MOBY-DICK

JAKE HEGGIE AND GENE SCHEER

MATH: Problem Solving

Students will

- Utilize charts and analyze data to answer questions.
- Convert units within a measurement system
- Use mathematical operations to solve real world situations

Copies for Each Student: *Moby-Dick* Synopsis, Glossary, Activity Sheet

For the Teacher: *Moby-Dick* Synopsis, Glossary, Activity Sheet, Answer Sheet

Getting Ready

Decide which section(s) of the lesson you wish your group to complete.

Gather materials:

- Notebook paper
- Pencils
- Calculators (optional)

Be sure your students are familiar with the story of *Moby-Dick*.

Instructional Time: One 45-minute class period

Introduction

The story of this opera, and novel of the same name, centers around Captain Ahab who is traveling aboard his whaling ship seeking revenge on the white sperm whale, Moby-Dick, who he blames for the loss of his leg. Aboard the ship is a young man who joined the crew and keeps a descriptive log of all the whales they encounter in their travels at sea.

In this lesson, students will be solving problems based on the characteristics of different whale species as it relates to size and the speeds and distances they are able to travel. Explain to students that when traveling by water, different units of measurement are used than those used for land travel. Using the Glossary, discuss the definitions and differences between miles (land), nautical miles, and knots.

Guided Practice:

Present the Activity Worksheet to the class. Discuss the different conversion formulas given and how they correlate to complete the chart given. As a class, review the word problems and chart. Then, allow the students to complete the worksheet.

Independent Practice

Depending on your grade level, the ability of your students, and time constraints, you may choose to have students work as a whole class, in small groups, with a partner, or individually. Read the instructions on the Activity Worksheet and have the students fill in the missing information on the activity sheet and answer the questions that follow.

If time allows

Have the students create two new word problems by changing the miles per hour for a whale, and have students recalculate the nautical mile, knot and feet per hour. Then, the students will exchange word problems with their peers and see if their classmate can answer the problems correctly.

Evaluation:

1. Were the students able to give any prior knowledge about the nautical mile and knot?
2. Were the students able to complete the Activity Worksheet by answering the questions with 80% accuracy?
3. Were the students able to create and exchange their own word problems?

TEKS

Mathematics

6th Grade

111.26 b. 1 A,B,C,D,E,F,G Mathematical process standards
The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to: (A) apply mathematics to problems arising in everyday life, society, and the workplace; (B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution; (C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems; (D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate; (E) create and use representations to organize, record, and communicate mathematical ideas; (F) analyze mathematical relationships to connect and communicate mathematical ideas; and (G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

111.26 b. 2 A,B,C,D Number and operations
The student applies mathematical process standards to represent and use rational numbers in a variety of forms. The student is expected to: (A) classify whole numbers, integers, and rational numbers using a visual representation such as a Venn diagram to describe relationships between sets of numbers; (B) identify a number, its opposite, and its absolute value; (C) locate, compare, and order integers and rational numbers using a number line; (D) order a set of rational numbers arising from mathematical and real-world contexts.

111.26 b. 3A,C,D,E Number and operations
The student applies mathematical process standards to represent addition, subtraction, multiplication, and division while solving problems and justifying solutions. The student is expected to: (A) recognize that dividing by a rational number and multiplying by its reciprocal result in equivalent values; (C) represent integer operations with concrete models and connect the actions with the models to standardized algorithms; (D) add, subtract, multiply, and divide integers fluently; and (E) multiply and divide positive rational numbers fluently.

111.26 b. 4 D,E,F,G,H Proportionality
The student applies mathematical process standards to develop an understanding of proportional relationships in problem situations. The student is expected to: (D) give examples of rates as the comparison by division of two quantities having different attributes, including rates as quotients; (E) represent ratios and percents with concrete models, fractions, and decimals; (F) represent benchmark fractions and percents such as 1%, 10%, 25%, 33 1/3%, and multiples of these values using 10 by 10 grids, strip diagrams, number lines, and numbers; (G) generate equivalent forms of fractions, decimals, and percents using real-world problems, including problems that involve money; and (H) convert units within a measurement system, including the use of proportions and unit rates.

