Activity 3:
Teachers' guide

Thinking through a lesson protocol

Standards:

6.RP.A.3.C: Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.

7.RP.A.3: Use proportional relationships to solve multistep ratio and percent problems.

Mathematical Practices:

MP1: Make sense of problems and persevere in solving them.

MP2: Reason abstractly and quantitatively.

MP3: Construct viable arguments and critique the reasoning of others.

Setting up the problem - Launch	
Selecting tasks/goal setting	(5 minutes) Briefly discuss or ask students in a whole group setting for experiences they have had in shooting free throws and finding percentages. Other sports percentages could be included in this discussion. Then have students read individually the text stopping at Question #1. With a partner talk about what you think is the big idea in the reading and discuss what information is reported in Table 1.
Questions	How could we check to see if the percentages in Table 1 have been calculated correctly? Why do you think percentages are used instead of a decimal or a fraction?

Monitoring student work - Explore		
Strategies and misconceptions-Anticipating	**Who - Selecting and sequencing**	**Questions and statements - Monitoring**
(20 minutes) Have students answer questions # 1-7 on their own. Share out the results of questions #1-7. Students share out different strategies.		How can you justify each of your answers using information from the table? Teacher may wish to spend some time making sure that students understand the strategies explained.
Monitor student work and check for understanding as the group's progress. Have students read individually the Daniella Free Throw Shooting section and review Table 3.		Discuss how information is recorded in Table 3. What information does the table provide?
Have students solve questions #8-13 in small groups. Share strategies used with whole group.		While sharing out be sure to watch for students that may have used a correct strategy for solving but misread or miscounted information from the table and therefore have a different answer than others.

Monitoring individual student work - Explore		
Strategies and misconceptions-Anticipating	**Who - Selecting and sequencing**	**Questions and statements - Monitoring**
For off-task students or for students that seem to be self-conscious about you listening to them share.		I am just listening or looking to find out how you are working on the problem. This helps me think about what we will do later. What do you think is the Big Idea in the reading?
For students that appear to be stuck. Also for when you are having a difficult time understanding their strategies.		Can you tell me a little about your reading? How would you describe the problem in your own words? What facts do you have? What information do you have in the table? Could you try it with simpler numbers? Fewer numbers?
For students that want to ask you questions, these are ways to uncover their thinking and judge to what extent you want to respond.		Tell me what you've thought about so far. What do you know? Why are you interested in more information about that? Let me say a little about that part.

Managing the discussion – Summarize	
Parts of discussion - Connecting	**Questions and statements - Connecting**
Launching the discussion: Select the problems in questions #8-13 that students are struggling with or you wish to share out.	Will team 1 start us off by sharing one way of working on this problem? Please raise your hand when you are ready to share your solution. What did you do first when you were working on this problem? Let's start by clearing up a few things about the problem. Let's list some key parts in this problem? What was unclear in the problem?
Eliciting and uncovering student strategies	Joe would you be willing to start us off? What have you found so far? Can you repeat that? Can you explain how you got that answer? How do you know? Walk us through your steps. Where did you begin? Can you show us?
Focusing on mathematical ideas	Can you explain why this is true? Does this method always work? How is Bob's method similar to Kelly's method? What do all the solutions have in common? What would happen if I changed the numbers to _____?
Encouraging interactions	Do you agree or disagree with Kahlil's idea? What do others think? Would someone be willing to repeat what Tom just said? Would anyone be willing to add on to what Sue just said?
Concluding the discussion	Can anyone tell me some of the big ideas that we learned today? How would you explain what we learned today to a 5th grader? Some of the key points from our discussion today are . . . Tomorrow we will continue our exploration of _____ beginning with the idea from today that _____.
Post lesson notes	You may wish to assign the practice problems that you feel would benefit the students.

Solutions: Free throw percentages

1. In Table 5 what were the best and worst seasons for Andre Drummond?

   Andre's best season was 2013-2014 with 41.8% of free throws made because 41.8% is the largest percentage. Andre's worst season was 2015-16 with only 35.5% of free throws made because of the four seasons 35.5% is the lowest percentage.

