

Grade 3: Place Value Unit

Assessment Math Task

Home Towns in Texas

Amy, Clara, Joel, Eric, Ryan, and Brody are students attending a summer math camp together. Each student comes from a different town in Texas. The students work in teams of two to determine which team comes from towns with the greatest combined population. The teams also decide to use the greater than and less than symbols to compare their home town populations. The students look online to find the population of each of their home towns. Here is what the students find out.

Team 1

Amy lives in Odessa which has a population of 99,940.

Clara lives in Denton which has a population of 113,383.

Team 2

Joel lives in Richardson which has a population of 99,203.

Eric lives in College Station which has a population of 93,857.

Team 3

Ryan lives in Amarillo which has a population of 190,695.

Brody lives in Grapevine which has a population of 46,334.

The students decide to round each population number to the nearest hundreds place to make calculating easier. Which team lives in towns with the greatest combined rounded population?

Team 1 uses the greater than or less than symbol to compare the exact populations of their two towns. What statement does Team 1 write?

Team 2 uses the greater than or less than symbol to compare the rounded populations of their two towns. What statement does Team 2 write?

Team 3 uses the greater than or less than symbol to compare the exact and rounded populations of their two towns. What statements does Team 3 write?

Show all your mathematical thinking.

Home Towns in Texas

Place Value Unit

Mathematical Processes: 3.1A, 3.1B, 3.1E, 3.1G

Task

Amy, Clara, Joel, Eric, Ryan, and Brody are students attending a summer math camp together. Each student comes from a different town in Texas. The students work in teams of two to determine which team comes from towns with the greatest combined population. The teams also decide to use the greater than and less than symbols to compare their home town populations. The students look online to find the population of each of their home towns. Here is what the students find out.

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Team 3

Ryan lives in Amarillo which has a population of 190,695.

Brody lives in Grapevine which has a population of 46,334.

The students decide to round each population number to the nearest hundreds place to make calculating easier. Which team lives in towns with the greatest combined rounded population?

Team 1 uses the greater than or less than symbol to compare the exact populations of their two towns. What statement does Team 1 write?

Team 2 uses the greater than or less than symbol to compare the rounded populations of their two towns. What statement does Team 2 write?

Team 3 uses the greater than or less than symbol to compare the exact and rounded populations of their two towns. What statements does Team 3 write?

Show all your mathematical thinking.

TEKS Unit of Study and Evidence

Place Value Unit

The Place Value Unit involves understanding and representing the relative position, magnitude and relationships within the numeration system in order to answer questions such as:

- How can you use the additive property of place value to decompose this number?
- How can you use the multiplicative property of place value to describe the meaning of each digit in the number 654,321?
- How can you use the base ten property of place value to explain the relationship between each of the digits in the number 555,555?
- What other way(s) can you use hundred thousands, ten thousands, thousands, hundreds, tens, and ones to show this number without changing its value?

Exemplars Task-Specific Evidence

This task requires students to use place value to round whole numbers to the nearest 100. Students are also expected to add rounded numbers to find a total and then use comparative symbols to compare totals.

Underlying Mathematical Concepts

- Rounding whole numbers to the nearest 100
- Adding/Combining whole numbers
- Comparing whole numbers

Possible Problem-Solving Strategies

- Model (manipulatives)
- Diagram/Key
- Table
- Chart
- Number line

Possible Mathematical Vocabulary/Symbolic Representation

- Model
- Diagram/Key
- Table
- Chart
- Number line
- Odd/Even
- Greater than ($>$)/Less than ($<$)
- Estimate/Estimation
- Round
- Place value

Possible Solutions

Team 3 lives in towns with the greatest rounded population. Comparison statements each team could write are as follows:

Comparison Statements:

Team 1: $99,940 < 113,383$ or $113,383 > 99,940$

Team 2: $93,900 < 99,200$ or $99,200 > 93,900$

Team 3: $190,695 < 190,700$ or $190,700 > 190,695$

Team	Student	Town	Rounded Population	Total Rounded Population
1	Amy	Odessa	99,900	
1	Clara	Denton	113,400	213,300
2	Joel	Richardson	99,200	
2	Eric	College Station	93,900	193,100
3	Ryan	Amarillo	190,700	
3	Brody	Grapevine	46,300	237,000

Possible Connections

Below are some examples of mathematical connections. Your students may discover some that are not on this list.

