

TEACHING NOTES

Fred Pasquale: Shipping Paper

Appropriate Grade Levels: 6 – 8

Implementation Time:

One class period (45 minutes to one hour) required for basic exercise and for students to begin work on their written assignment.

An additional class period may be desired to debrief students.

Materials Needed:

Teaching notes for “Fred Pasquale” case study

Student copies of “Fred Pasquale”

Notepaper for students to use when calculating answers and writing their assignment

Career Pathway: Business & Management

Subject Area: Mathematics

Learner Outcome(s): What will happen for learners as a result of this lesson?

Students will explore a career opportunity in international trade. They will use problem solving approaches to investigate and understand mathematical content. They will develop and apply a variety of strategies to solve a multistep, nonroutine problem. They will use their reading and listening skills to interpret and evaluate mathematical ideas. And they will demonstrate their knowledge of the pervasive use and power of reasoning as part of mathematics.

Washington State Essential Academic Learning Requirements: How will students learn?

- **Mathematics:** Students will demonstrate their ability to perform basic mathematical operations on rational numbers, including their ability to work with percentages and ratios; will demonstrate their ability to use mathematics to investigate a problem; will organize and interpret relevant information from multiple sources; will use reading, listening, and observation skills to access and extract mathematical information; and will investigate the use of mathematics within a career context. (EALR's 1.1, 1.4, 2.1, 2.3, 3.1, 4.1, 5.3)
- **Communication:** Students will demonstrate listening and observation skills to gain understanding; will practice communicating ideas clearly and effectively; will demonstrate communication strategies and skills to work effectively with others; and will analyze how communication is used in career settings. (EALR's 1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 4.4)
- **Writing:** Students will practice writing clearly and effectively. Students will practice writing for career applications, producing technical and non-technical documents using resources from career settings. (EALR's 1.1, 1.2, 1.3, 2.4)

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Washington Assessment of Student Learning (WASL). *How will students' learning be assessed?* This lesson plan is designed to help prepare students for the 7th grade WASL exams in reading, writing, and mathematics. The math problems are designed to be similar to story problems the students will encounter on the WASL; similarly, the written assignment will help students hone their abilities to respond to a persuasive writing prompt.

Procedure:

This lesson is designed to be taught in one or two sessions.

1. *For session one*, distribute the students' version of the "Fred Pasquale" case study to your class. Have the students work alone or divide them into groups of two or three.
2. Read aloud to them or let them read one section of the case study at a time. Don't let them read ahead. After each section, either ask the students to brainstorm the answer to the question they have been asked or distribute the worksheets and have them proceed through the worksheets to answer the questions.
3. Finish by giving students the remainder of the class period to begin the written assignment, the paper for Fred's boss. Answer keys for all worksheets and the written assignment are included with these teaching notes.

Closure/Assessment:

Review students' written work both for basic writing skills as well as for students' ability to explain the steps Fred took in calculating the costs of various shipping methods, and for students' ability to synthesize this information into a coherent explanation for Fred's boss.

Then, in small groups or as a whole group, have students review the steps they should follow when they are confronted with a problem and don't have enough information to decide what to do. Ask them to share personal experiences of having to gather information to solve a problem. What did they do? How did they use the information they gathered? What did they do right or wrong? What would they do if they were confronted with the same problem today?

Fred Pasquale: Shipping Paper

Part One - *Read to the bottom of this page then stop.*

Fred Pasquale had numbers whirling around his head. He had a problem to solve, and needed to figure it out fast.

Fred Pasquale was the Transportation Manager for Port Townsend Paper Corporation. That meant he was responsible for getting supplies in and finished paper products out of the paper mill his company owned and operated in Port Townsend, Washington.

The Port Townsend Paper Corporation's mill had been built in 1918, and was designed to ship most of its products by railcar and barge to customers within the United States. During the last 15 years, however, things had changed. For one thing, the company's customer base had changed dramatically. Now, a full 60% of its products were shipped to Asia. With the change in customers, the railroad had been removed. Thus, in terms of shipping finished products out of the mill, Fred had two choices: (1) He could load his product on barges and have it sent to Seattle to be put into cargo containers and then shipped to Asia. (2) Or, he could have cargo containers filled at the mill, trucked to Seattle, and then shipped.

But shipping wasn't Fred's problem right now. Storage was. Except that storage affected shipping. As the mill had been modernized, its production capabilities had increased dramatically, but its storage hadn't. The mill could produce either 500 metric tons (MT) of kraft paper (for paper bags) or 1,000 metric tons (MT) of kraft linerboard (for boxes) each day. Usually, for efficiency, the mill would produce paper for seven days and then linerboard for seven days.

