, and the History Channel) that involve transportation or transportation technology.
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Read at least three articles about transportation or transportation technology. (Examples of magazine sources include Popular Mechanics, Popular Science, Science Illustrated, Discover Magazine, Professional Motor Mechanic, Odyssey, and Scientific American). Good resources, but NOT an exhaustive list -
        1. http://www.popularmechanics.com/cars/alternative-fuel/
        2. Diesel fuel history and future http://www.edmunds.com/fuel-economy/diesel-reborn.html
        3. Aviation Week, alternative jet fuels, http://www.aviationweek.com/aw/generic/story_generic.jsp?channel=bca&id=news/bca0907p3.xml&headline=null&prev=10
        ii. Make a list of at least two questions or ideas from each article
        iii. Discuss the ideas and questions with your counselor
    c. Do a combination of reading and watching
        i. Make a list of at least two questions or ideas from each article or production
        ii. Discuss the ideas and questions with your counselor

2. Complete a merit badge from the following list. (If you have already completed one of these merit badges, please complete a different merit badge for this award.)

Automotive Maintenance	Motor Boating
Aviation	Railroading
Canoeing	Small-Boat Sailing
Cycling	Space Exploration
Farm Mechanics	Truck Transportation

3. Energy Sources
   a. Using the requirements from the above list of merit badges,
      i. Tell your counselor the energy source(s) for the types of transportation in the listed merit badges
      ii. Discuss the pros and cons of each energy source with your counselor

Automotive Maintenance Gasoline, Diesel fuel, Electric, Blended gasoline, Biodiesel, Hybrid	**Motor Boating** Gasoline, Diesel fuel, Blended gasoline, Biodiesel
Aviation Aviation fuel/kerosene	**Railroading** Diesel fuel
Canoeing Human power	**Small-Boat Sailing** Wind
Cycling Human power	**Space Exploration** Most common solid - Ammonium perchlorate mixed with powdered aluminum Liquids for first stage rockets - RP-1 Liquids for second stage rockets – liquid hydrogen, liquid oxygen
Farm Mechanics Diesel fuel	**Truck Transportation** Diesel fuel

1. Places to start - Fuel types pros and cons
   a. http://www.carsdirect.com/car-buying/diesel-fuel-vs-unleaded-gasoline-understand-the-pros-and-cons Pros and cons of gasoline and diesel for cars
   b. http://www.carsdirect.com/car-buying/diesel-fuel-vs-unleaded-gasoline-understand-the-pros-and-cons pros and cons of electric vs. gasoline for cars
   c. http://www.ehow.com/facts_5098606_pros-cons-biodiesel-fuel.html Pros and cons of biodiesel

d. http://www.centennialofflight.gov/essay/Evolution_of_Technology/fuel/Tech21.htm Aviation fuel
e. http://www.csgnetwork.com/jetfuel.html Aviation jet fuel information
f. http://www.suite101.com/content/todays-marine-fuel-choices-a27218 Motor boat fuel choices
g. http://www.scientificamerican.com/article.cfm?id=what-kind-of-fuel-do-rock Rocket fuel types

b. Make a list of other sources of energy that may be possible to use in transportation
c. With your counselor
   i. Discuss alternative sources of energy
   ii. Discuss the pros and cons of using alternative energy sources

Places to start:

a. A Student's Guide to Alternative Fuels http://www.energyquest.ca.gov/transportation/index.html
b. Overview of Alternative fuels http://www.edmunds.com/fuel-economy/ethanol-fuel-cell-biodiesel-an-alternative-fuel-overview.html?articleid=110054&
c. Department of Energy Comparison of Alternatively-fueled Vehicles http://www.afdc.energy.gov/afdc/vehicles/electric_benefits.html
d. Alternative fuels for Vehicles http://www.fueleconomy.gov/feg/current.shtml
e. Aviation alternative fuels http://www.energybulletin.net/node/23098

2. Solar Power
   a. Introduction to Solar Energy http://www.ccs.neu.edu/home/feneric/solar.html
   b. Solar Power for Transportation http://gas2.org/2008/03/25/how-solar-panels-could-power-90-of-us-transportation/
3. Nuclear Power
   a. Nuclear Power to Reduce Oil Imports http://www.ans.org/pi/ps/docs/ps82.pdf
   b. Nuclear Power and the Environment http://www.eia.doe.gov/cneaf/nuclear/page/nuclearenvissues.html
4. Wind Power
   a. Wind and Solar Powered Vehicle
      i. http://inhabitat.com/venturi-eclectic-the-1st-energy-autonomous-vehicle/
      ii. http://windpowerauthority.com/wind-power-for-cars/

   b. Denmark's experiment http://www.guardian.co.uk/environment/2009/jun/19/denmark-wind-electric-cars