- The total rounded population of all 6 towns is 643,400.
- The total exact population of all 6 towns is 643,412.
- $643,412 > 643,400$
- The difference between the exact population of all six towns and the rounded population of all six towns is only 12 people.
- Relate to a similar task and state a math link.
- Solve more than one way to verify the solution.

Novice Scoring Rationales

Criteria and Performance Level	Assessment Rationales
Problem Solving <i>Novice</i>	<p>The student's strategy of using table to indicate the population stated in the task for each student and replacing the ones, tens, and hundreds places with zeros in the "round number" column would not work to solve the first part of the task. The student's answer, "Amy has the most population because she has 3 nines 99,9 4 0 on my table," is not correct. The student does not provide a strategy to solve the second part of the task. The student's statement, "Amy is > everyone," is not correct.</p>
Reasoning Proof <i>Novice</i>	<p>The student is able create a table to list the six students and scribe the correct population from the task but demonstrates no understanding of the underlying concepts of the task. The student does not demonstrate understanding that the six students form three teams. The student does not demonstrate understanding of the mathematical concept of rounding to the hundreds place. The student replaces all the ones, tens, and hundreds place value numbers with zeros. The student is not comparing numbers by place value but by the magnitude of the first numbers reading from left to right. Therefore, 99,940 is considered the greatest population. The student does not demonstrate understanding of the concept of using greater than and less than to compare the exact and rounded town populations between two students.</p>
Communication <i>Practitioner</i>	<p>The student correctly uses the mathematical terms <i>population</i>, <i>greater than</i>, <i>symbol</i> from the task. The student also correctly uses the term <i>table</i>. The student does not use the mathematical symbol, $>$, correctly.</p>
Connections <i>Novice</i>	<p>The student solves the task and does not attempt to make a mathematically relevant observation about her/his solution.</p>
Representation <i>Apprentice</i>	<p>The student's table is appropriate to part of the task but is not accurate. The third column should be a labeled rounded number of population. All the entered data for the third column is not accurate.</p>

Novice

P/S	R/P	Com	Con	Rep	A/Level
N	N	P	N	A	N

I have to find which team has the most population and use the greater and less symbols. I will use a table.

Students	Population	round number
Amy	99,940	99,000
Clara	113,383	113,000
Joel	99,203	99,000
Eric	93,857	93,000
Ryan	190,965	190,000
Brody	46,334	46,000

Answers

Amy has the most population because she has 3 nines 99,940 on my table. $>$ means greater than

Amy is $>$ everyone so I am done.

Apprentice Scoring Rationales

Criteria and Performance Level	Assessment Rationales
<p>Problem Solving <i>Apprentice</i></p>	<p>The student's strategy of using a table to indicate the exact and rounded populations of six towns and applying addition to determine the team with the greatest combined population works to solve the first part of the task. The student's answer, "Team 3 has a greater population," is correct. The student's strategy of using a table to compare the exact and rounded populations using greater and less than symbols per student would not work to solve the second part of the task. The student's answer, "I compared every town with the $>$ and $<$ symbols," is not correct.</p>
<p>Reasoning Proof <i>Apprentice</i></p>	<p>The student demonstrates understanding of the first part of the task by correctly applying the concept of rounding to the nearest hundred for populations of five towns. The student's error for College Station is considered a careless error and not a flaw in the student's reasoning. The student uses addition to calculate each team's total rounded population and determines the team with the greatest combined population. The notation flaw for College Station does not lead to an incorrect answer to the question. The student does not show correct reasoning in the second part of the task. The questions require the student to compare the exact population, the rounded population, or the exact and rounded population between each teams' two home towns. This student is just comparing the exact and rounded populations per student.</p>
<p>Communication <i>Practitioner</i></p>	<p>The student correctly uses the mathematical terms <i>population, greater/less than, symbols, number, greatest</i> from the task. The student also correctly uses the terms <i>table, least</i>. The student correctly uses the mathematical symbols, $<$ and $>$.</p>
<p>Connections <i>Practitioner</i></p>	<p>The student makes mathematically relevant observations about her/his solution. The student states, "I noticed that Ryan lives in Amarillo and it has the greatest number of people living there," and "His team friend lives in Grapevine and has the least people living there."</p>

Apprentice Scoring Rationales (cont.)