But, the mill only had storage space for 1,000 MT. So, on weeks when the mill was producing linerboard, the mill ran out of storage quickly. And that meant that Fred had to figure out how to ship more linerboard out of the mill more quickly.

STOP

Fred Pasquale: Teaching Notes for Part One

Make sure students understand Fred 's role and his job.

Then, make sure students understand Fred 's problem. Ask students what they would do if they were in his shoes.

Then, prompt the students to discuss what Fred needs to know to solve the problem.

He needs to know how much he can ship with each shipping option – trucking and barging – and how much it costs.

Part Two - Read to the bottom of this page then stop.

Fred looked at the numbers again. He had to tell his boss which type of shipping he would recommend for the linerboard. He wanted to recommend the least expensive option to his boss. He thought about what he knew about each shipping option.

Trucking. When linerboard was trucked out of the mill, it had to be loaded into cargo containers. The cargo containers were then trucked to Seattle where they could be loaded directly on to container ships. Each container could hold 25 MT of linerboard. The mill had two people employed as paper loaders. Each of them was paid \$25/hour and each of them could load a cargo container in one and one-half hours. Then, it cost \$405 to hire a trucking company to take the cargo container to Seattle.

Barging. When linerboard was barged out of the mill, it was first loaded onto a flat barge. The barge was towed to Seattle where the linerboard would then be loaded into cargo containers, which were then loaded onto a container ship. The mill's two paper loaders, working together, could load a barge with 2,000 MT of linerboard in 12 hours. (A barge could not be shipped with less than 2,000 MT.) It then cost \$12/MT to tow the barge to Seattle and \$6/MT to load the linerboard into cargo containers.

Fred decided to figure out the cost of each shipping option for 1,000 MT of linerboard. Then he could decide which was cheapest.

STOP

Fred Pasquale: Teaching Notes for Part Two

Teachers: *There are two choices for solving the problem posed in Part Two:*

- (1) Have your students calculate the answers by working from the “story problem” information given in the case study. You can have them solve the problem as a whole group, in small groups, or individually. If students are working in groups or by themselves, ask them to clearly document each step they take and calculation they make in solving the problem so that you can track their work.*
- (2) Alternatively, if you would prefer to have students receive a little more guidance as they proceed through the calculations, please copy and distribute the worksheet which is found on the following page. (An answer key follows.)*

Fred Pasquale's Shipping Worksheet

The cost of trucking for 1,000 MT of linerboard.

1. To load 25 MT into a cargo container, requires one worker, who is paid \$25 per hour, to work for 1.5 hours. $1 \times 1.5 \times 25 = \underline{\hspace{2cm}}$.
2. It then costs \$405 to transport the cargo container to Seattle.
3. The total cost to load and transport a cargo container is $\underline{\hspace{2cm}}$.
(Hint: Add the answer to #1 with the cost in #2.)
4. If that is the cost to truck 25 MT of linerboard, the cost to truck 1,000 MT of linerboard is $\underline{\hspace{2cm}}$. (Hint: How many times does 25 go into 1,000?)

The cost of barging for 1,000 MT of linerboard.

1. To load 2,000 MT onto a barge, requires two workers for 12 hours. Each worker is paid \$25 per hour. $2 \times 12 \times 25 = \underline{\hspace{2cm}}$.
2. Towing the barge to Seattle costs \$12/MT. $12 \times 2000 = \underline{\hspace{2cm}}$.
3. Loading the linerboard into cargo containers in Seattle costs \$6/MT. $6 \times 2000 = \underline{\hspace{2cm}}$.
4. The cost to barge 2,000 MT of linerboard is $\underline{\hspace{2cm}}$. (HINT: 1 + 2 + 3)
5. If that is the cost to barge 2,000 MT of linerboard, the cost to barge 1,000 MT of linerboard is $\underline{\hspace{2cm}}$.

Which shipping option is cheaper?

Trucking costs $\underline{\hspace{2cm}}$ per 1,000 MT.

Barging costs $\underline{\hspace{2cm}}$ per 1,000 MT.

Fred Pasquale's Shipping Worksheet – ANSWER KEY

The cost of trucking for 1,000 MT of linerboard.