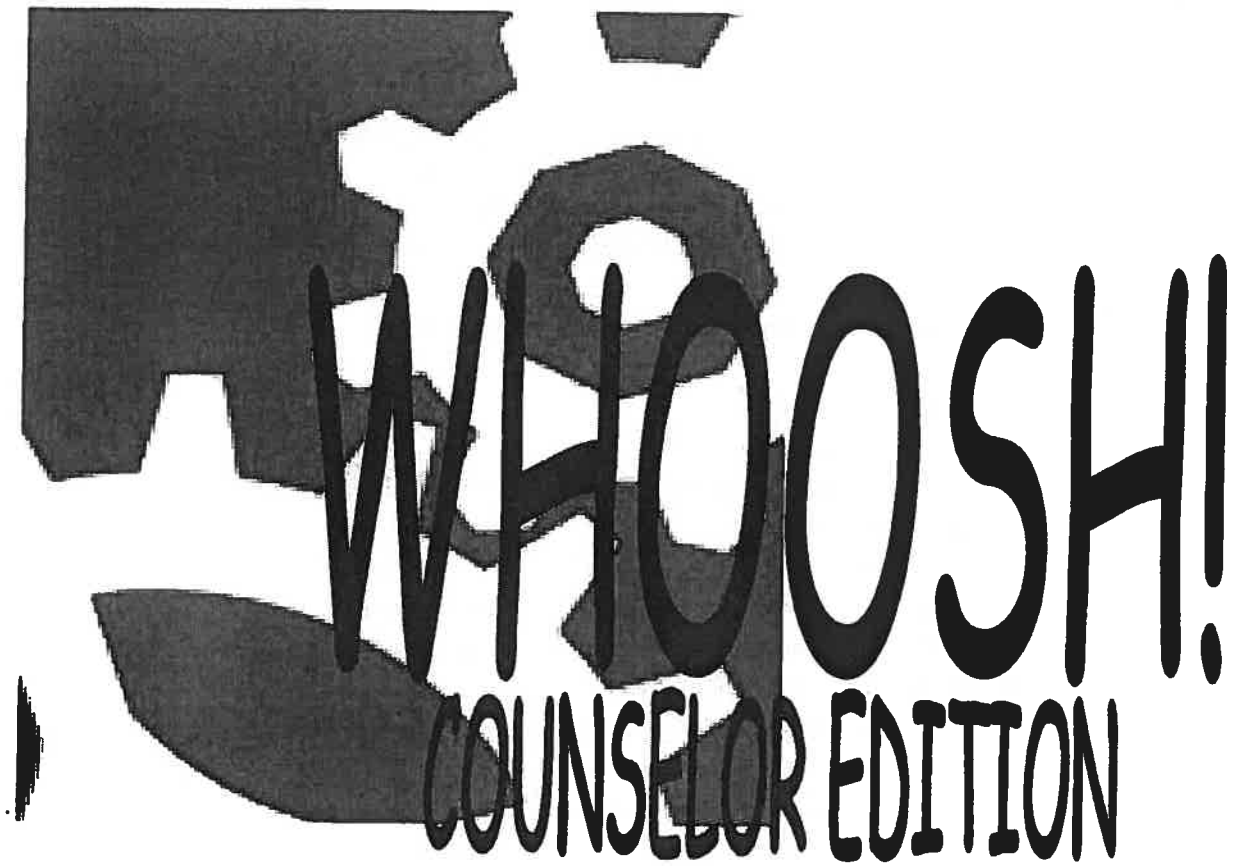
4. Design and build a working model vehicle (not from a kit)
   a. Make drawings and specifications of your model vehicle before you begin to build
   b. Include an energy source to power your vehicle
      i. Solar power
      ii. Wind power
      iii. Battery power
      iv. (Do not use gasoline or other combustible fuel source)
   c. Test your model
      i. How well did it perform?
      ii. Did it move as well as you thought it would?
      iii. Did you encounter problems? How can these problems be corrected?
   d. Discuss with your counselor
      i. What difficulties you encountered in designing and building your model
      ii. Why you chose your energy source
      iii. If your model met your specifications
      iv. How you would modify your design to make it better