111.26 b. 5 A,B,C Proportionality
The student applies mathematical process standards to solve problems involving proportional relationships. The student is expected to: (A) represent mathematical and real-world problems involving ratios and rates using scale factors, tables, graphs, and proportions; (B) solve real-world problems to find the whole given a part and the percent, to find the part given the whole and the percent, and to find the percent given the part and the whole, including the

use of concrete and pictorial models; and (C) use equivalent fractions, decimals, and percents to show equal parts of the same whole.

111.26 b. 6 A,B Expressions, equations, and relationships
The student applies mathematical process standards to use multiple representations to describe algebraic relationships. The student is expected to: (A) identify independent and dependent quantities from tables and graphs; (B) write an equation that represents the relationship between independent and dependent quantities from a table.

111.26 b. 7 B,C Expressions, equations, and relationships
The student applies mathematical process standards to develop concepts of expressions and equations. The student is expected to: (B) distinguish between expressions and equations verbally, numerically, and algebraically; (C) determine if two expressions are equivalent using concrete models, pictorial models, and algebraic representations.

7th Grade

111.27 b. 1 A,B,C,D,E,F,G Mathematical process standards
The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to: (A) apply mathematics to problems arising in everyday life, society, and the workplace; (B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution; (C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems; (D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate; (E) create and use representations to organize, record, and communicate mathematical ideas; (F) analyze mathematical relationships to connect and communicate mathematical ideas; and (G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

111.27 b. 2 Number and operations
The student applies mathematical process standards to represent and use rational numbers in a variety of forms. The student is expected to extend previous knowledge of sets and subsets using a visual representation to describe relationships between sets of rational numbers.

111.27 b. 3 A,B Number and operations
The student applies mathematical process standards to add, subtract, multiply, and divide while solving problems and justifying solutions. The student is expected to: (A) add, subtract, multiply, and divide rational numbers fluently; and (B) apply and extend previous understandings of operations to solve problems using addition, subtraction, multiplication, and division of rational numbers.

111.27 b. 4 B,D,E Proportionality
The student applies mathematical process standards to represent and solve problems involving proportional relationships. The student is expected to: (B) calculate unit rates from rates in mathematical and real-world problems; (D) solve problems involving ratios, rates, and percents, including multi-step problems involving percent increase and percent decrease, and financial literacy problems; and (E) convert between measurement systems, including the use of proportions and the use of unit rates.

111.27 b. 6 G Proportionality
The student applies mathematical process standards to use probability and statistics to describe or solve problems involving proportional relationships. The student is expected to: (G) solve problems using data represented in bar graphs, dot plots, and circle graphs, including part-to-whole and part-to-part comparisons and equivalents;

8th Grade

111.28 b. 1 A,B,C,D,E,F,G Mathematical process standards
The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to: (A) apply mathematics to problems arising in everyday life, society, and the workplace; (B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution; (C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and

techniques, including mental math, estimation, and number sense as appropriate, to solve problems; (D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate; (E) create and use representations to organize, record, and communicate mathematical ideas; (F) analyze mathematical relationships to connect and communicate mathematical ideas; and (G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

111.28 b. 2 A,D Number and operations
The student applies mathematical process standards to represent and use real numbers in a variety of forms. The student is expected to: (A) extend previous knowledge of sets and subsets using a visual representation to describe relationships between sets of real numbers; (D) order a set of real numbers arising from mathematical and real-world contexts.

