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| **Lesson Title**: Ratios, Proportions & Percents  **Created by:** Kathleen DeMars | | | **NRS Level of Lesson:** NRS 4 |
| **Intended Modality:** (check all that apply)  **x** In-person □ Virtual □ Hybrid | | | |
| **Content Area(s)** | **Targeted** [**IL ABE/ASE Content Standards**](http://www.excellenceinadulted.com/resources/abease-curriculum-project/) | | |
| **4.RP.3 (MWOTL)** | Recognize and represent proportional relationships between quantities  b. Identify the constant of proportionality (unit rate) in equations and verbal descriptions of proportional relationships.  c. Represent proportional relationships by equations. | | |
| **4.RP.1b (MWOTL)** | Use ratio and rate reasoning to solve real-world and  mathematical problems: solve unit rate problems including those using pricing | | |
| **Integrated** [**Essential Employability Skills**](https://www.illinoisworknet.com/DownloadPrint/ILEssentialEmployabilitySkills-Handout.pdf) |  | | |
| **x** Personal Ethic *(Integrity, Respect, Perseverance, Positive Attitude)* | | | | □ Teamwork *(Critical Thinking, Effective & Cooperative Work)* |
| □ Work Ethic *(Dependability, Professionalism)* | | **x** Communication *(Active Listening, Clear Communication)* | |
| **Lesson Objectives *(Students will be able to)****:*   * Students will be able to articulate ratios using fractions and colons. * Students will be able to construct a proportion with a missing quantity or percent. * Students will be able to solve a proportion to find a missing quantity or percent and they can apply this ability to solve to real world situations. | |  | |
| **Engagement is not “one size fits all.” How are you providing multiple ways to engage all learners? Click on** [**Multiple Means of Engagement**](https://udlguidelines.cast.org/engagement) **to learn more about providing options for learners and explain how you are including this below:**   * We will **optimize relevance, value, and authenticity** by discussing how ratios, proportions, and percents are used in our real lives. * We will **foster collaboration and community** by offering the opportunity for peer supports while working. Students may work together to solve problems during our application activity. * We will **facilitate personal coping skills and strategies** by recognizing and acknowledging the challenge of the material. We will also engage in metacognition by asking ourselves, “what is our brain telling us to do first, second, etc.?” | | | |
| **Key Vocabulary**:  **Ratio-** A **ratio** is a relationship between amounts or quantities.  **Proportion-**A **Proportion** is an **equation** where two ratios are set to equal one another. We use proportions to solve for unknown amounts, like percentages!  **Percent-**A percent is a fraction of a number out of 100. When we discuss percents, 100 is the whole that the percent is out of. | | | |
| **Instructional Materials:**  Textbooks or online curriculum: Google slides with notes and application activity. Both created by Kathleen DeMars (2022).  Websites: none | | | |
| **Lesson Activities:**  **Slide 2:** *First, use direct instruction to clearly define a ratio. A ratio is the relationship between two amounts. It can be represented as a fraction or as two numbers separated by a colon. In the next four slides, students will practice identifying and naming ratios.*  **Slide 3:** *The order of the ratio is important. The question asks students to find the ratio of red to yellow circles. This means that the red circles must come before the yellow circles in our ratio. It is important to emphasize this to students.*  ***Questions to ask might include:*** *“What order should the ratio be in? Which should come first, the number of yellow or the number of red? What in the directions lets you know?*  **Slide 4:** *Notice that the number of red circles came before the number of yellow circles.*  **Slide 5:** *The ratio of skateboards to borders is 4:5 or ⅘. Note: this does not ask students to give any particular direction of relationship, so it would be okay if students showed this as 5:4 or 5/4 so long as their accompanying sentence indicated boarders to boards instead of boards to boarders.*  **Slide 7:** *Most students will be familiar with the idea that a percent is out of 100. However, it is important that this is stated clearly. Students need to know that a percent can be represented as a quantity over 100 in fraction form. This will guide them toward solving percentage problems using proportions.*  ***Ask students:*** *What fraction could we use to represent 75%? How about 98%? Students should be able to say 75/100 and 98/100. Emphasize that the x/100 is the same as the percentage %*  **Slide 8:** *It is important to clearly define a proportion. Use repetition. Encourage students to write down the definition. Remind students that a ratio can be written as a fraction and a proportion sets two ratios equal to one another.