1. Watch or research. Choose a, b, or c and complete all the requirements:
    a. Watch 3 episodes/hours of NOVA or other media productions (examples include Discovery Channel, Science Channel, National Geographic, and the History Channel) that involve motion or motion-inspired technology. (NOVA website on Ancient Egypt and the use of levers http://www.pbs.org/wgbh/nova/egypt/raising/lever.html)
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Read at least three articles about motion or motion-inspired technology. (Examples of magazine sources include Odyssey, Popular Mechanics, Popular Science, Science Illustrated, Discover Magazine, and Scientific American).
        i. Make a list of at least two questions or ideas from each article
        ii. Discuss the ideas and questions with your counselor
    c. Do a combination of reading and watching
        i. Make a list of at least two questions or ideas from each article or production
        ii. Discuss the ideas and questions with your counselor

2. Complete a merit badge from the following list. (If you have already completed one of these merit badges, please complete a different merit badge for this award.)

Archery	Rifle Shooting
Auto Mechanics	Rowing
Aviation	Shotgun Shooting
Canoeing	Small Boat Sailing
Music	Truck Transportation
Railroading	

3. Machines
    a. Make a list or drawing of the six simple machines.
    b. Be able to tell your counselor
        i. The name of each machine
        ii. How it works.
        http://www.constructionknowledge.net/general_technical_knowledge/general_tech_basic_six_simple_machines.php
    c. With your counselor, discuss
        i. The simple machines were involved with the motion in your chosen merit badge (Hint - look at the moving parts of an engine to find simple machines)
        ii. The energy source causing the motion for the subject of your merit badge
        iii. What you learned about motion from doing the requirements of the merit badge
4. Visit – choose one
    a. An amusement park
        i. Discuss with your counselor
            1. What simple machines were present in at least two of the rides
            2. What forces were involved in the motion of any two rides.
    b. A playground
        i. Discuss with your counselor
            1. What simple machines were present in the playground equipment
            2. What forces are involved in the motion of any two playground fixtures.
5. Design
    a. Design, including a drawing or sketch, one of the following
        i. A new amusement park ride
        ii. A new playground fixture
        iii. A new method of transportation
    b. Discuss with your counselor
        i. The simple machines present in your new design
        ii. The energy source powering the motion of your new creation



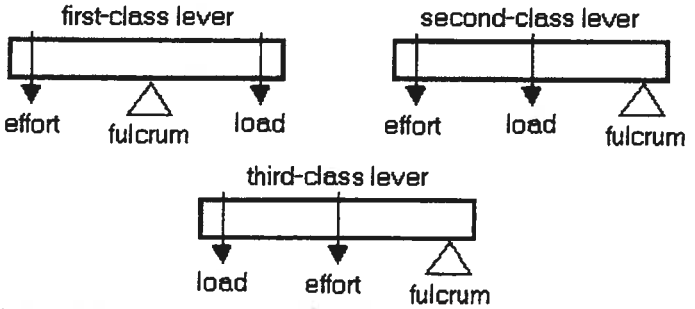
1. Watch or research. Choose a, b, or c and complete all the requirements:
    a. Watch 3 episodes/hours of NOVA or other media productions (examples include Discovery Channel, Science Channel, National Geographic, and the History Channel) that involve motion or motion-inspired technology. (NOVA website on Ancient Egypt and the use of levers http://www.pbs.org/wgbh/nova/egypt/raising/lever.html)
        i. Make a list of at least two questions or ideas from each production
        ii. Discuss the ideas and questions with your counselor
    b. Read at least three articles about motion or motion-inspired technology. (Examples of magazine sources include Odyssey, Popular Mechanics, Popular Science, Science Illustrated, Discover Magazine, and Scientific American).
        i. Make a list of at least two questions or ideas from each article
        ii. Discuss the ideas and questions with your counselor
    c. Do a combination of reading and watching
        i. Make a list of at least two questions or ideas from each article or production
        ii. Discuss the ideas and questions with your counselor

2. Complete a merit badge from the following list. (If you have already completed one of these merit badges, please complete a different merit badge for this award.)

