

Troop 730 Stem / Nova Program Summary

It is important to review the complete requirements of the Boy Scout STEM / Nova awards when reading the following information as the information below only summarizes the requirements. All Stem Meetings and Merit Badge meetings are 3:00pm-5:00pm at St. Anne's unless advised otherwise.

The Boy Scout Stem Nova Program is composed of four (4) awards. Awards are earned individually.

- Shoot: explore how **science** affects your life each day.
- Start your Engines: explore how **technology** affects your life each day
- Whoosh: explore how **engineering** affects your life each day
- Designed to Crunch: explore how **math** affects your life each day

This program breaks apart each award into three (3) parts

1. **At Home:** Read, watch, research the applicable award. This work must be done BEFORE the "Meeting."
2. **Merit Badge:** Earn a merit badge from the list for each applicable award. If a Scout has already earned a merit badge from the applicable Stem Nova tAward list, he has finished that requirement and he is not required to earn additional merit badges from the list that are also offered as a part of this program. Check the applicable list for details
3. **Meeting:** Discuss with the Counselor what you read, watched or researched. Perform a project

The following Merit Badges will be offered as a part of the program. The Merit Badges may be earned by any member of Troop 730 through this program (even if you are not participating in the Stem/Nova program). Doug Mischlich is a registered Counselor for Engineering, Electricity, Energy and Drafting Merit Badges. Scouts may make arrangements with Mr. Mischlich to earn these Merit Badges outside of the dates listed above.

- Electricity
- Engineering
- Drafting

Following the Stem NOVA program, the Boy Scouts offer two (2) **SUPERNOVA** awards. We intend to offer this program at later date. See http://www.scouting.org/stem/Awards/BoyScouts_Supernova_Awards.aspx for details.

Troop 730 Stem / Nova Program Schedule

AT HOME "SHOOT": 1A or 1B or 1C: SCIENCE: Watch or read about 3 hours and make a list of questions to discuss with your counselor.

AT HOME "START YOUR ENGINES": 1A or 1B or 1C: TECHNOLOGY: Watch or read about 3 hours and make a list of questions to discuss with your counselor.

Feb. 28, 2016: "Start your Engines" Merit Badge: **Electricity Merit badge**

Prerequisite(s):

Read Merit Badge Pamphlet (this is NOT the Workbook)

Item 2: Electrical home safety inspection of your home

Item 9: Bring an electrical bill

April 3, 2016: **STEM NOVA Meeting #1: Shoot and Start your Engines**

Shoot 1.A.2: Discuss "Shoot" questions with Counselor

Shoot 3.B:

Shoot 4.B:

Shoot 5.C: Design and build a marble run or roller coaster

Shoot 6: Discuss with your counselor how science affects your everyday life

SYE 1.A.2: Start your Engines: Discuss questions with Counselor

SYE 3: Discussions with Counselor

SYE 4: Design and build a working model vehicle

SYE 5: Discuss with your counselor how technology affects your everyday life.

April 10, 2016: “Whoosh” Merit Badge: ***Engineering Merit Badge***

Prerequisite(s):

Read Merit Badge Pamphlet (this is NOT the Workbook)

Item 1: Select a manufactured item in your home and investigate how and why it works

Item 2: Select an engineering achievement that has had a major impact on society

AT HOME “WHOOSH”:

1A or 1B or 1C: ENGINEERING: Watch or read about 3 hours and make a list of questions to discuss with your counselor.

3. Make a list or drawing of the six simple machines. Be able to tell your counselor the name of each machine and how each machine works.

5.A: Design one of the following and include a drawing or sketch: an amusement park ride OR a playground fixture OR a method of transportation

AT HOME “DESIGNED TO CRUNCH”:

1A or 1B or 1C: MATH: Watch or read about 3 hours and make a list of questions to discuss with your counselor.

3B, 3C, 3D, or 3E: Do ONE (1)

April 24, 2016: “Designed to Crunch” or “Whoosh” Merit Badge: ***Drafting Merit Badge***

Prerequisite(s): Read Merit Badge Pamphlet (this is NOT the Workbook)

May 1, 2016: **STEM NOVA Meeting #2: *Whoosh* and *Designed to Crunch***

Whoosh 1.A.2: Discuss “Shoot” questions with Counselor

Whoosh 3.C: Discuss items with your counselor

Whoosh 4.B: Visit a playground and discuss

Whoosh 5.B: Discuss items with your counselor

Whoosh 6: Discuss with your counselor how engineering affects your daily life

Designed to Crunch 1.A.2: Start your Engines: Discuss questions with Counselor

Designed to Crunch 3A: Calculate your horsepower when you run up stairs

Designed to Crunch 4: Investigate your calculator, etc.