*  *IS over OF equals X over 100 is a helpful way to remember how to set up the proportion for a percent, which is coming next. Tell students that the x over 100 is how we usually think of a percent. 81/100 = 81% for example. The proportion allows us to take a smaller total and score and relate it to our common understanding of percents out of 100.*  **Slide 9:** *In this slide we are going to guide students through setting up a percentage proportion. First we ask the question, what percent is 40 of 160. Draw students’ attention to the language “is” and “of.”. Is over of equals x over 100 where x over 100 is the percentage like we discussed in the previous slide.*  ***Ask students:*** *why does the 40 goes over the 160 and not the other way around?*  ***Answer:*** *The proportion needs to be equivalent across the equals sign. The 40 is the piece of the whole and the 160 is the whole just like the x is the piece of the whole and 100 is the whole. They need to match up!*  **Slide 10:** *The first step in solving for an unknown value in a proportion is to cross multiply. This means we multiply 160 times x to give us 160x and 40 times 100 to give us 4,000. This is set up as an algebraic equation. 160x = 4000.*  **Slide 11:** *Here, we can see how the proportion turns into an algebraic equation.*  *Next, we use our understanding of inverse operations to isolate x by itself on one side of the equals sign. To do this, we divide both 160x and 4000 by 160. This gives us a quotient of x = 25.*  ***Remember:*** *X is not JUST 25. X is 25%. We were solving for the percentage and used our knowledge that a percent is an amount out of 100 to set up an equivalent proportion and solve for x.*  *The answer is 40 is 25% of 160*  **Slide 12:** *Here, students are given a proportion that is already set up. This time we are not solving for a percent, we are simply solving for a missing value. The steps are the same.*  *This slide explicitly scaffolds the steps for students and it should be clearly instructed with repetition: 1. Cross Multiply 2. Solve the algebraic equation to find x.*  **Slide 13:** *Here, we can see that the proportion becomes the equation 3x = 72*  *Ask the students: What should I do next?*  *Likely Answer: Divide by 3… ask students to clarify - divide WHAT by 3? Why should I divide by three? Answer: because 3x means 3 times x and the opposite of multiply is divide so we have to divide to get x by itself. Guide students toward explaining their thinking about inverse operations. You may ask them, “what math vocabulary tells us that multiplication and division are opposite? Answer: inverse operations.*  **Slide 14:** *Our next slide shows the division that we talked about on the previous slide. This is here to cement the students’ thinking and show them how the proportion unfolds.*  *Ask students: What does, “isolate the variable” mean?*  *Answer: this means to get the unknown amount alone on one side of the equals sign. We want to do this because then we will know that whatever is on the other side of the equals sign is the value of the unknown variable.*  *USE THE MATHEMATICAL LANGUAGE. Explain it while you use it but use it so that students gain comfort speaking as a mathematician.*  **Slide 15:** *Give students a few minutes to set up their proportions on their own.*  **Slide 16:** *Before students continue to solve the equation fully, pause to make sure that their proportions make sense. Price to price (top) and quantity to quantity (bottom).*  *Once the proportion is established, encourage the students to take the next step and set up the algebraic equation.*  **Slide 17:** *This slide shows how we have moved from proportion to algebraic equation by using cross multiplication.  Once students have set up the equation, encourage them to use their background knowledge to solve for x.*  **Slide 18:** *Students should have come up with a decimal of 3.557… using their calculators. Remind students that this problem was asking for a price. When we talk about money, we can talk about dollars and cents. In our monetary system, cents to the hundredths place value so that is how far our answer can go.*  *Ask students: How can we make our answer look like money? What do we need to do?*  *Answer: Round*  *Follow up: What place value should we round to?*  *Answer: Hundredths place. Students might answer “pennies.” If they do, relate that to the second place value to the right of the decimal by asking, “what decimal place value is pennies?”*  **Slide 19:** *Read the prompt out loud. Encourage students to set up their proportion first. Then, be quiet and let them work for a few minutes.  