Algebra I
111.39 c. 1 A,B,C,D,E,F,G Mathematical process standards
The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to: (A) apply mathematics to problems arising in everyday life, society, and the workplace; (B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution; (C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems; (D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate; (E) create and use representations to organize, record, and communicate mathematical ideas; (F) analyze mathematical relationships to connect and communicate mathematical ideas; and (G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

Algebra II
111.40 c. 1 A,B,C,D,E,F,G Mathematical process standards

The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to: (A) apply mathematics to problems arising in everyday life, society, and the workplace; (B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution; (C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems; (D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate; (E) create and use representations to organize, record, and communicate mathematical ideas; (F) analyze mathematical relationships to connect and communicate mathematical ideas; and (G) display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

Correlates: Science

Gardner's Intelligences: Linguistic, Logical-Mathematical

Bloom's Taxonomy: Understand, Analyze, Apply, Evaluate

Sources
http://oceanservice.noaa.gov/facts/nauticalmile_knot.html, http://www.math-salamanders.com/image-files/printable-math-worksheets-whales-standard-ans.gif, https://www.grc.nasa.gov/WWW/k-12/WindTunnel/Activities/knots_vs_mph.html https://oceanwide-expeditions.com/to-do/wildlife/bowhead-whale, http://www.whalefacts.org/blue-whale-facts/ http://www.coolantarctica.com/Antarctica%20fact%20file/wildlife/whales/fin_whale.php, http://www.dulcimoo.com/graywhale/, http://www.dec.ny.gov/animals/9363.html, https://www.britannica.com/animal/sperm-whale, http://factslist.net/2013/02/beluga-whales-facts-file/, http://science.howstuffworks.com/innovation/science-questions/question79.htm

Moby-Dick
Synopsis

ACT ONE

Scenes 1 to 4. Day One: The whaling ship Pequod *has been at sea for one week*

Captain Ahab stands alone on deck in the hours before dawn. Below deck, while most of the crew sleeps, the harpooneer Queequeg prays and wakes Greenhorn, a loner and newcomer to whaling. Dawn breaks and the call is made for "All Hands!" While the crew is raising the ship's sails, Starbuck, Stubb, and Flask talk about Ahab, whom no one has seen since the ship left Nantucket.

The crew sings of whales, wealth and home when suddenly, Captain Ahab appears. He tells them of Moby Dick, the white whale that took off one of his legs, then nails a gold doubloon to the mast and promises it to the man who first sights him. This is the real reason they have sailed, he explains: to search the globe to find and destroy this one whale. His rousing call of "Death to Moby Dick!" excites everyone but the first mate, Starbuck. To no avail, he confronts Ahab about what he sees as a futile and blasphemous mission.

Starbuck instructs Greenhorn about the dangers of whaling. When he ponders never again seeing his wife and son, he is overcome with emotion and orders Queequeg to complete the lesson. Stubb sights a pod of whales, but Ahab will not allow the eager crew to hunt since they have not yet found Moby Dick. Starbuck orders the crew to sail on and sends Greenhorn up to the lookout on the masthead, joined by Queequeg.

As the sun begins to set, Ahab looks over the wake of the ship and mourns that his obsession deprives him of any enjoyment of beauty. All is anguish to him. At the masthead, Queequeg and Greenhorn look over the world, while Starbuck, on deck, bemoans Ahab's madness.

Scenes 5 to 7. Day Two: Three months later

After three months without a single whale hunt, Stubb jokes with the young cabin boy Pip about the sharks circling the ship. The song ignites a dance for the full crew, but rising tensions take over and a dangerous racial fight erupts. When Greenhorn suddenly sights a pod of whales, Starbuck is at last able to persuade Ahab to let the men hunt. Starbuck and Stubb harpoon whales, but Flask's boat is capsized and Pip is lost at sea.

On board the Pequod, an enormous whale is being butchered and the oil rendered in the burning tryworks. Flask tells Ahab that the search for Pip is under way, but Ahab thinks only of finding Moby Dick. As they butcher the whale, the crew imagines Pip lost and struggling in the heart of the sea. Flask tells Starbuck that many oil barrels are leaking and he goes below to tell Ahab they must find a port for repairs.

Ahab is unmoved by Starbuck's report, and is concerned only with the white whale. When Starbuck refuses to leave, Ahab grabs a musket and orders him to his knees. From afar, Greenhorn shouts that Pip has been found. Ahab orders Starbuck out of the cabin.

On deck, the crew listens to Greenhorn describe how Queequeg rescued Pip. As the men return to work, Greenhorn pleads with Starbuck to get help for Pip, who has gone mad. But, the first mate ignores him. Greenhorn observes how life really works on the ship and decides to befriend Queequeg.