Designed to Crunch 5: Discuss how math affects your everyday life.

May 15, 2016: **STEM NOVA Meeting #3 – Meeting #1 or Meeting #2 Makeup, Merit Badge “cleanup” day**

AT HOME “SHOOT” MERIT BADGE: Earn one of the following Merit Badges: Archery, Astronomy, Athletics, Aviation, Rifle Shooting

Questions: Please contact Doug Mischlich (doug@mischlich.org, 713-742-5712 office and rings cell) or Ray Carroll (Raymond.Carroll@goodmanmfg.com)



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Home > STEM/Nova > Requirements > Boy Scouts

Boy Scouts



Shoot!



Start Your Engines!



Whoosh!



Designed to Crunch



Supernova Awards


Please use the Advancement Report, No.34403, as documentation for the Nova Award. Submit the [Supernova Award Application](#), below, as instructed in the requirements.

Submit any questions regarding the Nova or Supernova awards to program.content@scouting.org

Shoot!

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



1. Choose A or B or C and complete ALL the requirements.
 - A. Watch about three hours total of science-related shows or documentaries that involve projectiles, aviation, weather, astronomy, or space technology. Then do the following:
 1. Make a list of at least five questions or ideas from the show(s) you watched.
 2. Discuss two of the questions or ideas with your counselor. 

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

- B. Read (about three hours total) about projectiles, aviation, space, weather, astronomy, or aviation or space technology. Then do the following:
 1. Make a list of at least two questions or ideas from each article.
 2. Discuss two of the questions or ideas with your counselor.

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

- C. Do a combination of reading and watching (about three hours total). Then do the following:
 1. Make a list of at least two questions or ideas from each article or show.
 2. Discuss two of the questions or ideas with your counselor.



2. Complete ONE merit badge from the following list. (Choose one that you have not already used toward another Nova award.) After completion, discuss with your counselor how the merit badge you earned uses science.

Archery	Robotics

Scout to earn one of these Merit Badges on their own

Astronomy	Shotgun Shooting
Athletics	Space Exploration
Aviation	Weather
Rifle Shooting	

Meeting 1

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

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

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

Helpful Links

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

Projectile Motion Applets

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

Fowler's Physics Applets

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

Java Applets on Physics

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

3. Discuss with your counselor:

- a. What a projectile is
- b. What projectile motion is
- c. The factors affecting the path of a projectile
- d. The difference between forward velocity and acceleration due to gravity

Meeting 1

B. Discover. Explain to your counselor the difference between escape velocity (not the game), orbital velocity, and terminal velocity. Then answer TWO of the following questions. (With your parent's or guardian's permission, you may explore websites to find this information.)

1. Why are satellites usually launched toward the east, and what is a launch window?
2. What is the average terminal velocity of a skydiver? (What is the fastest you would go if you were to jump out of an airplane?)
3. How fast does a bullet, baseball, airplane, or rocket have to travel in order to escape Earth's gravitational field? (What is Earth's escape velocity?)

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

A. Visit an observatory or a flight, aviation, or space museum.

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

Meeting 1

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

1. Find out what time a satellite will pass over your area. (A good resource to find the times for satellite passes is the Heavens Above website at www.heavens-above.com.)
2. Watch the satellite using binoculars. Record the time of your viewing, the weather conditions, how long the satellite was visible, and the path of the satellite. Then discuss your viewing with your counselor.

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

A. Design and build a catapult that will launch a marshmallow a distance of 4 feet. Then do the following:

1. Keep track of your experimental data for every attempt. Include the angle of launch and the distance projected.
 2. Make sure you apply the same force every time, perhaps by using a weight to launch the marshmallow. Discuss your design, data, and experiments—both successes and failures - with your counselor.
- B. Design a pitching machine that will lob a softball into the strike zone. Answer the following questions, then discuss your design, data, and experiments - both successes and failures—with your counselor.
1. At what angle and velocity will your machine need to eject the softball in order for the ball to travel through the strike zone from the pitcher's mound?
 2. How much force will you need to apply in order to power the ball to the plate?
 3. If you were to use a power supply for your machine, what power source would you choose and why?



- C. Design and build a marble run or roller coaster that includes an empty space where the marble has to jump from one part of the chute to the other. Do the following, then discuss your design, data, and experiments—both successes and failures—with your counselor.
1. Keep track of your experimental data for every attempt. Include the vertical angle between the two parts of the chute and the horizontal distance between the two parts of the chute.
 2. Experiment with different starting heights for the marble. How do the starting heights affect the velocity of the marble? How does the starting height affect the jump distance?



