



## Numbers Don't Lie

This module is designed to help the Venturer or Sea Scout explore how math affects his or her life each day.

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

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

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

### **Helpful Link**

**“The Mathematics of Cryptology”: University of Massachusetts**

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

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

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

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

2. Choose ONE STEM field of interest from the following list. Complete ALL the requirements for a STEM exploration in that field. See STEM Explorations for the requirements. (If you have already completed a Venturing STEM exploration in one of these fields, please choose a different field for this award.) After completion, discuss with your counselor how the Venturing STEM exploration you completed uses mathematics.

|                   |                     |           |
|-------------------|---------------------|-----------|
| American Business | Entrepreneurship    | Surveying |
| Chess             | Orienteering        | Weather   |
| Computers         | Personal management |           |
| Drafting          | Radio               |           |

3. Choose TWO from A or B or C or D or E and complete ALL the requirements. (Write down your data and calculations to support your explanation to your counselor. You may use a spreadsheet. Do not use someone else’s data or calculations.)
- A. Calculate your horsepower when you run up a flight of stairs.

### Helpful Links

“How to Calculate Your Horsepower”: wikiHow

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

“Lab Power”: haplosciences.net

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

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

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

- B. Attend at least two track, cross-country, or swim meets.
- (1) For each meet, time at least three racers. (Time the same racers at each meet.)

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

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

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

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

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

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

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

- (1) Visit NASA's Student Observation Network website (with your parent's or guardian's permission) at [www.nasa.gov/audience/foreducators/son/energy/starcount/](http://www.nasa.gov/audience/foreducators/son/energy/starcount/) for instructions on performing a star count.
- (2) Do a star count on five clear nights at the same time each night.
- (3) Report your results on NASA's Student Observation Network website (with your parent's or guardian's permission) and see how your data compares to others. There are several websites for participating in star counts, but NASA's website seems the most general and straightforward to use. (The others require specific nights for observations.) This website has nice step-by-step instructions for the star count and it provides a calculation sheet that simplifies the star count data ([http://www.nasa.gov/pdf/145989main\\_StarCountDataSheet\\_v4a.pdf](http://www.nasa.gov/pdf/145989main_StarCountDataSheet_v4a.pdf)).

4. Do ALL of the following.
  - A. Investigate your calculator and explore the different functions.
  - B. Discuss the functions, abilities, and limitations of your calculator with your counselor. Talk about how these affect what you can and cannot do with a calculator. (See your counselor for some ideas to consider.)
5. Discuss with your counselor how math affects your everyday life.

Last Modified 2018 Nov 28

## Numbers Don't Lie **Counselor's notes**

This module is designed to help the Venturer explore how math affects his or her life each day.

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

D. Do a combination of reading, watching, or researching (about three hours total). Then do the following:

- (1) Make a list of at least two questions or ideas from each article, website, or show.
- (2) Discuss two of the questions or questions with your counselor.

2. Choose ONE STEM field of interest from the following list. Complete ALL the requirements for a STEM exploration in that field. See STEM Explorations for the requirements. (If you have already completed a Venturing STEM exploration in one of these fields, please choose a different field for this award.) After completion, discuss with your counselor how the Venturing STEM exploration you completed uses mathematics.

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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>

“Lab Power”: haplosciences.net

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

1. Find out how much you weigh in kilograms and write it down. (Multiply your weight in pounds by 0.454 to get kilograms.)
2. Find a stair, ladder, or something similar (as long as it gets you upward).
3. Measure the height (not the length) of the stairs (or whatever you use) from the bottom 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 (it doesn't matter how long the stairs are.)
4. Take a running start toward the stairs. When you step on the first step, start the timer; when both feet are on the top step, stop the timer. (You may skip stairs.) Now you have all the numbers needed.
5. Calculate the Power (P) with this formula:

$mah/t$  ( $m \times 9.80 \times h$ )/ $t$ , where

$m$  = mass (your weight) in kilograms

$a$  = acceleration (9.80 m/sec<sup>2</sup> is the acceleration caused by Earth's gravity)

$h$  = height of staircase in meters

$t$  = time in seconds

6. 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 (or energy) is measured in newton meters or joules; power is measured in joules/second or watts.

7. Divide the number of watts by 745.6 w/hp to get the number in horsepower.

(1) How does your horsepower compare to the power of a horse?

Horsepower is a unit of power. One horsepower equals 33,000 foot-pounds 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. (See "What Is Horsepower" at [www.web-cars.com/math/horsepower.html](http://www.web-cars.com/math/horsepower.html).)

(2) How does your horsepower compare to the horsepower of your favorite car?

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

Most car information packets and many websites list the horsepower of cars.

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.

Average speed = Distance/Time

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- (1) Soccer—Goals, assists, corner kicks, keeper saves, fouls, offsides
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Share your calculations with your counselor, and discuss your conclusions about the players' strengths and weaknesses.

### Helpful Links

The following are some sites to suggest but that do not have to be used.

“SoccerXpert.com Soccer Stats”: SoccerXpert.com

Website: <http://www.soccerxpert.com/docs/GameStats.pdf>

The Baseball Scorecard

Website: <http://www.baseballscorecard.com/downloads.htm>

“How to Take Statistics at a Basketball Game”

Website: eHow[http://www.ehow.com/how\\_4451141\\_take-statisticsbasketball-game.html](http://www.ehow.com/how_4451141_take-statisticsbasketball-game.html)

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

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

Half of the world's people live in cities. Because of light pollution, many city dwellers have never been able to see dark skies clearly. Among the issues associated with light pollution are energy conservation, effects on wildlife, and the ability to clearly see the night sky. While light pollution is a concern on the global level, it is also something that can be easily addressed at the local level.

#### Helpful Links

Several web-based efforts exist to bring awareness to the diminishing night skies.

“Less of Our Light for More Star Light”: GLOBE at Night

Website: <http://www.globeatnight.org>

“Windows to the Universe”: National Earth Science Teachers Association

Website: <http://www.windows2universe.org>

International Dark-Sky Association

Website: <http://www.darksky.org>

“Seeing in the dark”: Dark Skies Awareness

Website: <http://www.darkskiesawareness.org>

- (1) Visit NASA's Student Observation Network website (with your parent's or guardian's permission) at [www.nasa.gov/audience/foreducators/son/energy/starcount/](http://www.nasa.gov/audience/foreducators/son/energy/starcount/) for instructions on performing a star count.
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  - A. Investigate your calculator and explore the different functions.
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5. Discuss with your counselor how math affects your everyday life.

Here are some ideas for your Venturer or Sea 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 display? What if the answer to your calculation has more digits than your calculator can display? 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 does it sometimes show only a portion of the graph? If it shows only a portion of the 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, no graph, or a graph that cannot be readily interpreted?)
- Are there numerical calculations that calculators can't do? If possible, give an example.