Criteria and Performance Level	Assessment Rationales
<p>Representation <i>Apprentice</i></p>	<p>The student's first table is appropriate to the task but is not accurate. The student provides all necessary labels but the entered data for the rounded population for Eric from College Station is not correct. It should state 93,900. The student's second table is not appropriate to the task and has errors. The fourth column should be labeled rounded population. Eric's rounded population should read 93,900. Ryan's population should read 190,695 and his rounded population should read 190,700.</p>

Apprentice

P/S	R/P	Com	Con	Rep	A/Level
A	A	P	P	A	A

I'm going to find which team has a greater population in their towns. I also need to use greater or less than symbols to compare towns. I will make a table.

The Teams	student names	population	rounded population
1	Amy	99,940	99,900
1	Clara	113,383	113,400
2	Joel	99,230	99,200
2	Eric	93,857	99,900
3	Ryan	190,695	190,700
3	Brody	46,334	46,300

$$\begin{array}{r} 99,900 \\ +113,400 \\ \hline 213,300 \end{array} \quad \begin{array}{r} 99,200 \\ +99,900 \\ \hline 199,100 \end{array} \quad \begin{array}{r} 190,700 \\ +46,300 \\ \hline 237,000 \end{array}$$

Team 3 has a greater population

Student names	population	symbol	Rounded towns
Amy	99,940	>	99,900
Clara	113,383	>	113,400
Joel	99,203	>	99,200
Eric	93,857	<	99,900
Ryan	190,645	>	190,600
Brody	46,334	>	46,300

I compared every town with the > and < symbols.

I noticed that Ryan lives in Amarillo and it has the greatest number of people living there. His team friend lives in Grapevine and has the least people living there.

Practitioner Scoring Rationales, Student 1

Criteria and Performance Level	Assessment Rationales
Problem Solving <i>Practitioner</i>	<p>The student's strategy of using a table to indicate the exact and rounded populations of six towns, applying addition and the correct use of the greater and less than symbols works to solve this task. The student's answers, "Team 3 has more population than Teams 1 and 2," "Team 1 Amy 99,940 < 113,383 Clara," "Team 2 Joel 99,200 > 93,900 Eric," and "Ryan 190,695 > 46,334, Brody, Ryan 190,700 > 46,300 Brody," are correct.</p>
Reasoning Proof <i>Practitioner</i>	<p>The student demonstrates correct understanding of the first part of the task by applying the concept of rounding to the nearest hundred to the population of six towns. The student uses addition correctly to calculate each team's total rounded population and determines the team with the greatest rounded combined population. The student shows correct reasoning of the second part of the task by comparing the exact and/or rounded town populations for each team and using the greater than and less than symbols correctly in stating the comparisons.</p>
Communication <i>Practitioner</i>	<p>The student correctly uses the mathematical terms <i>greatest, greater than, less than, symbols, population</i> from the task. The student also correctly uses the terms <i>total, table, more than, most, least, 10,000s place</i>. The student correctly uses the mathematical symbols, < and >.</p>
Connections <i>Practitioner</i>	<p>The student makes mathematically relevant observations about her/his solution. The student states, "Ryan's town has the most population," "Joel's has the least population," and "Amy Joel Eric and Ryan have a 9 in the 10,000s place."</p>
Representation <i>Practitioner</i>	<p>The student's use of a table is appropriate to the task and accurate. The student provides all necessary labels and the entered data is correct.</p>

Practitioner, Student 1

P/S	R/P	Com	Con	Rep	A/Level
P	P	P	P	P	P

I need to find which team has a greatest rounded total population. I need to use the greater than or less than symbols to compare the exact and rounded populations. I will use a table.

