

Title: Working with Ratios, Rates, and Conversions

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Externship Business: [Verso Corporation](#)

Overview / Description:

While touring the central lab area at Verso Corporation, the environmental engineers gave an example of how they use mathematics within their job responsibilities. Verso is mandated to complete environmental reports showing they meet the state environmental standards. Often times when data is collected, it is not in the proper units that the state reports require. This was something that both the environmental engineer and co-op engineer were working on--properly converting rates that are specified for the reports. Students will experience finding unit rates and using conversion factors to convert measurements and rates into alternate units of measure.

Subject(s):

Mathematics

Grade Level(s):

Algebra I (Grade 8-12)

Learning goals/objectives:

After completing this activity, students should be able to:

- Develop an understanding of ratios and rates
- Find unit rates to compare quantities
- Successfully use conversion factors to convert measurements and rates into different units of measure

Type of Activity:

- ✓ Individual
- ✓ Small Group
- ✓ Whole Class

Teaching Strategies:

- ✓ Discussion
- ✓ Partner work

- ✓ Performance Assessment
- ✓ Other . . . exit ticket

Content Standards

Model Academic Standards for School Counseling

Academic Development Domain

Content Standard C: Students will understand the relationship of academics to the world of work, and to life at home and in the community.

- Core Performance Standard 1: Understand how to relate school to life experiences.

Career Development Domain

Content Standard H: Students will understand the relationship between educational achievement and career development.

- Core Performance Standard 1: Attain educational achievement and performance levels needed to reach personal and career goals.

Wisconsin Standards for Mathematics

Number and Quantity

Quantities - Reason quantitatively and use units to solve problems.

N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.

Length of Time and length of class periods:

Two class periods of 50 minutes

Materials List:

- Calculators
- Conversion Reference sheet (please use one from your textbook or make use of a variety of online references with conversions from metric to standard)
- Worksheet
 - [Practice on Converting Rates](#)
- [Exit Tickets](#)
- [Completing a State Report by Converting Rates Quiz](#)

Directions (Step-by-Step):

1. Warm up: briefly review ratios, ask for examples of ratios, and explain that a ratio can be thought of as a multiplicative relationships. For example: if the ratio of the number of pencils to the number pens is 2:1, then the number of pencils is two times the number of pens.
2. Define:

- a. rate--a ratio that compares quantities measured in different units
- b. unit rate--a rate with a denominator of 1 unit
3. Provide examples for comparing unit rates.
4. Define:
 - a. conversion factor--a ratio of two equivalent measures in different units
 - b. dimensional analysis--the process of including units for each quantity in the calculations
5. Provide multiple examples for converting rates (See [Khan Academy video](#))
6. Break students into groups of 2 or 3. Have student work together on the [Practice on Converting Rates worksheet](#). Circulate room offering support when needed.

Wrap-Up:

1. Reconvene as a whole and correct worksheet. Provide any additional instruction to resolve any misconceptions and answer any questions.
2. Prepare students for summative assessment the next day.
3. Hand out [Exit Tickets](#) to students.

Formative/Summative Assessment:

- Formative assessment will take place on the first day through discussions, teacher questioning, and observation of small group work. It will also occur with the analyzing of the [Exit Tickets](#).
- A summative assessment will be given the next day - [Water Limits for a State Report](#).

Extension Activity for differentiation:

- Discuss how dimensional analysis is used within the science classroom. Gather supplemental material (worksheets/activities) from the science teacher to use within the math classroom.
- Provide option for Khan Academy or other websites to use as a resource.
 - www.khanacademy.com
 - [Converting Rates from One Unit to Another](#)
 - [How Do You Convert a Rate To A Unit Rate? | Virtual Nerd](#)
- AACT (American Association of Chemistry Teachers) has a great supplementary lesson for teachers who are members of AACT. The lesson is password protected for members at <https://teachchemistry.org/classroom-resources/chemistry-is-out-of-this-world>

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Practice on Converting Rates

1. $9 \text{ gal/s} = \underline{\hspace{2cm}} \text{ qt/min}$

2. $12 \text{ mi/hr} = \underline{\hspace{2cm}} \text{ m/min}$

3. $16 \text{ dollars/hr} = \underline{\hspace{2cm}} \text{ cents/min}$

4. $8 \text{ m/s} = \underline{\hspace{2cm}} \text{ ft/s}$

5. $2 \text{ fl oz/min} = \underline{\hspace{2cm}} \text{ gal/hr}$

6. $26 \text{ mi/gal} = \underline{\hspace{2cm}} \text{ km/L}$

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Water Limits for a State Report

At the local paper mill there is a waste water treatment plant on site. Water is cleaned before it is put back into a nearby river. The Michigan Department of Environmental Quality set a limit for the local paper mill of 22.5 million gallons of water per day. In the table below, daily water rates were collected and recorded for one week. Express the following rates in gallons per day so it is ready for the state report.

Time collected	gals/min	gals/day
Sunday 10 pm	25,500 gal/15 min	1)
Monday 9 pm	833,400 gal/45 min	2)
Tuesday 9 pm	53,400 gal/30 min	3)
Wednesday 9:30 pm	16,660 gal/10 min	4)
Thursday 10 pm	20,325 gal/15 min	5)
Friday 9:30 pm	38,000 gal/20 min	6)
Saturday 9 pm	50,340 gal/30 min	7)