



# Shoot!

## Projectiles and Space



### Boy Scout Nova Award Workbook

This workbook can help you but you still need to read the Boy Scout Nova Awards Guidebook.  
 This Workbook can help you organize your thoughts as you prepare to meet with your counselor.  
 You still must satisfy your counselor that you can demonstrate each skill and have learned the information.  
 You should use the work space provided for each requirement to keep track of which requirements have been completed,  
 and to make notes for discussing the item with your counselor, not for providing full and complete answers.  
 If a requirement says that you must take an action using words such as "discuss", "show",  
 "tell", "explain", "demonstrate", "identify", etc, that is what you must do.

**Counselors may not require the use of this or any similar workbooks.**

No one may add or subtract from the official requirements found in the Boy Scout Nova Awards Guidebook (Pub. 34033 – SKU 614936).  
 The requirements were issued in 2015 • This workbook was updated in October 2016.

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](mailto:Workbooks@USScouts.Org)  
 Send comments or suggestions for changes to the **requirements** for the **Nova Award** to: [Program.Content@Scouting.Org](mailto:Program.Content@Scouting.Org)

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

- 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.

What was watched?	Date	Start Time	Duration

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.

**Workbook © Copyright 2016 - U.S. Scouting Service Project, Inc. - All Rights Reserved**  
**Requirements © Copyright, Boy Scouts of America (Used with permission.)**

This workbook may be reproduced and used locally by Scouts and Scouters for purposes consistent with the programs of the Boy Scouts of America (BSA), the World Organization of the Scout Movement (WOSM) or other Scouting and Guiding Organizations. However it may NOT be used or reproduced for electronic redistribution or for commercial or other non-Scouting purposes without the express permission of the U. S. Scouting Service Project, Inc. (USSSP).

Then do the following:

1. Make a list of at least five questions or ideas from the show(s) you watched.

1.	
2.	
3.	
4.	
5.	

2. Discuss two of the questions or ideas with your counselor.

1.	
2.	

- B. Read (about three hours total) about projectiles, aviation, space, weather, astronomy, or aviation or space technology.

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.*

What was read?	Date	Start Time	Duration

Then do the following:

- 1. Make a list of at least two questions or ideas from each article.

1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

2. Discuss two of the questions or ideas with your counselor.

1.	
2.	

C Do a combination of reading and watching (about three hours total).

What was watched or read?	Date	Start Time	Duration

Then do the following:

1. Make a list of at least two questions or ideas from each article or show.

1.	
2.	
3.	
4.	
5.	

6. 


2. Discuss two of the questions or ideas with your counselor.

1. 


2. 


2. Complete ONE merit badge from the following list. (Choose one that you have not already used toward another Nova award.)

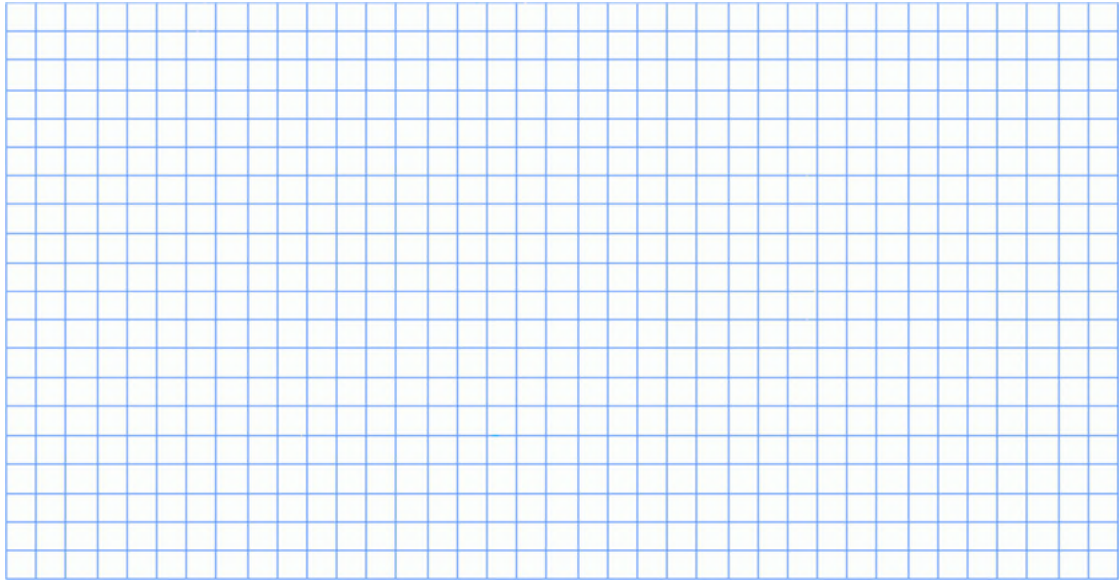
- |                                    |   |  |
|------------------------------------|---|--|
| <input type="checkbox"/> Archery   | <input type="checkbox"/> Game Design      | <input type="checkbox"/> Space Exploration |
| <input type="checkbox"/> Astronomy | <input type="checkbox"/> Rifle Shooting   | <input type="checkbox"/> Sustainability    |
| <input type="checkbox"/> Athletics | <input type="checkbox"/> Robotics         | <input type="checkbox"/> Weather           |
| <input type="checkbox"/> Aviation  | <input type="checkbox"/> Shotgun Shooting |  |