2. To load 25 MT into a cargo container, requires one worker, who is paid \$25 per hour, to work for 1.5 hours. $1 \times 1.5 \times 25 = \underline{\$37.50}$.
2. It then costs \$405 to transport the cargo container to Seattle.
3. The total cost to load and transport a cargo container is \$442.50.
(Hint: Add the answer to #1 with the cost in #2.)
4. If that is the cost to truck 25 MT of linerboard, the cost to truck 1,000 MT of linerboard is \$17,700. (Hint: How many times does 25 go into 1,000?)

The cost of barging for 1,000 MT of linerboard.

1. To load 2,000 MT onto a barge, requires two workers for 12 hours. Each worker is paid \$25 per hour. $2 \times 12 \times 25 = \underline{\$600}$.
2. Towing the barge to Seattle costs \$12/MT. $12 \times 2000 = \underline{\$24,000}$.
3. Loading the linerboard into cargo containers in Seattle costs \$6/MT. $6 \times 2000 = \underline{\$12,000}$.
4. The cost to barge 2,000 MT of linerboard is \$36,600. (HINT: $1 + 2 + 3$)
5. If that is the cost to barge 2,000 MT of linerboard, the cost to barge 1,000 MT of linerboard is \$18,300.

Which shipping option is cheaper?

Trucking costs \$17,700 per 1,000 MT.

Barging costs \$18,300 per 1,000 MT.

Part Three - Read to the bottom of this page then stop.

Fred now had a good idea what each of his shipping options cost. It was clear that trucking was less expensive than barging. But, he had the nagging feeling he hadn't necessarily solved his storage problem.

If each of his paper loaders could fill a cargo container with 25 MT of linerboard in one and one-half hours, how many tons could they load if both of them worked at top speed for a full twelve-hour day? Could they load enough linerboard each day to solve Fred's storage problem?

Fred realized that to solve his storage problem, he had to find a shipping option that would allow him to ship 858 MT of linerboard a day. Fred had calculated the 858 MT-a-day figure by realizing that if the mill produced 1,000 MT of linerboard each day for seven days, he had approximately 142 MT of storage capacity each day. That is, if he stored 142 MT of linerboard each day and shipped 858 MT of linerboard each day, his storage shed would be completely full by the end of the week. The storage shed could then be emptied during the following week when the mill was producing 500 MT of paper each day.

Was trucking more or less expensive than barging if he needed to ship at least 858 MT of linerboard a day?

STOP

Fred Pasquale: Teaching Notes for Part Three

Again, you can lead students through the problem-solving requested in Part Three either with or without the following worksheet. Answer key follows the worksheet.

Fred Pasquale's Shipping Worksheet – Page Two

The cost of trucking if at least 858 MT of linerboard must be shipped each day.

1. To load 25 MT into a cargo container, requires one worker for 1.5 hours who is paid \$25 per hour. One worker, working at top speed for 12 hours can load _____ metric tons. (*Hint: Calculate how many tons one worker can load in 3 hours. Then multiply that number by 4 to get the number of tons a single worker can load in 12 hours.*)
2. The paper mill has two people who work as paper loaders. If both of these people work at top speed all day for 12 hours, how many tons can they load total? _____
3. Is this enough to meet Fred's goal of 858 MT per day? _____
4. If it is not, how many ADDITIONAL workers must Fred hire to meet his goal? (NOTE: It is OK to hire a worker for less than a full day, but each worker must work at least six hours a day). _____ (*Hint: Take the number of tons the two existing workers can load. Then add to this number the amount one more person could load, the amount two more people could load... and so on until you have reached at least 858 MT*)
5. Fred must pay each additional worker \$25 per hour. So, to ship 858 MT of linerboard each day by truck will cost an additional: _____ new workers x 12 hours x \$25/hour = _____.
6. The NEW cost of trucking 1,000 MT if the work must be done fast enough to make Fred's goal of 858 MT/day is: _____ (original cost of trucking) + _____ (additional cost for loaders) = _____.

Which shipping option is cheaper now?

Trucking costs _____ per 1,000 MT.

Barging costs _____ per 1,000 MT.

Fred Pasquale's Shipping Worksheet – Page Two – ANSWER KEY

The cost of trucking to ship at least 858 MT of linerboard each day.