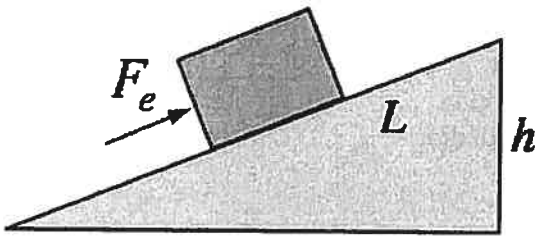
Archery	Rifle Shooting
Auto Mechanics	Rowing
Aviation	Shotgun Shooting
Bugling	Small Boat Sailing
Canoeing	Truck Transportation
Railroading	

3. Machines
   a. Make a list or drawing of the six simple machines.

A lever is a rigid bar that turns around a fulcrum (a fixed point). The force, a push or a pull, which is applied to the lever is called the effort. The farther the effort is from the fulcrum, the easier it is to use the lever. What the lever moves is called the load or the resistance. Levers can change the direction of motion, make it easier to move something, or cause something to move a greater distance.
There are three classes of levers.
Class 1 lever. The fulcrum is located between the effort and the load. The direction the load moves is opposite to the direction of the effort. Depending on where the fulcrum is placed, a first class lever can either make the load move more easily or move a greater distance. Examples of first class levers include seesaws, crowbars, scissors, and pliers.
Class 2 lever. The fulcrum is at one end, the effort is at the other end, and the load is in the middle. The effort and the load move in the same direction. A Class 2 lever makes an object easier to move. Examples of second class levers include catapults, screwdrivers, nutcrackers, staplers, and wheelbarrows.
Class 3 lever. The fulcrum is at one end. The effort is applied between the fulcrum and the load. The effort and the load move in the same direction. A third class lever makes an object harder to move, but moves the object through a much greater distance than the effort force moves. Because the load end moves faster than the effort (it has to travel farther during the same time length) the load gains speed. Many sporting activities use Class 3 levers. Class 3 levers include bats, rackets, paddles, clubs, clubs, fishing poles, and brooms.
http://www.fi.edu/pieces/knox/automaton/lever.htm



Incline Plane – a ramp (stair. hill, ladder) used to raise a load using less force. The mechanical advantage (ease to move) increases as the slope of the incline decreases but the load will then have to be moved a greater distance.



Incline $IMA = \frac{L}{h}$

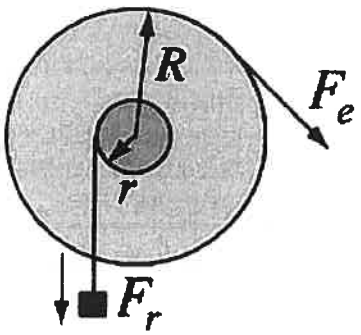
Wedge – a moveable double incline plane used to separate object by the use of force (knife, ax, nail)

Wedge $IMA = \frac{L}{t}$

L = depth of penetration

t = separation of wedged surfaces

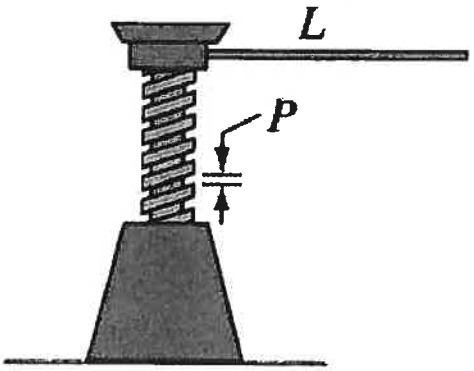
Wheel and Axle - essentially a modified lever, but it can move a load farther than a lever can. The center of the axle serves as a fulcrum.



Wheel and axle $IMA = \frac{R}{r}$

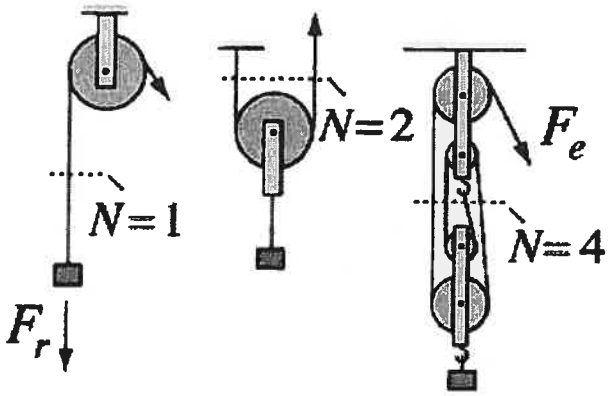
Gears, Belts. Cams, and Cranks include applications of wheel and axles.
http://cnx.org/content/m13594/latest/

Screw - an inclined plane wrapped in a spiral around a shaft.