After completion, discuss with your counselor how the merit badge you earned uses science.


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

Java Applets on Physics

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

- 3. Discuss with your counselor
  - a. What a projectile is


- b. What projectile motion is


c. The factors affecting the path of a projectile


d. The difference between forward velocity and acceleration due to gravity.


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

Escape Velocity


Orbital Velocity


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.

Location visited: 

--

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


- 2. Discuss your visit with your counselor.




- B. Discover the latitude and longitude coordinates of your current position.

Latitude:  Longitude:

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](http://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.

The time of your viewing	
The weather conditions	
How long the satellite was visible	
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, and 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?


Discuss your design, data, and experiments—both successes and failures—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. 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?


Discuss your design, data, and experiments—both successes and failures—with your counselor.


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


## **Important excerpts from the Guide To Advancement - 2015, No. 33088 (SKU-620573)**

### **[1.0.0.0] — Introduction**

The current edition of the *Guide to Advancement* is the official source for administering advancement in all Boy Scouts of America programs: Cub Scouting, Boy Scouting, Varsity Scouting, Venturing, and Sea Scouts. It replaces any previous BSA advancement manuals and previous editions of the *Guide to Advancement*.

### **[Page 2, and 5.0.1.4] — Policy on Unauthorized Changes to Advancement Program**

**No council, committee, district, unit, or individual has the authority to add to, or subtract from, advancement requirements.** There are limited exceptions relating only to youth members with special needs. For details see section 10, "Advancement for Members With Special Needs".

### **[Page 2] — The "Guide to Safe Scouting" Applies**

Policies and procedures outlined in the *Guide to Safe Scouting*, No. 34416, apply to all BSA activities, including those related to advancement and Eagle Scout service projects.

### **[7.0.3.1] — The Buddy System and Certifying Completion**

A youth member must not meet one-on-one with an adult. Sessions with counselors must take place where others can view the interaction, or the Scout must have a buddy: a friend, parent, guardian, brother, sister, or other relative—or better yet, another Scout working on the same badge—along with him attending the session. If merit badge counseling or instruction includes any Web-based interaction, it must be conducted in accordance with the BSA Social Media Guidelines (<http://www.scouting.org/Marketing/Resources/SocialMedia>). For example, always copy one or more authorized adults on email messages between counselors and Scouts.

When the Scout meets with the counselor, he should bring any required projects. If these cannot be transported, he should present evidence, such as photographs or adult verification. His unit leader, for example, might state that a satisfactory bridge or tower has been built for the Pioneering merit badge, or that meals were prepared for Cooking. If there are questions that requirements were met, a counselor may confirm with adults involved. Once satisfied, the counselor signs the blue card using the date upon which the Scout completed the requirements, or in the case of partials, initials the individual requirements passed.