Once they seem to be finished, ask them to share what they did. They might come to the board or explain from their seats.*  **Slide 20:** *Show students this after they’ve explained what THEY did on their own. Verbally walk through each step.*   1. *Cross multiply* 2. *Set up algebraic equation* 3. *Use inverse operation to divide isoloating x on one side of the quals sign* 4. *X = 20 penalties in 60 minutes. Always relate the answer back to the problem. Ask yourself, “does this make sense?”*   **Slide 21:** *Do not read the question out loud and do not prompt students to set up their proportion on their own first. LET THEM DO IT ALL BY THEMSELVES.*  *When most seem finished, repeat the process from the last problem asking them what they did*   1. *Set up the percent proportion* 2. *Cross multiply to get the algebraic equation* 3. *Use inverse ops to divide and isolate the variable* 4. *The variable = the percent.*   *NOTE: Students will have had to round to the nearest whole number.*  **Slide 22:** *Share this step-by-step approach to the problem.*  *Finally, distribute the application classwork assessment and collect to get a snapshot of each student’s understanding of this concept.*  **Slide 23:** *Pass out the application worksheet. Use this to assess your students' understanding of the core concepts from the lesson. Allow them to work together if they’d like. We learn by teaching others, so explaining steps to each other can be helpful in solidifying the content.* | | | |
| **Learners vary in the way that they react to and grasp information that is presented to them. Click on** [**Multiple Means of Representation**](https://udlguidelines.cast.org/representation) **to explore ways that you can provide options for representing content and explain how you are including this below:**   * We will **activate or supply background knowledge** by explicitly connecting to prior knowledge of fractions. We will use relevant analogies and metaphors to connect content to real-world experience. * We will **highlight syntax and structure** by making connections to previously learned structure of fractions and by being explicitly about the structure of ratios compared to fractions and percents represented as fractions. * We will **offer ways of customizing the display of information.** This can be accomplished by providing our slides as notes that students may have at their seats to write on. The instructor can also slow the pace of content delivery and they may repeat key ideas several times and allow for auditory processing to occur. * We will **clarify vocabulary and symbols** by pre-teaching the vocabulary and symbols that correlate with that vocabulary, especially relating to percentages. | | | |
| **Performance Tasks:**  The students should complete the accompanying application activity with six questions allowing them to apply the skill they’ve learned in the lesson. This can be done independently or with a partner or small group. Discussion and group learning is encouraged. This is a formative assessment.  Additionally, there is a quiz that may be used with this lesson. It is not recommended that the quiz be administered during the lesson. It is meant to be a summative assessment. | | | |
| **Learners best express what they know in different ways. Click on** [**Multiple Means of Action & Expression**](https://udlguidelines.cast.org/action-expression) **to explore ways to offer options for learners and explain how you are doing this below:**   * We will **build fluencies with graduated levels of support for practice and performance** through our application activity. The application activity will increase in complexity and will allow students to apply what they’ve learned in a graduated way. Additionally, the direct instruction allows students to start at the beginning and scaffold idea upon idea with growing complexity before attempting to work independently and in a small group. * We will **enhance capacity for monitoring progress** during our direct instruction. We will use metacognitive language to think about what we should do first, second, next, last, etc. and we will discuss our thinking out loud as a class multiple times. This language of asking ourselves what to do first is echoed in the application activity. | | | |
| **Notes:**  **Math Practice(s) taught and practiced by students:**  **MP1:** Make sense of problems and persevere in solving them. See relationships between various representations.  **MP2:** Reason abstractly and quantitatively. Ability to represent a problem symbolically and make sense of symbols in a problem.  **MP6:** Attend to precision. Calculate efficiently and accurately. Communicate precisely with others and try to use clear mathematical language. | | | |