Screw $IMA = \frac{2\pi L}{P}$

Pulley- a wheel over which a rope or belt is passed. It is also a form of the wheel and axle. Pulleys are often interconnected in order to obtain considerable mechanical advantage. Pulleys may be used to change the direction of the force or to increase the ease of lifting an object.

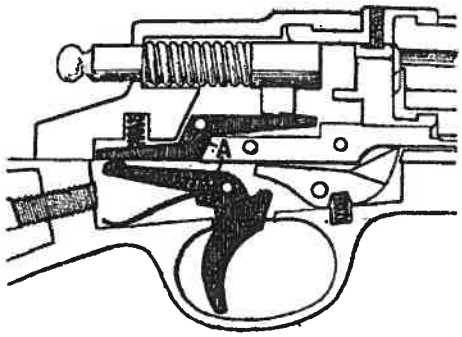


Pulley $IMA = N$

http://www.phy.ilstu.edu/pte/489.01content/simple_machines/simple_machines.html

b. **Be able to tell your counselor**
   i. **The name of each machine**
   ii. How it works.
   http://www.constructionknowledge.net/general_technical_knowledge/general_tech_basic_six_simple_machines.php (This is a great resource about machines and how they work.)
   http://juniorengineering.usu.edu/workshops/machines machines.php

c. With your counselor, discuss
   i. The simple machines were involved with the motion in your chosen merit badge (Hint - look at the moving parts of an engine to find simple machines)

Archery The bow is a lever and the hand is the fulcrum. Crossbows use a pulley Energy source is human power.	**Rifle Shooting**  http://en.wikipedia.org/wiki/File:Trigger_mechanism_bf_1923.jpg The fulcrum (pivot point) is between the effort (applied by the trigger finger) and where the pressure (the load or resistance) is applied to the spring.
Auto Mechanics Levers in pedals, gear shifts, Wheel and Axle Gears are compound machines based on screws and wheel and axles. http://www.edheads.org/activities/simple-machines/glossary.htm	**Rowing** Levers
Aviation Wheel and Axle Levers Pulleys Airplane propellers are a type of screw	**Shotgun Shooting** See Rifle Shooting
Canoeing Third class Lever	**Small Boat Sailing** Levers, Pulleys
Music Levers	**Truck Transportation** Levers in pedals, gear shifts. Wheel and Axle Gears are compound machines based on screws and wheel and axles. http://www.edheads.org/activities/simple-machines/glossary.htm

Railroading Levers Wheel and axle http://cnx.org/content/m13594/latest/	

ii. The energy source causing the motion for the subject of your merit badge
Wind, gasoline/fossil fuel, electric power, human power
iii. What you learned about motion from doing the requirements of the merit badge

4. Visit – choose one
   a. An amusement park
      i. Discuss with your counselor
         1. What simple machines were present in at least two of the rides
         2. What forces were involved in the motion of any two rides.
            A Force is a push or a pull. Many rides use the force of gravity to cause changes in up and down motion. Rides that go in a circle use centripetal force.
   b. A playground
      i. Discuss with your counselor
         1. What simple machines were present in the playground equipment
         2. What forces are involved in the motion of any two playground fixtures. A Force is a push or a pull. Many rides use the force of gravity to cause changes in up and down motion. Rides that go in a circle use centripetal force.

5. Design
   a. Design, including a drawing or sketch, one of the following
      i. A new amusement park ride
      ii. A new playground fixture
      iii. A new method of transportation
   b. Discuss with your counselor
      i. The simple machines present in your new design
      ii. The energy source powering the motion of your new creation

SUPERNOVA
Boy Scouts

Boy Scout SUPERNOVA Award

Purpose: To recognize superior achievement by a Boy Scout in the field of Science, Technology, Engineering and Mathematics (**STEM**).