6. Discuss with your counselor how science affects your everyday life.

Start Your Engines!

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



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

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

- B. Read (about three hours total) about transportation or transportation technology. Then do the following:
 1. Make a list of at least two questions or ideas from each article.
 2. Discuss two of the questions or ideas with your counselor.

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

- C. Do a combination of reading and watching (about three hours total). Then do the following:
 1. Make a list of at least two questions or ideas from each article or show.
 2. Discuss two of the questions or ideas with your counselor.

2. Complete ONE merit badge from the following list. (Choose one that you have not already used toward another Nova award.) After completion, discuss with your counselor how the merit badge you earned uses technology.

Automotive Maintenance	Farm Mechanics
Aviation	Motorboating


 Meeting 1

Canoeing	Nuclear Science
Cycling	Railroading
Drafting	Small - Boat Sailing
Electricity	Space Exploration
Energy	Truck Transportation

3. Do ALL of the following.

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


 Meeting 1

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

- A. Make drawings and specifications of your model vehicle before you begin to build.
- B. Include one of the following energy sources to power your vehicle (do not use gasoline or other combustible fuel source): solar power, wind power, or battery power.
- C. Test your model. Then answer the following questions:
 1. How well did it perform?
 2. Did it move as well as you thought it would?
 3. Did you encounter problems? How can these problems be corrected?
- D. Discuss with your counselor:
 1. Any difficulties you encountered in designing and building your model
 2. Why you chose a particular energy source
 3. Whether your model met your specifications
 4. How you would modify your design to make it better


 Meeting 1

5. Discuss with your counselor how technology affects your everyday life.

Whoosh!

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


 AT HOME

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

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

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

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

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



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

AT HOME

Helpful Link

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

Website: http://www.constructionknowledge.net/general_technical_knowledge/general_tech_basic_six_simple_machines.php

Meeting 2



- C. Discuss the following with your counselor:
 - 1. The simple machines that were involved with the motion in your chosen merit badge (Hint: Look at the moving parts of an engine to find simple machines.)
 - 2. The energy source causing the motion for the subject of your merit badge
 - 3. What you learned about motion from earning your merit badge

4. Choose A or B and complete ALL the requirements.
- A. Visit an amusement park. Then discuss the following with your counselor:
 - 1. The simple machines present in at least two of the rides
 - 2. The forces involved in the motion of any two rides
 - B. Visit a playground. Then discuss the following with your counselor:
 - 1. The simple machines present in the playground equipment
 - 2. The forces involved in the motion of any two playground fixtures

Meeting 2



AT HOME

5. Do the following:
- A. On your own, design one of the following and include a drawing or sketch: an amusement park ride OR a playground fixture OR a method of transportation.
 - B. Discuss with your counselor:
 - 1. The simple machines present in your design
 - 2. The energy source powering the motion of your creation

Meeting 2



6. Discuss with your counselor how engineering affects your everyday life.

Designed to Crunch

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

AT HOME

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



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

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

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

Helpful Link

"The Mathematics of Cryptology": University of Massachusetts

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

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

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

- D. Do a combination of reading, watching, or researching (about three hours total). Then do the following:
 1. Make a list of at least two questions or ideas from each article, website, or show.
 2. Discuss two of the questions or questions with your counselor.

- 2. Complete ONE merit badge from the following list. (Choose one that you have not already used toward another Nova award.) After completion, discuss with your counselor how the merit badge you earned uses mathematics.

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



Meeting 2

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



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

Helpful Links

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

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

[Haplosciences.net](#)

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

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

AT HOME

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

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

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

AT HOME

- C. Attend a soccer, baseball, softball, or basketball game. Choose two players and keep track of their efforts during the game. (Make sure you write down your data and calculations.) Calculate their statistics using the following as examples:
1. Soccer—Goals, assists, corner kicks, keeper saves, fouls, offsides
 2. Baseball or softball—Batting average, runs batted in, fielding statistics, pitching statistics
 3. Basketball—Points, baskets attempted, rebounds, steals, turnovers, and blocked shots

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

AT HOME

- D. Attend a football game or watch one on TV. (This is a fun activity to do with a parent or friend!) Keep track of the efforts of your favorite team during the game. (Make sure you write down your data and calculations.) Calculate your team's statistics using the following as examples:
1. Kicks/punts
 - a. Kickoff—Kick return yards
 - b. Punt—Number, yards
 - c. Field goals—Attempted, percent completed, yards
 - d. Extra point—Attempted, percent completed
 2. Offense
 - a. Number of first downs
 - b. Forward passes—Attempted, percent completed, total length of passes, longest pass, number and length of passes caught by each receiver, yardage gained by each receiver after catching a pass
 - c. Running plays—Number, yards gained or lost for each run, longest run from scrimmage line, total yards gained or lost, and number of touchdowns
 3. Defense—Number of quarterback sacks, interceptions turnovers, and safeties

