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TOPIC: Distance-Rate-Time, Conversions, and Bullfighting

NCTM STANDARDS: Problem Solving, Communication, Connections

GOALS: Students will learn and form opinions about the Spanish tradition of bullfighting. Students will be able to use the distance equation to make calculations, as well as use proportions to make conversions.

INTRODUCTION:

Bullfighting is a Spanish tradition that dates back to the Roman times. Bullfights continue today in Spain, Portugal, France, and some Latin American countries, including Mexico. A lot of controversy actual surrounds bullfighting. Animal rights activists are very opposed to it because of the harm it does to the bull, while those in favor of bullfighting see it as a cultural tradition and even an art form. So at least for now, bullfighting remains.

Bullfights take place in what is called a *plaza de toros*, a stadium with a round dirt area in the center which is typically about 50 meters in diameter. There are many participants involved in the actual fight, including the *matador*, the main fighter, his three assistants called *banderilleros*, and two others on horseback called *picadors*. While the matador does most of what is considering fighting, where he waves the cape and the *toro* (bull) charges, the job of the *banderilleros* and the *picadors* is to give the matador a feel for the movement of the *toro*, as well as to weaken the *toro* before the final fight. During the final portion of the event, the *matador* waves a red cape called a *muleta,* and the *toro* charges. (Contrary to popular belief, the red cape does not make the *toro* any angrier since *toros* are in fact colorblind.) The *matador* is scored based on grace as well as on the amount of danger to which he exposes himself. At the end of the fight, the *matador* kills the *toro* with his sword and the fight is over. Rarely, if the *toro* is considered to be a valiant fighter, then the *toro*'s life is spared. If the *matador* has fought well, then the crowd yells *Ole!* and the *matador* is allowed to keep one of the *toro*'s ears.

ACTIVITIES:

Part 1: Introduction to Bullfighting. Teacher neutrally introduces facts about bullfighting to students. Students become familiar with the role each character plays during a bullfight (see Introduction above).

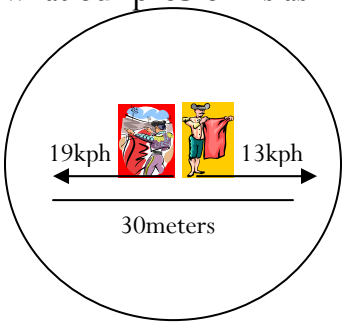
Part 2: Introduction to the Distance Equation

distance = rate X time **time = distance ÷ rate** **rate = distance ÷ time**

***If rate (speed) is measured in kilometers per hour (kph), then the distance must be in kilometers and the time must be in hours. (i.e., if the units do not match up in what is given in the problem, then the units must first be converted so that they all match)

Example problem: If the *matador*, running at 13 kph, and the *banderillero,* running at 19 kph, both start at the center of the *plaza de toros* and run in opposite directions, how many seconds will it take until they are 30 meters apart?

First set up the scenario using the manipulatives to give students a visual representation about what our problem is asking.



◦Step 1: First notice that the rate is given in kph, but the distance is given in meters. Therefore, we must convert meters to kilometers by setting up a proportion:

$$\frac{1000m}{1km} = \frac{30m}{x} \longrightarrow 1.km \bullet 30m = 1000m \bullet x \longrightarrow x = \frac{1km \bullet 30m}{1000m} \longrightarrow x = .03km$$

◦Step 2: Now that we have the same units, we can begin to use our distance equation. Let d_1 represent the distance run by the *matador* and d_2 be the distance run by the *banderillo*. Let r_1 be the rate of the *matador* and r_2 the rate of the *banderillero*. In this example, we are solving for time so we will use the equation **time = distance ÷ rate.** Also, since we know they must be .03 km apart, we know $\mathbf{d_1 + d_2 = .03}$ km so $\mathbf{d_2 = .03 - d_1}$

$$\mathbf{t_1 = d_1 \div r_1 = d_1 \div 13}$$

$$\mathbf{t_2 = d_2 \div r_2 = (.03 - d_1) \div 19}$$

Setting the times equal gives: $\mathbf{d_1 \div 13 = (.03 - d_1) \div 19}$

Cross multiplying gives: $\mathbf{19 d_1 = 13(.03 - d_1) = .39 - 13\ d_1}$

Solving for d_1 gives: $\mathbf{39\ d_1 = .39}$ so $\mathbf{d_1 = .01}$

◦Step 3: Plug $\mathbf{d_1 = .01}$ into the distance equation to find the time.

$$\mathbf{t_1 = d_1 \div r_1 = .01 \div 13 = .00077 \text{ hours}}$$

◦Step 4: Now we have found the time, but we are not quite done. The problem asks for the time in *seconds*, not hours. To convert .00077 hours to seconds, we must multiply by the number of seconds in an hour, which is 3600.

.00077 x 3600 = 2.77 seconds!

Part 3: Bullfighting and Distance-Rate-Time Activity (see below)

Students should be divided into groups of two or three to collaborate and work on this assignment.