Starbuck returns to Ahab's cabin, where he finds the captain asleep. He picks up the musket with which Ahab had threatened him and contemplates what he should do. Pull the trigger and he may survive to see his wife and child again. When Ahab cries out in his sleep, Starbuck replaces the musket and leaves the cabin.

ACT TWO

Scenes 1-3. Day Three: One year later

An enormous storm is approaching, but Stubb, Flask and the crew sing a jolly work song. From the mastheads, Greenhorn and Queequeg talk of traveling together to his native island. Greenhorn wants to learn Queequeg's language and write down their adventures. Suddenly, Queequeg collapses. The crew gets him down and Ahab announces he will take the masthead watch himself, as he wants to sight Moby Dick first.

Below deck, Queequeg tells Greenhorn that he is dying and asks that a coffin be built for him. Pip enters from the shadows and sings a lament, joined by Greenhorn.

The massive storm now surrounds the *Pequod*. As Ahab sings defiantly to the heavens, bolts of lightning engulf the ship and the masts glow with St. Elmo's fire. Ahab demands that the men hold their posts, promising them the white flame is a sign from heaven to guide them to the white whale. The crew is inspired once again by the captain, much to Starbuck's distress.

Scenes 4 to 7. Day Four: The next morning

The ship has made it through the storm. From afar, the voice of Gardiner, captain of the *Rachel*, calls out. He pleads with Ahab to help him search for his 12-year-old son who was lost in the storm, but Ahab refuses. Pip shouts to Gardiner of the *Pequod*'s own lost boy. Pip cuts himself and gets blood on Ahab's clothes. The captain orders the ship to sail on, leaving Gardiner behind. Ahab contemplates the heartless God who devastates so many lives and baptizes his new harpoon with Pip's blood.

Below deck, Greenhorn sees Queequeg's newly built coffin and contemplates the madness that seems to surround him.

On deck, Ahab and Starbuck gaze over the horizon. Ahab describes his forty years at sea and all he has left behind. And why? To what end? He cannot say. But he sees in Starbuck's eye a human soul and it touches him deeply. Starbuck seizes the moment and persuades Ahab that they should return to the wives and sons who wait for them in Nantucket.

Just as Ahab appears to relent, he sights Moby Dick on the horizon. Great excitement ensues and the whale boats are lowered. Ahab looks again in Starbuck's eye and orders him to stay on board. The crew declares its loyalty to Ahab. During the chase, Moby Dick destroys two whaleboats in succession, drowning their crews. Then, the *Pequod* is rammed and sunk, killing all aboard. Ahab's boat is then attacked and all but the captain jump or fall off. Finally alone with the white whale, Ahab cries out and stabs at Moby Dick before being dragged down into the sea.

Epilogue: Many days later

Greenhorn floats on Queequeg's coffin, barely alive, softly singing his lost friend's prayer. Gardiner calls from afar, thinking he has at last found his missing son. Instead, he learns that Ahab and all the crew of the *Pequod* have drowned, except for this one survivor.

Name: _____ Date: _____

Moby-Dick
Activity Worksheet

Glossary

Knot: A **knot** is a unit of measure for speed. A knot is one nautical mile per hour (1 knot = 1.15 miles per hour). The term knot dates from the 17th century, when sailors measured the speed of their ship by using a device called a "common log." This device was a coil of rope with uniformly spaced knots, attached to a piece of wood shaped like a slice of pie. The piece of wood was lowered from the back of the ship and allowed to float behind it. The line was allowed to pay out freely from the coil as the piece of wood fell behind the ship for a specific amount of time. When the specified time had passed, the line was pulled in and the number of knots on the rope between the ship and the wood were counted. The speed of the ship was said to be the number of knots counted.

Mile: A **mile** (or land mile) is a unit of linear measure equal to 5,280 feet. Miles are used for measuring distances on land.