Teams	Name	Populations	rounded Populations
1	Amy	99,940	99,900
1	Clara	113,383	113,400
2	Joel	99,203	99,200
2	Eric	93,857	93,900
3	Ryan	190,695	190,700
3	Brody	46,334	46,300

$\begin{array}{r} 1 \\ 99,900 \\ + 113,400 \\ \hline 213,300 \end{array}$	$\begin{array}{r} 2 \\ 99,200 \\ + 93,900 \\ \hline 193,100 \end{array}$	$\begin{array}{r} 3 \\ 190,700 \\ + 46,300 \\ \hline 237,000 \end{array}$
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Answers

Team 3 has more population than Teams 1 and 2

Team 1 Amy 99,940 < 113,383 Clara

Team 2 Joel 99,200 > 93,900 Eric

Team 3 Ryan 190,695 > 46,334 Brody

Ryan 190,700 > 46,300 Brody

Ryan's town has the most population.
Joel's has the least population.
Amy Joel Eric and Ryan have a 9 in the 10,000's place.

Practitioner Scoring Rationales, Student 2

Criteria and Performance Level	Assessment Rationales
Problem Solving <i>Practitioner</i>	<p>The student's strategy of using a table to indicate the exact and rounded populations of six towns and applying addition works to solve the first part of the task. The student's strategy of using number lines and the greater than and less than symbols works to solve the second part of the task. The student's answers, "Ryan and Brody have the most population rounded total. They are team 3" "$99,940 < 113,383$," "$99,200 > 93,900$," "$46,334 < 190,695$," and "$46,300 < 190,700$," are correct.</p>
Reasoning Proof <i>Practitioner</i>	<p>The student demonstrates correct understanding of the first part of the task by applying the concept of rounding to the nearest hundred for the population of six towns. The student uses addition correctly to calculate each team's total rounded population and determines the team with the greatest rounded combined population. The student shows correct reasoning of the second part of the task by comparing the exact and/or rounded town populations for each team and using the greater than and less than symbols correctly in stating the comparisons.</p>
Communication <i>Practitioner</i>	<p>The student correctly uses the mathematical terms <i>population, greatest, symbols</i> from the task. The student also correctly uses the terms <i>most, total, number lines, table, 100 thousands place, place value, least</i>. The student correctly uses the mathematical symbols, $<$ and $>$.</p>
Connections <i>Practitioner</i>	<p>The student makes mathematically relevant observations about her/his solution. The student states, "You don't have to add team 2 because they have no 100 thousands place and I can see they can't go past 1 in the 100 thousands total," "Ryan's town has greatest population," "I counted by 20,000 on team 3 number lines," and "Brody has least population."</p>
Representation <i>Practitioner</i>	<p>The student's use of a table is appropriate to the task and accurate. The student provides all necessary labels and the entered data is correct. The student's four number lines are appropriate to the task and accurate. Each number line has the team labeled, numbers labeled as either exact population or rounded population, and the intervals on the number lines are accurate and labeled correctly.</p>

Practitioner, Student 2

P/S	R/P	Com	Con	Rep	A/Level
P	P	P	P	P	P

I have to find the team with the most total population
And exact and rounded populations with $>$ and $<$ symbols.
My strategy is to make number lines and a table
for the students towns.

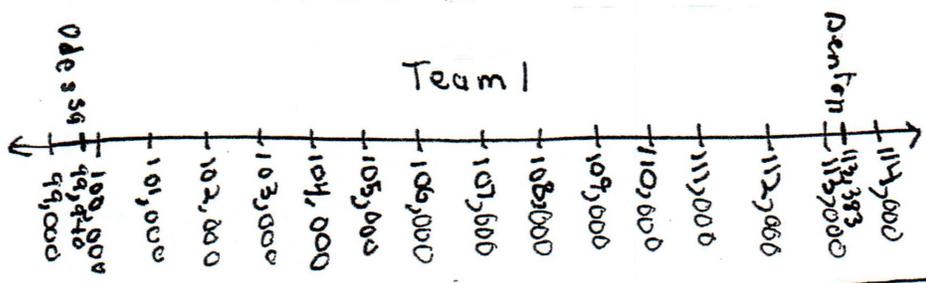
Town	Student	exact Population	Rounded Population
Odessa	Amy	99,940	99,900
Denton	Clara	113,383	113,400
Richardson	Joel	99,203	99,200
College Station	Eric	93,857	93,900
Amarillo	Ryan	190,695	190,700
Grapevine	Brody	46,334	46,300

$$\begin{array}{r}
 99,900 \\
 + 113,400 \\
 \hline
 213,300 \\
 \text{team 1}
 \end{array}
 \qquad
 \begin{array}{r}
 190,700 \\
 + 46,300 \\
 \hline
 237,000 \\
 \text{team 3}
 \end{array}$$

Answer:

Ryan and Brody have the most population rounded total. They are team 3.