Bullfighting and Distance-Rate-Time

●**Distance:** The width of the *plaza de toros* is 50 meters.

●**Conversions to know:** 1 kilometer = 1000 meters
1 hour = 3600 seconds

Question: What are the two sides of the argument over bullfighting? After learning more about it, what is your opinion? Should bullfighting be allowed or not? _____

_____

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Directions: Solve the following problems with your partner. If it helps you, set up the scenario using the cut-outs so you can visualize what is happening in each problem. ¡*Buena suerte*!

1. Suppose the *matador* and the *toro* are 30 meters apart and the *toro* runs toward the *matador,* who is standing still, at 22 kph. How many seconds will it take for the *toro* to reach the matador?

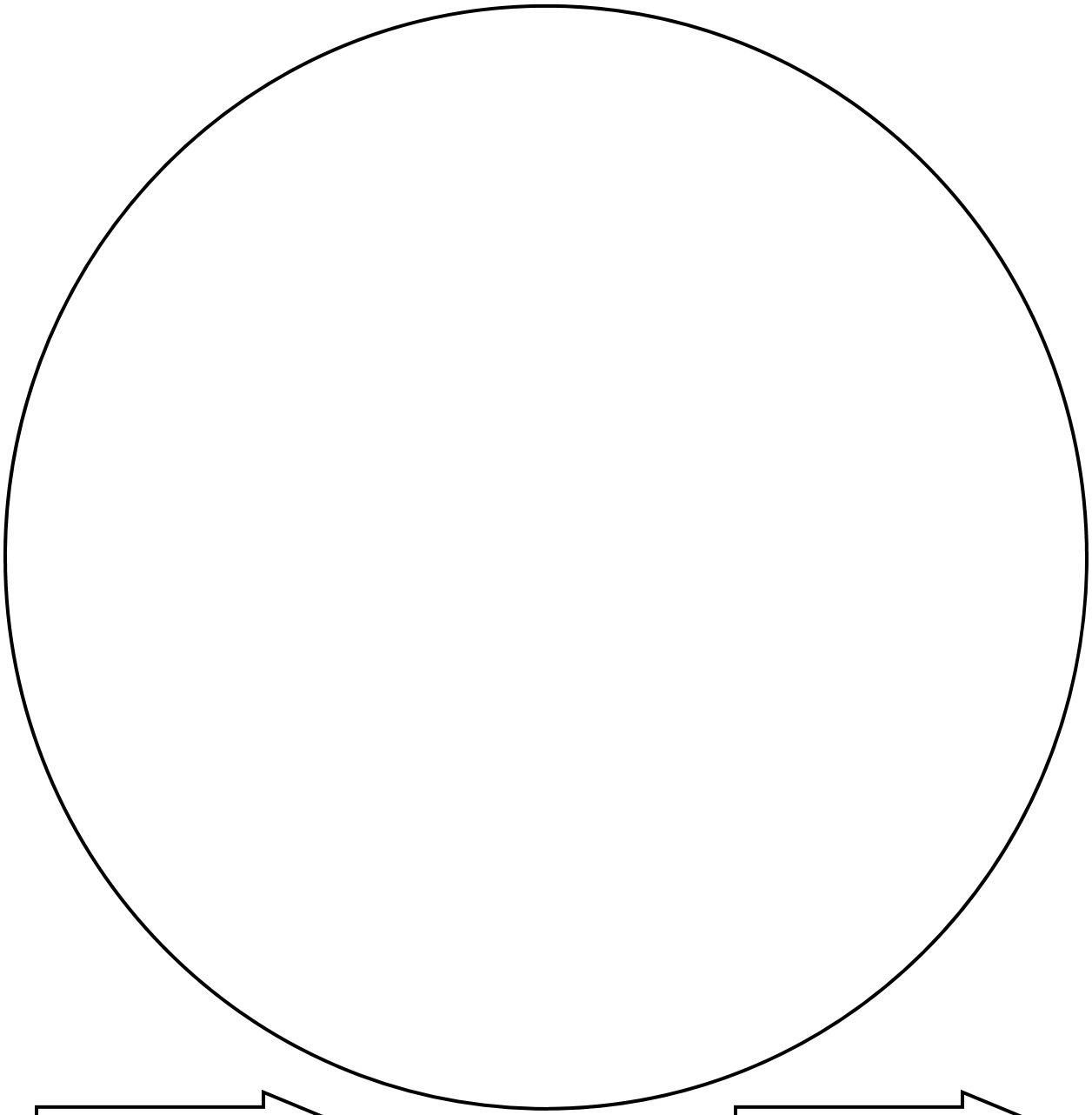
2. If the *banderillero*, who runs 19kph, is 5 meters ahead of the *toro* when the *toro* starts chasing him at 24 kph, how many seconds will it take for the *toro* to catch up?

3. If the *toro*, running 25 kph, and the *banderillero*, running 19kph, start on opposite sides of the *plaza de toros* and run towards one another, how many meters will the *toro* have to run until they run into one another?