MPH: mph (miles per hour) is the imperial and U.S. customary unit of speed used to calculate the number of land miles covered in one hour

Nautical Mile: A **nautical mile** is based on the circumference of the planet Earth and is equal to one minute of latitude. It is slightly more than a land mile (1 nautical mile = 1.1508 land miles). Nautical miles are used for charting and navigating. This unit of measurement is used by all nations for air and sea travel.

Part I

Instructions: Complete the chart using the conversions given below. All answers should be rounded to the nearest hundredth.

- **1 mile per hour** (mph) = 5280 feet per hour
- **1 mile per hour** = 1.1508 nautical miles per hour
- **1 knot** = 1.15 miles per hour

	Average Weight (lb)	Average Length (ft)	Highest Miles Per Hour	Nautical Mile Per Hour	Knots	Feet Per Hour
Blue Whale	242,500	83.70	25			
Bowhead Whale	120,000	49.20	19			
Fin Whale	125,500	67.60	30			
Gray Whale	43,000	44.30	3			
Right whale	128,000	50.00	6			
Sei Whale	49,500	48.60	40			
Sperm Whale	69,000	43.50	23			

Example: If a Humpback whale is moving at 9 mph, how would you calculate the nautical miles, knots and feet per hour?

- 9 mph / 1.1508 nautical miles per hour (nmph)= 7.82 nmph
- 9 mph x 1.15 knots = 10.35 knots
- 9 mph x 5280 feet per hour = 47,520 feet per hour

Name: _____ Date: _____

Moby-Dick

Activity Worksheet

Part II

Instructions: Answer the questions below using the information from the completed chart.

1. What is the difference in nautical miles per hour between the Sei whale and Blue whale?

   _____

2. What is the average weight of the heaviest three whales listed above?

   _____

3. List the whales in least to greatest order by length.

   _____

   _____

4. Calculate the average length of all the whales. _____

5. What is the percentage of the mass for the smallest three whales in relation to the total mass of all the whales? (Round to the nearest percentage) _____

6. If a Right whale and a Fin whale were to swim to an island 45 miles away, how many hours ahead of time would the Right whale need to leave in order for both whales to make it to the island at the same time? _____

7. A Sperm whale is swimming 8 mph faster than its highest mile per hour rate listed in the chart. Using that information, answer the following questions:
   - What is the new mile per hour rate? _____
   - How many miles were swam in 4 hours? _____
   - What would be the new nautical mile per hour? _____
   - What is the difference between the knots calculated in the chart and the new knot total?

     _____

Answer Key

	Average Weight (lb)	Average Length (ft)	Highest Miles Per Hour	Nautical Mile Per Hour	Knots	Feet Per Hour
Blue Whale	242,500	83.70	25	21.72	28.75	132,000
Bowhead Whale	120,000	49.20	19	16.51	21.85	100,320
Fin Whale	125,500	67.60	30	26.07	34.50	158,400
Gray Whale	43,000	44.30	3	2.61	3.45	15,840
Right whale	128,000	50.00	6	5.21	6.90	31,680
Sei Whale	49,500	48.60	40	34.76	46.00	211,200
Sperm Whale	69,000	43.50	23	19.99	26.45	121,440

1. What is the difference between the Sei whale and Blue whale in nautical miles? 13.40 nmph

2. What is the average weight of the heaviest three whales listed above? 165,333.33 lbs

3. List the whales in least to greatest order by length.
   Sperm, Gray, Sei, Bowhead, Right, Fin, Blue

4. Calculate the average length of all the whales. 55.27 ft

5. What is the total percentage of the lightest three whales when considering the total mass of all the whales listed above? 21%

6. If a Right whale and a Fin whale were to swim to an island 45 miles away, how many hours ahead would the Right whale need to leave be in order for both whales to make it to the island at the same time? 6 hours

7. A sperm whale is swimming 8 mph faster than its highest mile per hour rate as listed in the chart. Using that information, answer the following questions:
   - What is the new miles per hour rate? 31 mph
   - How many miles were swam in 4 hours? 124 mi
   - What would be the new nautical mile per hour? 26.94 nmph
   - What is the difference between the knots calculated in the chart and the new knot considering the new miles per hour? 9.2 knots