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

AT HOME

- E. How starry are your nights? Participate in a star count to find out. This may be done alone but is more fun with a group. Afterward, share your results with your counselor.
1. Visit the website of the Astronomical Society of the Pacific at <http://www.astrosociety.org/education/hands-on-astronomy-activities/> for instructions on performing a star count.
 2. Do a star count on five clear nights at the same time each night.

Meeting 2

4. Do ALL of the following.
- A. Investigate your calculator and explore the different functions.



Meeting 2

B. Discuss the functions, abilities, and limitations of your calculator with your counselor. Talk about how these affect what you can and cannot do with a calculator. (See your counselor for some ideas to consider.)

→ 5. Discuss with your counselor how math affects your everyday life.



Electricity

Merit Badge Workbook



This workbook can help you but you still need to read the merit badge pamphlet.

The work space provided for each requirement should be used by the Scout to make notes for discussing the item with his counselor, not for providing the full and complete answers. Each Scout must do each requirement.

No one may add or subtract from the official requirements found in **Boy Scout Requirements** (Pub. 33216 – SKU619576).

The requirements were last issued or revised in 2014 • This workbook was updated in January 2014.

Scout's Name: _____ Unit: _____

Counselor's Name: _____ Counselor's Phone No.: _____

<http://www.USScouts.Org> • <http://www.MeritBadge.Org>

Please submit errors, omissions, comments or suggestions about this **workbook** to: Workbooks@USScouts.Org
 Comments or suggestions for changes to the **requirements** for the **merit badge** should be sent to: Merit.Badge@Scouting.Org

1. Demonstrate that you know how to respond to electrical emergencies by doing the following:

- a. Show how to rescue a person touching a live wire in the home.
- b. Show how to render first aid to a person who is unconscious from electrical shock.
- c. Show how to treat an electrical burn.
- d. Explain what to do in an electrical storm.

e. Explain what to do in the event of an electrical fire.

2. Complete an electrical home safety inspection of your home, using the checklist found in this (the merit badge) pamphlet or one approved by your counselor. Discuss what you find with your counselor.
(See the Sample Home Electrical Inspection Checklist at the end of this workbook.)

9. Do the following:

a. Read an electric meter and, using your family's electric bill, determine the energy cost from the meter readings.

b. Discuss with your counselor five ways in which your family can conserve energy.

1.	
2.	
3.	
4.	
5.	

10. Explain the following electrical terms: volt, ampere, watt, ohm, resistance, potential difference, rectifier, rheostat, conductor, ground, circuit, and short circuit.

Volt;

Ampere;

Watt:

Ohm;

Resistance:

Potential difference:

Rectifier:

Rheostat:

Conductor:

Ground:

Circuit:

Short circuit:

11. Do any TWO of the following:

- a. Connect a buzzer, bell, or light with a battery. Have a key or switch in the line.
- b. Make and run a simple electric motor (not from a kit).
- c. Build a simple rheostat. Show that it works.
- d. Build a single-pole, double-throw switch. Show that it works.
- e. Hook a model electric train layout to a house circuit. Tell how it works.

Requirement resources can be found here:
http://www.meritbadge.org/wiki/index.php/Electricity#Requirement_resources

Sample Home Electrical Inspection Checklist

Outlets

- Check for outlets that have loose-fitting plugs, which can overheat and lead to fire.
- Replace any missing or broken wall plates.
- Make sure there are safety covers on all unused outlets that are accessible to children.

Line Cords

- Make sure cords are in good condition-not frayed or cracked.
- Make sure they are placed out of traffic areas.
- Make sure that cords are not nailed or stapled to the wall, baseboard or to another object.
- Make sure that cords are not under carpets or rugs or any furniture rests on them.

Extension Cords

- Check to see that extension cords are not overloaded & only be used on a temporary basis, not as permanent wiring.
- Make sure extension cords have safety closures to help protect children from shock hazards and mouth burns.

Plugs

- Make sure your plugs fit securely into your outlets.
- Make sure no plugs have had the ground pin (the third prong) removed in order to make a three-prong fit a two-conductor outlet; this could lead to an electrical shock.
- Never force a plug into an outlet if it doesn't fit.
- Avoid overloading outlets with too many appliances.

