

MYSTIC SEAPORT

THE MUSEUM OF AMERICA AND THE SEA

TM



*Chip Log, © Mystic Seaport, 1934.9*

## “Ready, Set, Row”

**Author:** Sandra Nichols, Smith Middle School, Glastonbury, CT

**Subject:** Concepts of Physics

**Grade Level:** Grade 8

**Timeframe:** 45 minutes (onsite lesson at Mystic Seaport; reservations and advanced notice required – contact 860-572-5322, prompt #1)

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**Introduction:** In the ancient times, the only way to measure ship speed was use a method called “heaving the log”. This approximate method of ship speed measurement was used until 1500-1600s when the 'chip log' method was invented. (Both methods were probably invented by Dutch sailors.) The later method involved knots, and in fact is the origin of the nautical speed unit: the knot.

**Science connections:** MS-PS3-4 Plan an investigation to determine the relationship among the energy transferred the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

MS-PS3-1 Construct and interpret graphical displays of data to describe the relationship of kinetic energy to mass of an object to the speed of the object.

**Geographic Connections:** Related to Global Cultural Themes (see C3 under geography: <http://www.socialstudies.org/system/files/c3/C3-Framework-for-Social-Studies.pdf>)

**Vocabulary:** speed, time, distance, buoyancy, knots, nautical mile, heave, friction, traffrail log,

**Content Standards:**

CCSS.ELA-LITERACY.RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

CCSS.ELA-LITERACY.RST.6-8.9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

**Compelling (Essential) Question:**

Can forces act upon an object to change the position, direction, and/or speed of its motion?

**Essential Questions:**

- How are the forces acting on an object related to its motion?
- Why do objects move?

**Literacy through the Content Area:**

Students will collect and interpret data

**Placement of Lesson within Broader Curriculum/Context:** Once the students have been exposed to the concepts of a force being a push or a pull they will explore different factors that affect these motions.

**Learner Background:** Students will have had lab investigations on how distance and time affect speed. While on the whale boat students will calculate their boar speed based on the two different techniques used by whalers.

**Objective for Lesson:** Students will be able to understand early navigation technologies and how advancements in technology have improved our ability to navigate

**Integration of 21st century skills:** Students will use various scientific tools (SloMo Pro app, digital media, timers...) to collect and analyze data. Based on the results they will evaluate the methods of data collection (past and present) to communicate how advances in technology have aided in navigation for boaters.

**Materials/Resources:**

- Timer
- Digital media device (camera, phone, iPad)
- Whaling boat

- Rowers (4-6)
- Log, Buoy or floating object
- Taffrail Log: [http://educators.mysticseaport.org/artifacts/taffrail\\_log/](http://educators.mysticseaport.org/artifacts/taffrail_log/)

**Lesson Development/Instructional Strategies**

Activity 1: Heave the log

1. Gather in groups of 4-6, and an oarsman
2. Record total weight of partners in the boat
3. Measure the distance from the bow to the stern of the boat and record.
4. As a group begin rowing
5. Once at a comfortable pace start the lab
6. The oarsman will yell release and as quick as they can release the log or buoyant object and start the stopwatch.
7. Once the log or buoyant object passes the end of the stern, record the time it took to travel that given distance.
8. Repeat 1-6, two more times.
9. Repeat, but this time use a buoy as your marker
10. Average time it took the object to travel
11. Calculate the average speed of each trial.
12. Obtain average speed traveled after 3 trials.

Total weight of rowers: \_\_\_\_\_

\_\_\_\_\_

|      | Distance | Trial 1 | Trial 2 | Trial 3 | Average time | Average speed |
|------|----------|---------|---------|---------|--------------|---------------|
| Log  |          |         |         |         |              |               |
| Buoy |          |         |         |         |              |               |

Activity 2: Chip Knot

1. Gather in your group of 4-6, and an oarsman
2. Record total weight and boat distance again
3. Decide on a time for recording
4. As a group begin rowing, once at a comfortable pace start the lab
5. The oarsman will yell release and as quick as they can release the taffrail log (illustrated in this Youtube clip: <https://www.youtube.com/watch?v=UQGee9JqXTE>)
6. After 14 seconds count the number of knots that went overboard
7. Record this knot speed



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**Assessment:**

**Formative Assessment**

1. Why would determining the speed of a ship be important? How would improvements to the log help?
2. How could a voyage be affected if sailors couldn't receive accurate measurements from nautical instruments?
3. Is it possible for sailors to accurately estimate their heading and speed to assist in the event of inaccurate readings?
4. What kinds of variables could *cause trouble in getting an accurate reading from this instrument?*

**Summative Assessment**

1. Why would determining the speed of a ship be important? How would improvements to the log help?
2. How could a voyage be affected if sailors couldn't receive accurate measurements from nautical instruments? Is it possible for sailors to accurately estimate their heading and speed to assist in the event of inaccurate readings?
3. What kinds of variables could cause trouble in getting an accurate reading from this instrument?

**Students Needing Differentiated Instruction:**

- Provide students with data from a previous experiment
- Provide students video of investigation so they can stop, fast forward and rewind. See link:
- Using the SloMo Pro App, allow students to manipulate data to understand cause and effect

- On lab assessment provide student with a more completed data table of headings along with a graph of independent and dependent variables
- Challenge: For the boater enthusiasts: *Chip Log Navigation Contest*  
[http://www.captaindale.com/Chip\\_Log\\_index.html](http://www.captaindale.com/Chip_Log_index.html)

**References:**

**>History of calculating speed on boats**

<http://www.physlink.com/Education/AskExperts/ae400.cfm>

**>Teach Engineering**

[https://www.teachengineering.org/view\\_activity.php?url=collection/cub\\_/activities/cub\\_navigation/cub\\_navigation\\_lesson08\\_activity2.xml](https://www.teachengineering.org/view_activity.php?url=collection/cub_/activities/cub_navigation/cub_navigation_lesson08_activity2.xml)

**>Why is speed at sea measured in knots?** <http://engineering.mit.edu/ask/why-speed-sea-measured-knots>

**>Knots versus miles per hour** [https://www.grc.nasa.gov/www/k-12/WindTunnel/Activities/knots\\_vs\\_mph.html](https://www.grc.nasa.gov/www/k-12/WindTunnel/Activities/knots_vs_mph.html)

**>Artifacts:**

**chip log:** [http://library.mysticseaport.org/ere/odetail.cfm?id\\_number=1934.9](http://library.mysticseaport.org/ere/odetail.cfm?id_number=1934.9)

**>How to make your own chip log:**

[http://www.captaindale.com/Chip\\_Log\\_How\\_to\\_Make.html](http://www.captaindale.com/Chip_Log_How_to_Make.html)

**>How to use a chip log**

[http://www.captaindale.com/Chip\\_Log\\_How\\_to\\_Use.html](http://www.captaindale.com/Chip_Log_How_to_Use.html)

**> Chip Log Navigation Contest**

[http://www.captaindale.com/Chip\\_Log\\_index.html](http://www.captaindale.com/Chip_Log_index.html)