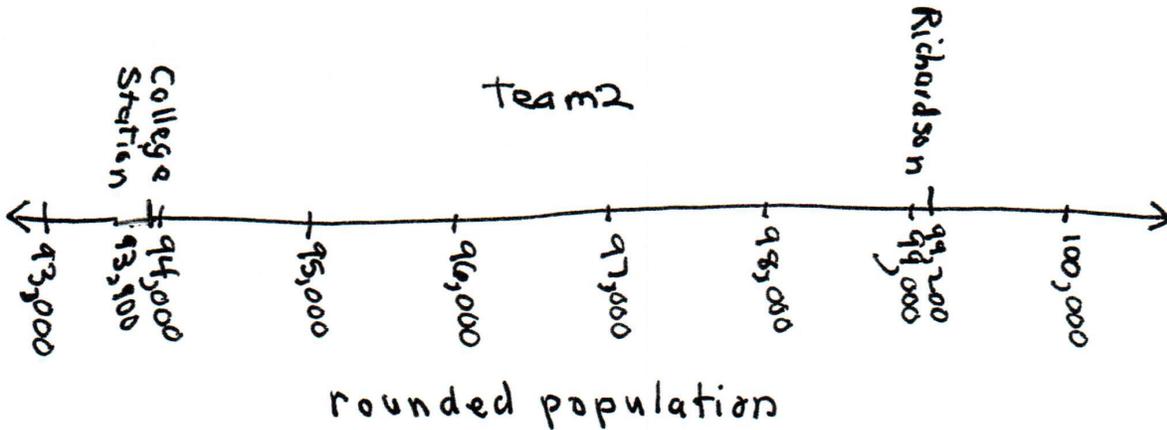
connection: You don't have to add team 2 because they have no 100 thousands place and I can see they can't go past 1 in the 100 thousands total.



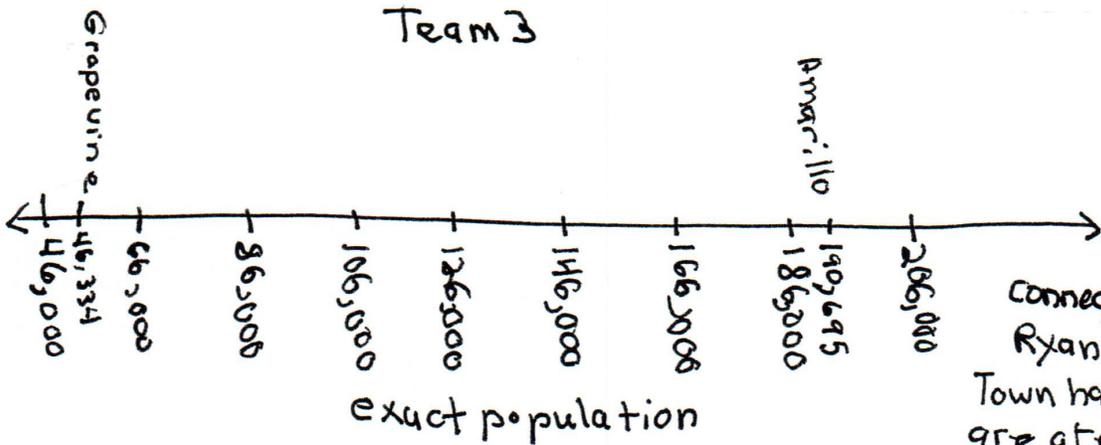
exact population

Answer:
 $99,940 < 113,383$

Practitioner, Student 2 (cont.)