Ground Fault Circuit Interrupters (GFCIs)

GFCIs can help prevent electrocution. When a GFCI senses current leakage in an electrical circuit, it assumes a ground fault has occurred. It then interrupts power fast enough to help prevent serious injury from electrical shock. GFCIs can be installed at the outlet, or as a replacement for the circuit breaker for an entire circuit at the fuse box.

- Kitchen Bathrooms Garage Laundry room Outdoors
- Test GFCIs according to the manufacturer's instructions monthly and after major electrical storms to make sure they are working properly.

Light Bulbs

- Check the wattage of all bulbs in light fixtures to make sure they are the correct wattage for the size of the fixture.
- Replace bulbs that have higher wattage than recommended; if you don't know the correct wattage, check with the manufacturer of the fixture.
- Make sure bulbs are screwed in securely; loose bulbs may overheat.

Circuit Breakers/Fuses

- Make sure circuit breakers and fuses are the correct size current rating for their circuit. If you do not know the correct size, have an electrician identify and label the size to be used. Always replace a fuse with the correctly specified size fuse.
- Make sure everyone in your home knows where the main breaker is located and how to shut off power to the entire house.

Plug In Appliances

- Make sure there are no plugged-in appliances where they might fall in contact with water. If a plugged-in appliance falls into water, NEVER reach in to pull it out—even if it's turned off. First turn off the power source at the panel board and then unplug the appliance. If you have an appliance that has gotten wet, don't use it until it has been checked by a qualified repair person.

Sample Home Electrical Inspection Checklist (page 2)**Appliances**

- If an appliance repeatedly blows a fuse, trips a circuit breaker or if it has given you a shock, unplug it and have it repaired or replaced.

Entertainment/Computer Equipment

- Check to see that the equipment is in good condition and working properly. Look for cracks or damage in wiring, plugs and connectors.
- Use a surge protector bearing the seal of a nationally recognized certification agency.

Outdoor Safety

- Electric-powered mowers and other electric tools should not be used in the rain, on wet grass or in wet conditions.
- Inspect power tools & electric lawn mowers before each use for frayed power cords, broken plugs & cracked or broken housings. If any part is damaged, stop using it immediately. Repair it or replace it.
- Always use an extension cord marked for outdoor use and rated for the power needs of your tools.
- Remember to unplug all portable power tools when not in use.
- When using ladders, watch out for overhead wires and power lines. Stay at least 10 feet from all overhead lines.

Lightning

- During an electrical storm, do not use appliances (i.e., hairdryers, toasters and radios) or telephones (except in an emergency); do not take a bath or shower;
- Keep batteries on hand for flashlights and radios in case of a power outage.
- Use surge protectors on electronic devices, appliances, phones, fax machines and modems.

Space Heaters

- Space heaters are meant to supply supplemental heat. Keep space heaters at least 3 ft. away from any combustible materials such as bedding, clothing, draperies, furniture and rugs.
- Don't use space heaters in rooms where children are unsupervised and remember to turn off and unplug when not in use.
- Do not use space heaters with extension cords; plug directly into an outlet on a relatively unburdened circuit.

Halogen Floor Lamps

- Halogen floor lamps operate at much higher temperatures than a standard incandescent light bulb. Never place a halogen floor lamp where it could come in contact with draperies, clothing or other combustible materials.
- Be sure to turn the lamp off whenever you leave the room for an extended period of time.
- Never use torchiere lamps in children's bedrooms or playrooms. Consider using cooler fluorescent floor lamps.

Discuss with your counselor what you learned and how you got the information.

2. Select an engineering achievement that has had a major impact on society.

Using resources such as the Internet (with your parent's permission), books, and magazines, find out about the engineers who made this engineering feat possible, the special obstacles they had to overcome, and how this achievement has influenced the world today. Tell your counselor what you have learned.

Engineers:	
Obstacles:	
Influence:	

4. Visit with an engineer (who may be your counselor or parent) and do the following:

Name of Engineer:

a. Discuss the work this engineer does and the tools the engineer uses.

Work:

Tools:

b. Discuss with the engineer a current project and the engineer's particular role in it.

Project:

Engineer's role:

c. Find out how the engineer's work is done and how results are achieved.

d. Ask to see the reports that the engineer writes concerning the project.

- e. Discuss with your counselor what you learned about engineering from this visit.

- 5. Do ONE of the following:

- a. Use the systems engineering approach to make step-by-step plans for your next campout.

