****

**What does being Captain of a Ship have to do with Math?**

**VIDEO:** [**https://youtu.be/f0m-TLubHJs**](https://youtu.be/f0m-TLubHJs)

**Lesson Plan**

**Teacher Note:** Please preview the entire video and pre-work the solutions in order to anticipate students’ needs, misconceptions and resources unique to your classroom.

You will also need to determine the background knowledge of your students regarding the following topics, and decide the best method for providing that background in order to support the conceptual understanding of the mathematics shown in the video.

* What is a formula? Why do we use them?
* Units of distance, rate, and time

**Common Core Mathematical Content Standards**

* 6.EE.2 Write, read and evaluate expressions in which letters stand for numbers
* 6.EE.9 Represent and analyze quantitative relationships between independent and dependent variables.
* 7.EE. Use properties of operations to generate equivalent expressions
* 7.EE Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

**Common Core Mathematical Practice Standards**

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively

3. Construct viable arguments and critique the reasoning of others.

7. Look for and make use of structure

**Company Information**

**Fincantieri Marinette Marine (FMM)** was founded in 1942 along the Menominee River in Marinette, Wisconsin to meet America's growing demand for naval construction. From humble beginnings with a contract to build five wooden barges, **FMM** has grown into a world-class shipbuilder, having designed and built more than 1,500 vessels.

Parent company, **FINCANTIERI**, has recently completed a $73.5 million capital expansion program for **Fincantieri Marinette Marine** which has transformed **FMM** into a modern shipbuilding powerhouse, now with 550,000 square feet of manufacturing, warehouse and receiving space, and the capacity to simultaneously build six Littoral Combat Ships in serial production. **FMM** employs cutting-edge computer-controlled manufacturing equipment and has heavy-lift capabilities to meet the most demanding requirement.

**FMM** boasts some of the best engineering and naval architecture minds in the industry, a skilled, safe and motivated workforce, and a management team keenly focused on quality. The company is internationally recognized for innovative and highly efficient, modular, subassembly and assembly-line manufacturing techniques. This sophistication in construction methods has allowed **Fincantieri Marinette Marine** to build some of the most technologically advanced vessels on the planet.

**Fincantieri Marinette Marine’s** performance on government contracts is impressive. Its portfolio includes the U.S. Navy’s Littoral Combat Ship, the improved Navy Lighterage System, mine countermeasure vessels and ocean tugs, as well as U.S. Coast Guard icebreakers, buoy tenders and response vessels. Because of its record of delivering ahead of schedule and within contracted costs, **FMM** has a long-standing relationship with the United States Navy and United States Coast Guard.

**Fincantieri Marinette Marine** is an FOCI mitigated SSA company and is part of the **Fincantieri Marine Group**, the United States division of Italian enterprise **FINCANTIERI**, one of the world's largest shipbuilders with 20 shipyards on four different continents and employing nearly 20,000 shipbuilding professionals. The company has a history dating back 200 years and a track record of producing more than 7,000 ships.

**Summary** *How can you use the formula distance = rate x time to help you deliver your ship’s cargo on time?*

As the captain of a ship, you rely on many things to help you make decisions; your crew, your colleagues on land, and your vessel’s instrument system. What if one of those systems failed and you needed to update a customer on your arrival? This video asks you to navigate that problem situation. Good thing you understand math and can problem solve!

**Pre-Activity Discussion:**

* Review the math and science formula distance = rate x time. In this scenario, rate is described as the speed of the ship in knots.
* Discuss how units play a role in the formula (hours vs minutes, miles vs feet etc.)
* The maritime field (meteorology and aeronautical fields as well) has specific units for distance that take into account the extra distance that the curvature of the earth adds to traveling long distances. There are many explanations and visuals online that teachers could use if they wish to explore this topic further.
* Vocabulary
	+ Nautical Mile (NM) 1 NM = 1.15078 miles
	+ Knot - Rate or speed in nautical miles. 1 knot = 1 nautical mile per hour

**Differentiation:**

* Unit analysis could be used when solving the problems posed.
* How solutions involving time are written can be adjusted.
* Students may also benefit by working with others as part of a partner/group investigation.

**Part 1: (0:00 – 1:16)**

BREAK 1

* Have students explore and explain how the presenters in the video came up with their formulas for distance, speed and time.
	+ Where did the 60 come from in the 60D = ST formula that is presented? Why do the presenters include the number 60 in the calculations?
	+ What mathematical thinking/properties allow us to take the formula 60D = ST and change it to be solved for distance, solved for time and solved for speed?
* Have students use part one of student handout to document their discussion.
* Share ideas whole group.
* After discussing why these formulas work, students can then use the formulas to complete the following problems on their handout.
	+ What is the distance traveled if a ship is travelling at a speed of 10 knots for 20 minutes?
	+ How long will it take to travel 20 nautical miles at a speed of 15 knots?
	+ How fast is the ship going if it can travel 15 nautical miles in 40 minutes?
* Before showing Part 2 have students share their answers and methods.
* Discuss any errors or misconceptions in student thinking and calculations.