Basic Requirements:

- First Class Scout
- Must select a Council approved SUPERNOVA "mentor" who is a registered Scouter and NOT the parent or unit leader of the candidate.
- Final approval for all SUPERNOVA awards must be by a special Council (or District) SUPERNOVA Award Committee or the existing Council (or District) Advancement Committee.

Merit Badges approved for Boy Scout SUPERNOVA Awards:

- SCHOLARSHIP – must be earned for all SUPERNOVA Awards
- ASTRONOMY, CHEMISTRY, ELECTRONICS, ENGINEERING and NUCLEAR SCIENCE – these are classified as the **"Strong Science"** merit badges and one or more of these must be earned for each of the different Boy Scout SUPERNOVA Awards.
- ANIMAL SCIENCE, ARCHAEOLOGY, ARCHITECTURE, AVIATION, COMPOSITE MATERIALS, COMPUTERS, DENTISTRY, DRAFTING, ELECTRICITY, ENERGY, FARM MECHANICS, GEOLOGY, MEDICINE, OCEANOGRAPHY, PLANT SCIENCE, PULP AND PAPER, RADIO, ROBOTICS, SCUBA, SPACE EXPLORATION, SURVEYING, VETERINARY MEDICINE and WEATHER – these are the optional merit badges for the different Boy Scout SUPERNOVA Awards.

Other approved parameters for Boy Scout SUPERNOVA Awards:

- High School Advanced Placement (AP) and Honors Classes are defined as those which qualify a student for substitute college credit.
- All experiments or projects should be conducted using the highest level of safety protocol and always under the supervision of a qualified, responsible adult.
- Merit badges or other requirements completed prior to October 2010 may be counted towards the NOVA award during the Pilot Program period subject to the review of the Mentor.

Dr. Bernard Harris SUPERNOVA Award (the basic SUPERNOVA award for Boy Scouts):

- Earn the SCHOLARSHIP merit badge, one merit badge from the **Strong Science** group and at least four other merit badges from the NOVA optional merit badge list.
- Join a **STEM** oriented club at your school or in your community (e.g. an Astronomy Club) OR a **STEM** oriented Explorer Post and actively participate for at least 3 months.
- Participate in a local, state or national science fair or mathematics competition OR any other equally challenging STEM oriented competition or workshop approved by your Mentor.
- Do ONE of the following:
    - Write a 1000 word essay on a career that is heavily involved with **STEM**.
    - Spend at least one day "shadowing" a local scientist or engineer and report on your experience and what you learned about STEM careers to your Mentor.
- Learn the Scientific Method and report orally on it to your Mentor (or NOVA Committee) using a combination of explanation and demonstration.
- Organize and conduct a **NOVA** Award or other **STEM** related program to a Cub Scout den or pack meeting working with the Mentor and approved by the appropriate unit leader.
- **Submit an application to the Council/District NOVA or Advancement Committee for approval.**

Thomas Edison SUPERNOVA Award (the intermediate SUPERNOVA award for Boy Scouts):

- Earn the SCHOLARSHIP merit badge, two merit badges from the **Strong Science** group and at least eight other merit badges from the SUPERNOVA optional merit badge list.
- Join a **STEM** oriented club at your school or in your community (e.g. an Astronomy Club) OR a **STEM** oriented Explorer Post and actively participate for at least one year.
- Participate in a local, state or national science fair or mathematics competition OR any other equally challenging STEM oriented competition or workshop approved by your Mentor at least two years.
- Do BOTH of the following:
    - Write a 1000 word essay on a career that is heavily involved with **STEM**.
    - Spend at least one day "shadowing" a local scientist or engineer and report on your experience and what you learned about STEM careers to your Mentor.
- Teach the Scientific Method to a Scouting or other appropriate youth group approved by your Mentor (or SUPERNOVA Committee) using a combination of explanation and demonstration.
- Organize and conduct at least two **NOVA** Award or other **STEM** related programs to a Cub Scout den or pack meeting working with the Mentor and approved by the appropriate unit leader.
- Research a scientific or mathematical breakthrough or invention of the past 25 years and write a 1500 word report on how this has affected our society to date and present your hypotheses on how it might further affect our society during your lifetime. Present your report to your Mentor.
- **Submit an application to the Council NOVA or Advancement Committee for approval.**

Albert Einstein SUPERNOVA Award (the advanced or challenge SUPERNOVA award for Boy Scouts):