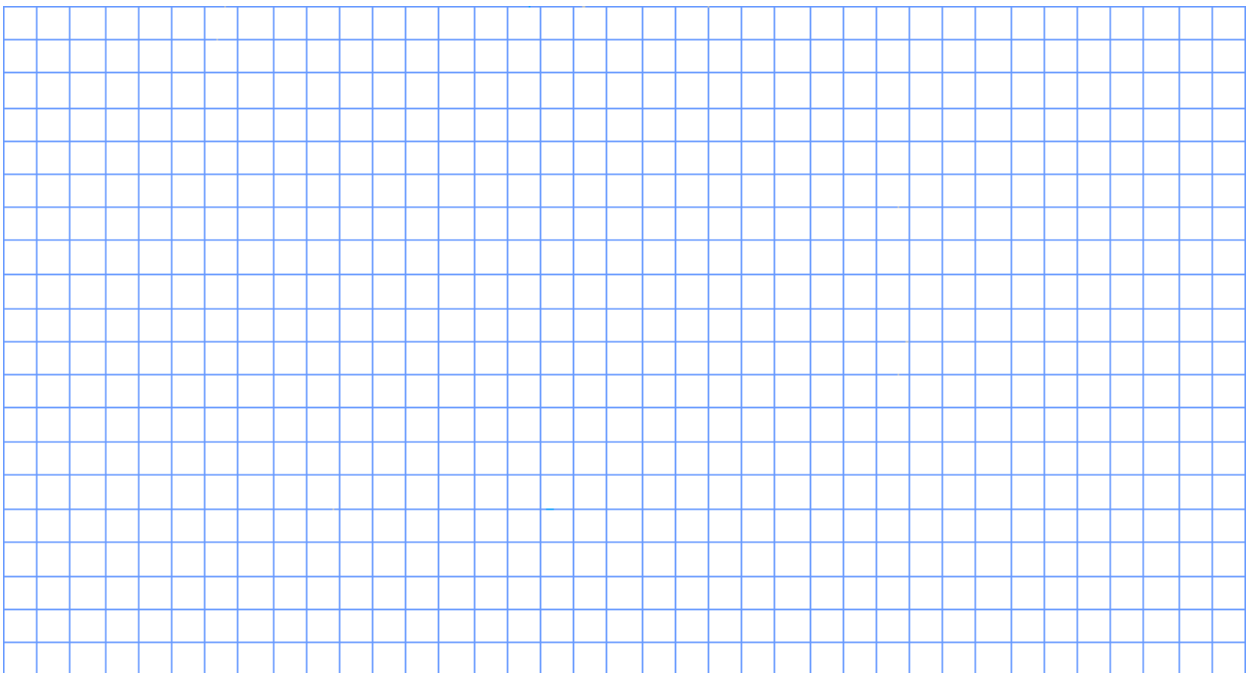
List alternative ideas for such items as program schedule, campsites, transportation, and costs.

Schedule:	
Campsites:	
Transportation:	
Costs:	

Tell why you made the choices you did and what improvements were made.

- b. Make an original design for a piece of patrol equipment.
Use the systems engineering approach to help you decide how it should work and look.

Draw plans for it.



Show the plans to your counselor, explain why you designed it the way you did, and explain how you would make it.

6. Do TWO of the following:

- a. **Transforming motion.** Using common materials or a construction set, make a simple model that will demonstrate motion. Explain how the model uses basic mechanical concepts like levers and inclined planes to demonstrate motion. Describe an example where this mechanism is used in a real product.
- b. **Using electricity.** Make a list of 10 electrical appliances in your home. Find out approximately how much electricity each uses in one month. Learn how to find out the amount and cost of electricity used in your home during periods of light and heavy use. List five ways to conserve electricity.
- c. **Understanding electronics.** Using an electronic device such as a mobile telephone or portable digital media player, find out how sound travels from one location to another. Explain how the device was designed for ease of use, function, and durability.
- d. **Using materials.** Do experiments to show the differences in strength and heat conductivity in wood, metal, and plastic. Discuss with your counselor what you have learned.
- e. **Converting energy.** Do an experiment to show how mechanical, heat, chemical, solar, and/or electrical energy may be converted from one or more types of energy to another. Explain your results. Describe to your counselor what energy is and how energy is converted and used in your surroundings.
- f. **Moving people.** Find out the different ways people in your community get to work. Make a study of traffic flow (number of vehicles and relative speed) in both heavy and light traffic periods. Discuss with your counselor what might be improved to make it easier for people in your community to get where they need to go.
- g. **Building an engineering project.** Enter a project in a science or engineering fair or similar competition. (This requirement may be met by participation on an engineering competition project team.) Discuss with your counselor what your project demonstrates, the kinds of questions visitors to the fair asked you about it, and how well were you able to answer their questions.