2. In Table 5, describe a big change in the data for 2015-2016 compared to the previous two seasons.

   In 2015-2016 Andre attempted many more free throws. He attempted over 200 more free throws than in the previous two seasons. He also made at least 50 more than in the previous two seasons, however his percentage is lower than either of the previous two seasons.

3. What do you think caused the change?

   Possible reasons: Teams became more aware of how poor a free throw shooter he was. He was fouled more often during the time he played in the games. It is possible Andre played in more games during the season or he was in each of the games for more minutes.

4. How much worse is Andre Drummond than the Detroit Pistons' player with the next lowest free throw percentage?

   The next lowest percentage is 74.9% by Marcus Morris. Andre is 39.4% worse than Marcus (74.9% - 35.5% = 39.4%).

5. Which player should the opposing team avoid fouling?

   Reggie Jackson because he has the highest percentage at 86.4%.

6. Which Detroit Pistons should handle the ball most often in the final two minutes?

   Reggie Jackson because he has the highest percentage for making free throws. In order from who should handle most to least it would be Reggie, Kentavious, Aron, Marcus and Andre because percentages from highest to lowest are 86.4%, 81.1%, 76.4%, 74.9%, and 35.5%.

7. What rule changes would you propose to discourage strategies like the Hack-a-Shaq?

   Anything is acceptable. Students *might suggest 3 or 4 free throws as opposed to only 2 in the last 2 minutes of the game. They might suggest no matter who is fouled, the team that is fouled gets to choose which player will shoot the free throws (either in game or on bench).*

8.   What is Daniella's free throw percentage for the shots recorded in Table 7?

Since there are 30 pairs of shots recorded, there are 60 shots attempted. Counting the X's for made shots, there are 36 made shots. Another way would be to add the numbers in the 'Points' columns, also 36. So, 36 made out of 60 attempted is $\frac{36}{60}$ as a fraction. I can divide 36 by 60 to get the decimal 0.6 and change it to a percent by multiplying by 100%. Daniella made 60% of her free throws.

Another way to think about it is 36 out of 60 is equal to what out of 100. I could use the proportion $\frac{36}{60} = \frac{x}{100}$ to solve.

60x = (36)(100)

60x = 3600
x = 60
60 out of 100 is the same as 60%

I could also set up a ratio table to solve this.

Made	36	6	60	
Attempted	60	10	100	

Daniella made 60% of her free throws

9.   Would you recommend that opposing teams repeatedly foul Daniella?

Although I am not a big fan of intentionally fouling a player, the paragraph above Table 7 indicated that Daniella is one of the poorer free throw shooters on the team so as far as the opposing team is concerned she would be a reasonable target to foul if she has the ball.

In the opening of the example it mentioned that poor free throw shooters are successful less than 60% of their attempts. Daniella is at exactly 60%, the next few attempts will indicate if she is over or under 60%.

10. Calculate Daniella's free throw percentage on the first shot?

There were 30 first shots given in the table. I counted the X's in column '1' only and got 19. So Daniella got 19 out of 30 attempts on first shots or $\frac{19}{30}$. To change this fraction to a decimal I would divide 19 by 30 to get the repeating decimal 0.633333... To change to a percent multiply by 100% to get 63.3% rounded to the nearest tenth.

11. Calculate Daniella's free throw percentage on the second shot?

There were 30 second shots given in the table. I counted the X's in column '2' only and got 17. So Daniella made 17 out of 30 attempts on second shots or $\frac{17}{30}$. To change this fraction to a decimal I would divide 17 by 30 to get the repeating decimal 0.566666… To change to a percent multiply by 100% to get 56.7% rounded to the nearest tenth.

12. Is there a big difference in her percentage of the first and second shots?

There is a 6.6% difference in first and second shots. This would be roughly 7 out of every 100 shots. I probably would not think of it as a big difference.