- Earn the SCHOLARSHIP merit badge, three merit badges from the **Strong Science** group and at least twelve other merit badges from the SUPERNOVA optional merit badge list.
- Organize a **STEM** oriented club at your school or in your community (e.g. an Astronomy Club) OR a **STEM** oriented Explorer Post and serve in a leadership position for at least one year. (If in the judgment of the Mentor this opportunity does not exist, an equally challenging requirement may be proposed to the NOVA Committee.)
- Participate in a local, state or national science fair or mathematics competition OR any other equally challenging STEM oriented competition or workshop approved by your Mentor at least two years.
- Take and successfully pass at least one AP or Honors mathematics or science course.
- Make contact with a professional involved in a **STEM** related career and spend at least 10 hours with that person learning about his career. Afterwards, write a 1000 word report describing the work that individual does, the training required by that individual to achieve his/her current position, and report on that experience to your Mentor.
- Organize and conduct a series of **NOVA** Award or other **STEM** related programs to a Cub Scout den or pack meeting working with the Mentor and approved by the appropriate unit leader. A minimum of 25 hours should be dedicated to the preparation of the program plans. The program should include an interesting combination of explanation and demonstration components designed to teach the Scientific Method.
- With guidance from your Mentor, select an area of current **STEM** related concern and develop a research project or experiment related to that area. This research project or experiment should be both challenging and interesting and should require a meaningful and significant investment of time and effort on the part of the candidate in the same manner in which an Eagle Scout project requires on the part of the Eagle Scout candidate. A suggested minimum commitment would be 100 total hours of time.
- Execute the research project or experiment selected above and present a complete and well documented written and oral report on same to your Mentor and local NOVA Committee.
- **Submit an application for this award to the National NOVA Committee for approval.**

Boy Scout SUPERNOVA Award Recognition Materials:

- Bernard Harris Award: Certificate and Bronze Pocket Medal.
- Thomas Edison Award: Certificate and Silver Pocket Medal.
- Albert Einstein Award: Certificate and Gold Pocket Medal.

All of the above awards will also earn a square knot and a temporary style pocket patch.

SUPERNOVA
Venturer

Venturer SUPERNOVA Award

Purpose: To recognize superior achievement by a Venturer in the field of Science, Technology, Engineering and Mathematics **(STEM)**.

Basic Requirements:

- Must select a Council approved "mentor" who is a registered Scouter and **NOT** the parent or unit leader of the candidate.
- Final approval for all SUPERNOVA awards must be by a special Council (or District) NOVA Award Committee or the existing Council (or District) Advancement Committee.

Approved parameters for Venturer SUPERNOVA Award:

- High School Advanced Placement (AP) and Honors Classes are defined as those which qualify a student for substitute college credit.
- All experiments or projects should be conducted using the highest level of safety protocol and always under the supervision of a qualified, responsible adult.

Sally Ride SUPERNOVA Award (the award for Venturers):

- Join a **STEM** oriented club at your school or in your community (e.g. an Astronomy Club) OR a **STEM** oriented Explorer Post and actively participate for at least six (6) months.
- Participate in a local, state or national science fair or mathematics competition OR any other equally challenging STEM oriented competition or workshop approved by your Mentor.
- Take and successfully pass an AP or Honors mathematics or science course.
- Organize and conduct a series of **NOVA** Award or other **STEM** related programs to a Cub Scout den or pack meeting working with the Mentor and approved by the appropriate unit leader. A minimum of 25 hours should be dedicated to the preparation of the program plans. The program should include an interesting combination of explanation and demonstration components designed to teach the Scientific Method.
- Make contact with a professional involved in a **STEM** related career and spend at least one day "shadowing" this professional and report on that experience to your Mentor.
- Do ONE of the following:
    - Research a scientific or mathematical breakthrough or invention of the past 25 years and write a 1500 word report on how this has affected our society to date and present your hypotheses on how it might further affect our society during your lifetime, OR
    - With guidance from your Mentor, select an area of current **STEM** related concern and develop a research project or experiment related to that area. Execute the research project or experiment selected above, AND.
    - Present your report on the choice selected above to your Mentor and NOVA Committee.
- **Submit an application for this award to the Council NOVA or Advancement Committee for approval.**

Venturer SUPERNOVA Award Recognition Materials: Certificate, Pocket Medal and Square Knot.