Project 1:	

Project 2:

7. Explain what it means to be a registered Professional Engineer (P.E.).

Name the types of engineering work for which registration is most important.

8. Study the Engineer's Code of Ethics. Explain how it is like the Scout Oath and Scout Law.

9. Find out about three career opportunities in engineering.

1.	
2.	
3.	

Pick one and research the education, training, and experience required for this profession.

Career:	
Education:	
Training:	
Experience:	

Discuss this with your counselor, and explain why this profession might interest you.

Requirement resources can be found here:
http://www.meritbadge.org/wiki/index.php/Engineering#Requirement_resources



Drafting

Merit Badge Workbook

This workbook can help you but you still need to read the merit badge pamphlet.

The work space provided for each requirement should be used by the Scout to make notes for discussing the item with his counselor, not for providing the full and complete answers. Each Scout must do each requirement.

No one may add or subtract from the official requirements found in **Boy Scout Requirements** (Pub. 33216 – SKU 34765).

The requirements were last issued or revised in 2009 • This workbook was updated in July 2014.

Scout's Name: _____

Unit: _____

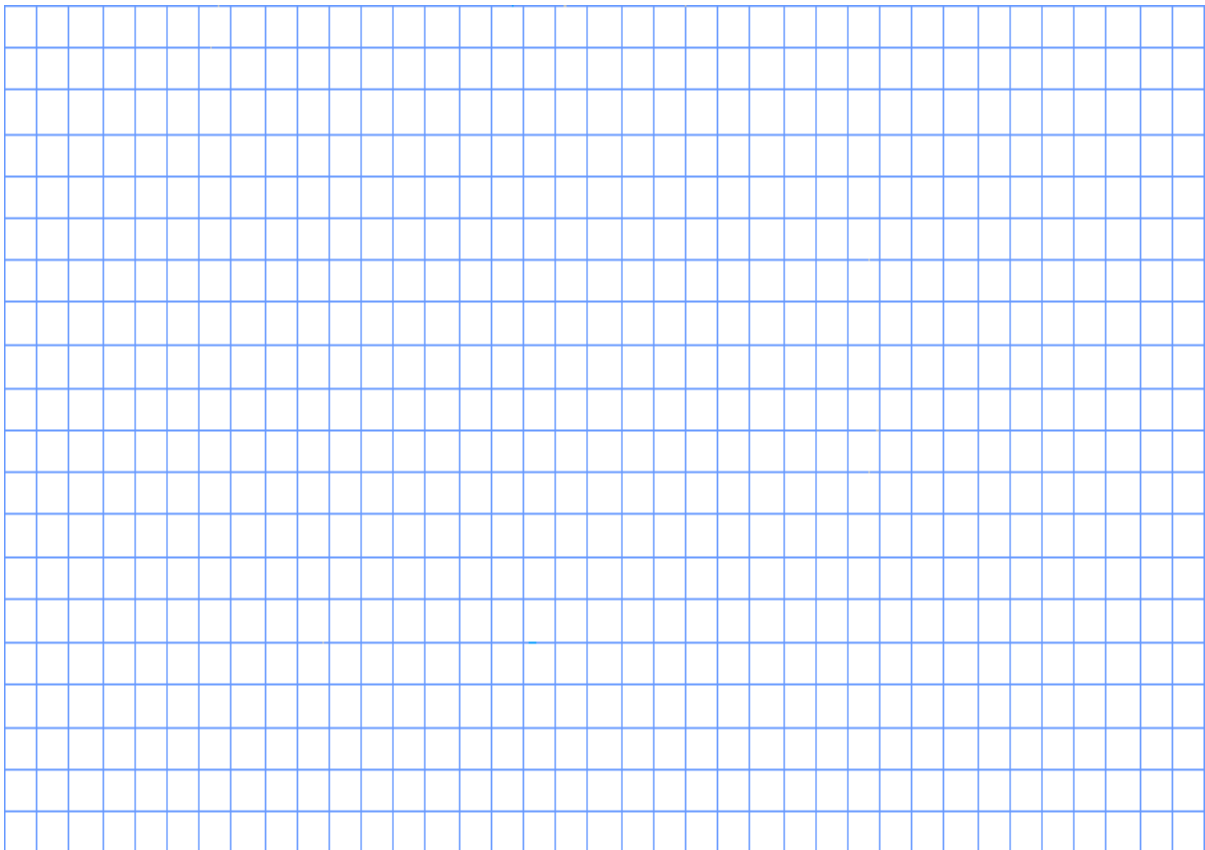
Counselor's Name: _____

Counselor's Phone No.: _____

<http://www.USScouts.Org> • <http://www.MeritBadge.Org>

Please submit errors, omissions, comments or suggestions about this **workbook** to: Workbooks@USScouts.Org
 Comments or suggestions for changes to the **requirements** for the **merit badge** should be sent to: Merit.Badge@Scouting.Org

1. Format TWO sheets of drawing paper with proper borders and title blocks - one for your manual project (see requirement 2) and one for your lettering project (see requirement 5).
- a. Make a rough sketch of your project drawings to determine the correct size of paper to format.