13. What percentage of times did Daniella miss both free throws?

I looked in the "Points" column of Table 7 and counted the number of zeros indicating both shots were missed. Of the 30 pairs, 8 times zero points were scored. So the fraction $\frac{8}{30}$ changed to a percent is roughly 26.7%.

14. What percentage of times did she make both free throws?

I looked in the "Points" column of Table 7 and counted the number of 2's indicating both shots were made. Of the 30 pairs, 14 times two points were scored. So the fraction $\frac{14}{30}$ changed to a percent is roughly 46.7%.

Solutions to practice problems

Elaine's Eagles Tennis Team

	First serve points won (including aces)	**Second serve points won**	**Total points won on serves**	**Percentage of total points won**
Player 1	15 points/20 serves	4/9	19/29	65.5%
Player 2	10/18	5/12	*15/30*	*50.0%*
Player 3	6/18	8/11	*14/29*	*48.3%*
Player 4	14/21	9/10	*23/31*	*74.2%*

Table 4. Service points during a tournament

Use the data in the table above to answer the following questions about Elaine's Tennis Team.

1. During the Eagles last tennis tournament, the team statistician collected the data in the table above. Complete the table for the statistician.

    See table above.

2. Which player had the better percentage of Total Points on their serve?

    Player 4 had 74.2% of points scored on their serve.

3. Which player performed the best in the category of First Serve Points Won for this tournament?
   Explain how you determined your conclusion.

    Player 1. Player 1 is 75%, Player 2 is 66.7%, Player 3 is 33.3%, and Player 4 is 66.7%.

4. Which player performed the best in the category of Second Serve Points Won for this tournament? Explain how you determined your conclusion.

    Player 4. Player 1 is 44.4%, Player 2 is 41.7%, Player 3 is 72.7%, and Player 4 is 90%.

National Football Conference (NFC) team records

The data below was collected on October 28, 2016 from the Score app.

	Win-Loss-Tie	Passing yards (average per game)	Rushing yards (average per game)	Points (average per game)
Detroit Lions (NFC North)	4-3-0	273.0	111.4	24.3
Arizona Cardinals (NFC West)	3-3-1	253.9	125.4	15.7
Green Bay Packers (NFC North)	4-2-0	239.3	104.8	23.3
Seattle Seahawks (NFC West)	4-1-1	226.0	84.2	14.0

5. Which team on average, has the most total yards per game (rushing and passing)?

   Detroit 384.4, Arizona 379.3, Green Bay 344.1, Seattle 310.2. The team with the highest total yards per game on average (rushing and passing) is the Detroit Lions.

6. Find the percentage of passing yards to total yards for each team above.

   Detroit Lions 273.0/384.4 = 71.0%
   Arizona Cardinals 253.9/379.3 = 66.9%
   Green Bay Packers 239.3/344.1 = 69.5%
   Seattle Seahawks 226.0/310.2 = 72.9%

7. Find the percentage of rushing yards to total yards for each team above.

   Detroit Lions 111.4/384.4 = 29.0%
   Arizona Cardinals 125.4/379.3 = 33.1%
   Green Bay Packers 104.8/344.1 = 30.5%
   Seattle Seahawks 84.2/310.2 = 27.1%

8. Teams strive to have a balanced offense. The closer the passing and running percentages are the more balanced the offense. Which team had the most balanced offense? Which had the least balanced offense?

   The Arizona Cardinals had the most balanced offense with passing accounting for only 66.9% of the total yards. The Seattle Seahawks had the least balanced offense. Passing accounted for 72.9% of the total yards.

9. Find the percentage of wins to games played for each of the teams above.

    Detroit Lions 4/7 or 57.1%
    Arizona Cardinals 3/7 or 42.9%
    Green Bay Packers 4/6 or 66.7%
    Seattle Seahawks 4/6 or 66.7%

10. Write two interesting facts from this data.

    Answers will vary.

    Examples: The Green Bay Packers and Seattle Seahawks have the same winning percentages. However, they don't have the same Win-Loss-Tie record. The Lions and Cardinals have played 7 games while the Packers and the Seahawks have only played 6 games.