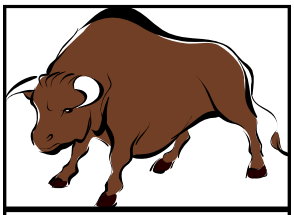
4. If the *toro,* who runs 23 kph, starts out 10 meters ahead of the *picador*, whose horse runs 29 kph, how many seconds will it take for the *picador* to catch the *toro*?

5. If the *toro* starts out 15 meters in front of the *picador* and runs 20 kph and the *picador* catches up to the toro in about 10 seconds, then how fast is the *picador*'s horse running?

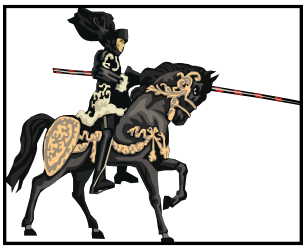
6. Now you and your partner create and solve your own scenario (imagine yourself as one of the characters if you like). Then give the problem to another group to see if they are able to solve it!



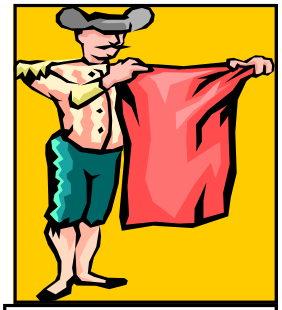
MATADOR



TORO



PICADOR



BANDERILLERO

Bullfighting and Distance-Rate-Time ANSWER KEY

1. Suppose the *matador* and the *toro* are 30 meters apart and the *toro* runs toward the *matador,* who is standing still, at 22 kph. How many seconds will it take for the *toro* to reach the *matador*?
Step 1: Change meters to kilometers since we are dealing with kph. (3 meters =.03 kilometers)

Step 2: Use the equation **time = distance ÷ rate** since we are trying to figure out how many seconds (time) it will take. (.00136 hours)
Step 3: Now convert hours to seconds. (4.91 seconds)

2. If the *banderillero*, who runs 19kph, is 5 meters ahead of the *toro* when the *toro* starts chasing him at 24 kph, how many seconds will it take for the *toro* to catch up?
Step 1: First convert 5 meters to kilometers. (5 meters = .005 kilometers)
Step 2: Let the rate of the *banderillero* be r_1 = 19 kph. Let the rate of the *toro* be r_2 = 24 kph.
Step 3: Let d_1 = the distance run by the *banderillero*, and let d_2 = the distance run by the *toro*. We know that since the *banderillero* starts out 5 meters = .005km ahead of the *toro*, then $d_1 = d_2 - .005$.

Step 4: The times each must run are equal so now we are ready to use the equation **time = distance ÷ rate**. (d_2 = .024)

Step 5: Now that we have solved for d_2, we can plug it into the equation **time = distance ÷ rate** to find out how long it took the *toro* to catch up to the *banderillero*. (t2 = .001hours = 3.6 sec).

3. If the *toro*, running 25 kph, and the *banderillero*, running 19kph, start on opposite sides of the *plaza de toros* and run towards one another, how many meters will the *toro* have to run until they run into one another?
Step 1: Let r_1 be the rate of the *toro*, and r_2 be the rate of the *banderillero*.
Step 2: From the culture lesson, we know the width of the *plaza de toros* is 50 meters, which is .05 kilometers. Letting the distance the *toro* must run be d1 and the distance the *banderillero* must run d_2, we know that $d_1 + d_2 = .05$, so $d_2 = .05 - d_1$
Step 3: They will be running the same amount of time until they run into each other so let $t_1 = t_2$. Now using the equation **time = distance ÷ rate** we can solve for d_1. (d_1=.0284km = 28.4 m)

4. If the *toro,* who runs 23 kph, starts out 3 meters ahead of the *picador*, whose horse runs 29 kph, how many meters will the *picador* go before he catches the *toro*?
Step 1: Let t_1 = the rate of the *toro* and t_2=the rate of the *picador's* horse and d_1 = the distance the *toro* runs and d_2 = the distance the *picador's* horse runs.
Step 2: Since the *toro* starts out 3 meters = .003km ahead of the *picador,* we know that $d_2 = .003 + d_1$.

Step 3: We can now use the equation **time = distance ÷ rate**. d_1 = .0115km=11.5m so (d_2 = 14.5m)

5. If the *toro* starts out 15 meters in front of the *picador* and runs 20 kph and the *picador* catches up to the toro in about 10 seconds, then how fast is the *picador*'s horse running?
Step 1: Let r_1 = the rate of the *toro* and r_2 = the rate of the *picador*. Let d_1 = the distance the *toro* runs and d_2 = the distance the *picador* runs. Let $t_1 = t_2$ = 10 seconds be the time it takes for the *picador* to catch up to the *toro*.
Step 2: We know that $d_1 = d_2 - .015$ since the *toro* starts out 15 m = .015 km ahead of the *picador*.
Step 3: Convert the seconds to hours. (10 seconds = .00278 hours)
Step 4: Set up and solve the equations. (r_2 = 25.4kph)