- b. Using either single-stroke vertical or slant Gothic lettering, fill in all important information in the title block sections of the formatted paper.
2. Using the formatted sheet of paper you prepared for your manual project, produce a pencil drawing as it would be used for manufacturing.
- Fill in all title block information.

The manual drawing may be any one of the following drawing types:

- a. **Architectural:** Make a scale drawing of an architectural project. The architectural drawing may be a floor plan, electrical, plumbing, or mechanical service plan; elevation plan; or landscaping plan. Use an architect's scale and show dimensions to communicate the actual size it features. Include any important notes and considerations necessary for construction.
 - b. **Mechanical:** Make a scale drawing of some mechanical device or interesting object. The mechanical drawing may be of the orthographic or isometric style. Use an engineer's scale and show dimensions to communicate the actual size of features. Include any important notes and considerations necessary for construction.
 - c. **Electrical:** Draw a simple schematic of a radio or electronic circuit. Properly print a bill of materials including all of the major electrical components used in the circuit. Use standard drawing symbols for the electronic components.
3. Produce a computer-aided design (CAD) drawing as it would be used in manufacturing. Fill in all title block information. The CAD drawing may be any one of the following drawing types:
- a. **Architectural:** Make a scale drawing of an architectural project. The architectural drawing may be a floor plan, electrical, plumbing, or mechanical service plan; elevation plan; or landscaping plan. Use an architect's scale and show dimensions to communicate the actual size if features. Include any important notes and considerations necessary for construction.
 - b. **Mechanical:** Make a scale drawing of some mechanical device or interesting object. The mechanical drawing may be of the orthographic or isometric style. Use an engineer's scale and show dimensions to communicate the actual size of features. Include any important notes and considerations necessary for construction.
 - c. **Electrical:** Draw a simple schematic of a radio or electronic circuit. Properly print a bill of materials including all of the major electrical components used in the circuit. Use standard drawing symbols for the electronic components.
4. Discuss with your counselor how fulfilling requirements 2 and 3 differed from each other.

Tell about the benefits derived from using CAD for requirement 3.

Include in your discussion the software you used as well as other software options that are available.

5. Using single-stroke slant or vertical Gothic lettering, (without the aid of a template or lettering guide) write a brief explanation of what you consider to be the most important benefit in using CAD in a particular industry (aerospace, electronics, manufacturing, architectural, or other). Use the experience gained in fulfilling requirements 2, 3, and 4 to support your opinion. Use the formatted sheet of paper you prepared in requirement 1 for your lettering project.

6. Do ONE of the following (a or b):

a. Visit a facility or industry workplace where drafting is part of the business. Ask to see an example of the work that is done there, the different drafting facilities, and the tools used.

1. Find out how much of the drafting done there is manual, and how much is done using CAD. If CAD is used, find out what software is used and how and why it was chosen.

2. Ask about the drafting services provided.

Ask who uses the designs produced and how those designs are used.

Discuss how the professionals who perform drafting cooperate with other individuals in the drafting area and other areas of the business.

- 3. Ask how important the role of drafting is to producing the end product or service that this business supplies.

Find out how drafting contributes to the company's end product or service

- b. Using resources you find on your own such as at the library and on the Internet (with your parent's permission), learn more about the drafting trade and discuss the following with your counselor.
 - 1. The drafting tools used in the past - why and how they were used. Explain which tools are still used today and how their use has changed with the advent of new tools. Discuss which tools are being made obsolete by newer tools in the industry.

2. Tell what media types were used in the past and how drawings were used, stored, and reproduced. Tell how the advent of CAD has changed the media used, and discuss how these changes affect the storage or reproduction of drawings.

3. Discuss whether the types of media have changed such that there are new uses for the drawings, or other outputs, produced by designers.

Briefly discuss how new media types are used in the industry today.

7. Find out about three career opportunities in drafting.

1.	
2.	
3.	

Pick one and find out about the education, training, and experience required for this profession.

Career:	
Education:	
Training:	
Experience:	

Discuss this with your counselor, and explain why this profession might interest you.

Requirement resources can be found here:
http://www.meritbadge.org/wiki/index.php/Drafting#Requirement_resources