Note that from time to time, it may be appropriate for a requirement that has been met for one badge to also count for another. See "Fulfilling More Than One Requirement With a Single Activity," 4.2.3.6.

### **[7.0.3.2] — Group Instruction**

It is acceptable—and sometimes desirable—for merit badges to be taught in group settings. This often occurs at camp and merit badge midways, fairs, clinics, or similar events. Interactive group discussions can support learning. The method can also be attractive to "guest experts" assisting registered and approved counselors. Slide shows, skits, demonstrations, panels, and various other techniques can also be employed, but as any teacher can attest, not everyone will learn all the material.

There must be attention to each individual's projects and his fulfillment of *all* requirements. We must know that every Scout—actually and *personally*—completed them. If, for example, a requirement uses words like "show," "demonstrate," or "discuss," then every Scout must do that. It is unacceptable to award badges on the basis of sitting in classrooms *watching* demonstrations, or remaining silent during discussions.

It is sometimes reported that Scouts who have received merit badges through group instructional settings have not fulfilled all the requirements. To offer a quality merit badge program, council and district advancement committees should ensure the following are in place for all group instructional events.

- A culture is established for merit badge group instructional events that partial completions are acceptable expected results.
- A guide or information sheet is distributed in advance of events that promotes the acceptability of partials, explains how merit badges can be finished after events, lists merit badge prerequisites, and provides other helpful information that will establish realistic expectations for the number of merit badges that can be earned at an event.
- Merit badge counselors are known to be registered and approved.
- Any guest experts or guest speakers, or others assisting who are not registered and approved as merit badge counselors, do not accept the responsibilities of, or behave as, merit badge counselors, either at a group instructional event or at any other time. Their service is temporary, not ongoing.
- Counselors agree to sign off only requirements that Scouts have actually and personally completed.
- Counselors agree not to assume prerequisites have been completed without some level of evidence that the work has been done. Pictures and letters from other merit badge counselors or unit leaders are the best form of prerequisite documentation when the actual work done cannot be brought to the camp or site of the merit badge event.
- There is a mechanism for unit leaders or others to report concerns to a council advancement committee on summer camp merit badge programs, group instructional events, and any other merit badge counseling issues—especially in instances where it is believed BSA procedures are not followed. See "Reporting Merit Badge Counseling Concerns," 11.1.0.0.
- There must be attention to each individual's projects and his fulfillment of all requirements. We must know that every Scout—actually and personally—completed them.

It is permissible for guest speakers, guest experts, or others who are not merit badge counselors to assist in the counseling process. Those providing such assistance must be under the direction of a registered and approved counselor who is readily available onsite, and provides personal supervision to assure all applicable BSA policies and procedures—including those related to BSA Youth Protection—are in place and followed.

### **[7.0.3.3] — Partial Completions**

A Scout need not pass all the requirements of one merit badge with the same counselor. It may be that due to timing or location issues, etc., he must meet with a different counselor to finish the badge. The Application for Merit Badge has a place to record what has been finished—a "partial." In the center section on the reverse of the blue card, the counselor initials for each requirement passed. In the case of a partial completion, the counselor does not retain his or her portion of the card. A subsequent counselor may choose not to accept partial work, but this should be rare. A Scout, if he believes he is being treated unfairly, may work with his unit leader to find another counselor. An example for the use of a signed partial would be to take it to camp as proof of prerequisites. Partial completions have no expiration except the Scout's 18th birthday. Units, districts, or councils shall not establish other expiration dates for partial merit badges.

### **[7.0.4.8] — Unofficial Worksheets and Learning Aids**

Worksheets and other materials that may be of assistance in earning merit badges are available from a variety of places including unofficial sources on the Internet and even troop libraries. Use of these aids is permissible as long as the materials can be correlated with the current requirements that Scouts must fulfill. Completing "worksheets" may suffice where a requirement calls for something in writing, but this would not work for a requirement where the Scout must discuss, tell, show, or demonstrate, etc. Note that Scouts shall not be required to use these learning aids in order to complete a merit badge.