7. To load 25 MT into a cargo container, requires one worker for 1.5 hours who is paid \$25 per hour. One worker, working at top speed for 12 hours can load 200 metric tons. (*Hint: Calculate how many tons one worker can load in 3 hours. Then multiply that number by 4 to get the number of tons a single worker can load in 12 hours.*)
8. The paper mill has two people who work as paper loaders. If both of these people work at top speed all day for 12 hours, how many tons can they load total? 400
9. Is this enough to meet Fred's goal of 858 MT per day? NO
10. If it is not, how many ADDITIONAL workers must Fred hire to meet his goal? (NOTE: It is OK to hire a worker for less than a full day, but each worker must work at least six hours a day). 2.5 (*Hint: Take the number of tons the two existing workers can load. Then add to this number the amount one more person could load, the amount two more people could load... and so on until you have reached at least 858 MT*)
11. Fred must pay each additional worker \$25 per hour. So, to ship 858 MT of linerboard each day by truck will cost an additional: 2.5 new workers x 12 hours x \$25/hour = \$750.
12. The NEW cost of trucking 1,000 MT if the work must be done fast enough to make Fred's goal of 858 MT/day is: \$17,700 (original cost of trucking) + \$750 (additional cost for loaders) = \$18,450.

Which shipping option is cheaper now?

Trucking costs \$18,450 per 1,000 MT.
Barging costs \$18,300 per 1,000 MT.

Part Four - *Read to the bottom of this page then stop.*

Well, Fred realized, it was kind of a toss-up. But barging was slightly cheaper than trucking when all things were considered. He decided he would recommend to his boss that the mill use barges to ship the linerboard to Seattle.

Fred decided to write a one-page paper to his boss outlining the problem and how he proposed to solve it.

His paper would have four paragraphs:

The Problem. Fred would define the mill's storage problem and show his boss the number of metric tons of linerboard he needed to ship each day.

Trucking. Fred would quickly summarize the costs involved in trucking that much linerboard.

Barging. Fred would then summarize the costs involved in barging the linerboard. For both shipping options, he would quickly describe to his boss the steps that were involved in shipping the product that way.

Conclusion. Fred's recommendation. In addition to the recommendation he has to make, are there any other options the company should be looking at?

Fred Pasquale: Teaching Notes for Part Four

Discuss with students how Fred should best present the information he has collected. Is his choice clear-cut? Are there any other options he hasn't looked at yet? (For instance, students might note that Fred should investigate the cost of building a bigger storage shed.)

Then ask students to write the one-page paper described in Part Four. Ask them to label each section of their paper as suggested above, and to write at least one paragraph of at least four to six sentences in each section.

An answer key follows. As you evaluate students' work, note their ability to write clearly and coherently, using good sentence structure, grammar, and connections between ideas. Note also students' ability to explain both the problem and the steps they took to understand and then solve it.

After students turn in their papers, you may want to ask several students to read their work out loud to the entire class or in small groups. Then, you may want to have students discuss how they could best communicate the information to Fred's boss. Should they use graphs? Pictures? A chart with numbers? Or do they think they can clearly explain the problem and solution in words?

Fred Pasquale Paper – ANSWER KEY

The Problem. *The Port Townsend Paper Company typically produces kraft paper for seven days, producing 500 metric tons (MT) each day. Then, it produces linerboard for seven days, producing 1,000 MT each day. These production levels are a significant increase over what the mill was able to produce in the past. Because the mill has only 1,000 MT of storage space, it quickly runs out of storage space during the weeks when it produces linerboard. Thus, PTPC staff have evaluated shipping options to determine the costs and benefits of shipping linerboard out of the mill more quickly.*

Trucking. *When trucks are used to ship finished linerboard, we load linerboard into cargo containers and truck the containers to Seattle. They are then loaded onto container ships to be sent to Asia. Trucking linerboard costs an average of \$17,700 per 1,000 MT. However, to load the cargo containers fast enough to ship enough linerboard by truck to avoid a storage problem, we will have to hire 2.5 additional paper loaders. When the cost of their wages is considered, the cost of trucking rises to approximately \$18,450 per 1,000 MT.*

Barging. *When barges are used to ship finished linerboard, we load linerboard onto barges and tow them to Seattle. In Seattle, the linerboard is transferred into cargo containers and the containers are then loaded onto container ships. With the cost of labor, towing, and reloading, the cost of barging averages \$18,300 per 1,000 MT. Because we can load the barges more quickly than we can load cargo containers, we will not need to hire any additional employees to solve our storage problem through barging.*

Conclusion. *Barging appears to be the most cost-effective way to solve our storage problem. However, we may wish to investigate the cost of adding new storage space by the mill for times when we want to keep extra linerboard on stock at the mill.*