**Part 2: (1:18 – 1:35)**

 BREAK 2

* Problem posed:
	+ You are the captain of an offshore supply vessel whose computer has failed. Your customer wants to know how soon you can deliver the supplies. Your ship is 48 nautical miles from the customer and you are travelling at a speed of 12 knots. How soon will you be there?
* Students should use their handout to record their problem solving methods.
* Before showing Part 3 have students share their answers and methods.
* Discuss any errors or misconceptions in student thinking and calculations.

**Part 3: (1:40 –** **2:00)**

 BREAK 3

* Problem posed:
	+ The rig superintendent (customer) really needs the product your ship is carrying. If you increase your speed from 12 knots to the maximum speed of 22 knots, how much time will you save if you are still 48 nautical miles away from the customer?
	+ Why wouldn’t a vessel travel at maximum speed on every customer delivery? What factors might be impacted by increasing to the maximum speed?
* Students should use their handout to record their problem solving methods
* Before showing Part 4 have students share their answers and methods.
* Discuss any errors or misconceptions in student thinking and calculations.

**Part 4: (2:05 – 2:31)**.

**Extension:**

* How fast would you have to travel if the 48 nautical mile trip took 1.5 hours?
* Explore vessel and cargo weight and their impact on vessel speed.
* Does water temperature affect a vessel’s speed?
* Does fresh water versus salt water affect way we calculate vessel speed?
* Explore the history of naval navigation and the origins of “nautical miles” as a unit of distance.

**Student Handout - *What does being Captain of a Ship have to do with math?***

Name(s):

**Pre-Video Discussion:**  *Notes on important background information.*

**Problem:** *How can you use the formula distance = rate x time to help you deliver your ship’s cargo on time?*

**Break 1:**

**The formulas presented in the graphic were:**

**60D = ST**

**D = (ST) / 60**

**T = (60D) / S**

**S = (60D) / T**

1. Where did the 60 come from in the 60D = ST formula that is presented? Why do the presenters include the number 60 in the calculations?

2. What mathematical thinking or properties allow us to take the formula 60D = ST and change it to the other formulas listed? (Solved for distance, solved for time and solved for speed)

3. Practice with the formulas (show your solution methods)

a. What is the distance traveled if a ship is travelling at a speed of 10 knots for 20 minutes?

b. How long will it take to travel 20 nautical miles at a speed of 15 knots?

c. How fast is the ship going if it can travel 15 nautical miles in 40 minutes?

**Break 2:**

4. Problem posed: (show your solution methods)

 You are the captain of an offshore supply vessel whose computer has failed. Your customer want to know how soon you can deliver the supplies. Your ship is 48 nautical miles from the customer and you are travelling at a speed of 12 knots. How soon will you be there?

**Break 3:**

5. Problem posed: (show your solution methods)

The rig superintendent (customer) really needs the product your ship is carrying. If you increase your speed from 12 knots to the maximum speed of 22 knots, how much time will you save if you are still 48 nautical miles away from the customer?

6. Why wouldn’t a vessel travel at maximum speed on every customer delivery? What factors might be impacted by increasing to the maximum speed?

**ANSWER KEY – What does being Captain of a Ship have to do with math?**

**Break 1:**

**The formulas presented in the graphic were:**

**60D = ST**

**D = (ST) / 60**

**T = (60D) / S**

**S = (60D) / T**

1. Where did the 60 come from in the 60D = ST formula that is presented? Why do the presenters include the number 60 in the calculations?

 **Distance (miles) = rate (mph) x time (hr)**

**60 min = 1 hour**

**It changes the units of time to minutes**.

2. What mathematical thinking or properties allow us to take the formula 60D = ST and change it to the other formulas listed? (Solved for distance, solved for time and solved for speed)

 **Multiplicative Property of Equality**

3. Practice with the formulas (show your solution methods)

a. What is the distance traveled if a ship is travelling at a speed of 10 knots for 20 minutes?

 **3.33 nautical miles**

b. How long will it take to travel 20 nautical miles at a speed of 15 knots?

 **80 minutes**

c. How fast is the ship going if it can travel 15 nautical miles in 40 minutes?

 **22.5 knots**

**Break 2:**

4. Problem posed: (show your solution methods)

 You are the captain of an offshore supply vessel whose computer has failed. Your customer want to know how soon you can deliver the supplies. Your ship is 48 nautical miles from the customer and you are travelling at a speed of 12 knots. How soon will you be there?

 **240 minutes**

**Break 3:**

5. Problem posed: (show your solution methods)

The rig superintendent (customer) really needs the product your ship is carrying. If you increase your speed from 12 knots to the maximum speed of 22 knots, how much time will you save if you are still 48 nautical miles away from the customer?

 **240 minutes - 130.91 minutes = 109.09 minutes saved.**

6. Why wouldn’t a vessel travel at maximum speed on every customer delivery? What factors might be impacted by increasing to the maximum speed?

 **crew and vessel safety, fuel costs, cargo stability, weather conditions**