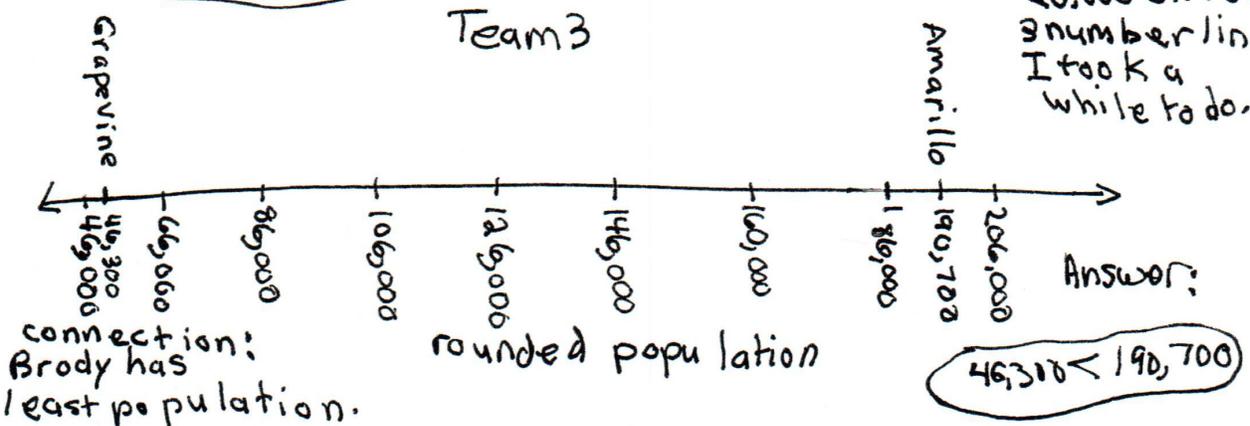


Answer: $99,200 > 93,900$



Answer: $46,334 < 190,695$

Connection:
Ryan's
Town has
greatest
population.
I counted by
20,000 on team
3 number line.
I took a
while to do.



connection:
Brody has
least population.

Answer: $46,300 < 190,700$

Expert Scoring Rationales

Criteria and Performance Level	Assessment Rationales
Problem Solving <i>Expert</i>	<p>The student's strategy of using a table to indicate the exact and rounded populations of six towns and applying addition works to solve the first part of the task. The student's strategy of using tables and the greater than and less than symbols works to solve the second part of the task. The student's answers, "team 3 has the most population sum," "$99,940 < 113,383$," "$99,200 > 93,900$," "$190,695 > 46,334$," and "$190,700 > 46,300$," are correct. The student brings prior knowledge of data and fractions to her/his solution.</p>
Reasoning Proof <i>Expert</i>	<p>The student demonstrates correct understanding of the first part of the task by applying the concept of rounding to the nearest hundred for populations of six towns. The student uses addition to calculate each team's total rounded population and correctly selects the team with the greatest population. The student shows correct reasoning for the second part of the task by comparing the exact and/or rounded town populations for each team and using the greater than and less than symbols in stating the comparisons. The student takes time to justify that her/his rounding was correct by discussing how one must be sure to be looking at the same place value when comparing two numbers. The student brings data concepts to her/his solution by including range, minimum, and maximum. The student also uses the fraction concept of one-half correctly.</p>
Communication <i>Expert</i>	<p>The student correctly uses the mathematical terms <i>population, greatest, symbols</i> from the task. The student also correctly uses the terms <i>tables, most, sum, difference, data, tens place, number, range, minimum, maximum, thousand, third</i>. The student correctly uses the mathematical symbols, $<$, $>$, $1/2$.</p>

Expert Scoring Rationales (cont.)

Criteria and Performance Level	Assessment Rationales
<p>Connections <i>Expert</i></p>	<p>The student makes mathematically relevant Practitioner observations about her/his solution. The student states, "Joel's population was a difference by only 3 people so it is really the most accurate [accurate] in real life. The student computes the exact and rounded population difference between Odessa and Richardson and states, "Closest population of towns." The student also states, "rounding to the tens place would make populations closer for each town in exact and rounding numbers." The student makes Expert connections. A warning is provided by the student to inform that one should be careful to compare the same place value positions when comparing numbers. It appears the student follows her/his advice as she/he states, "I almost picked Odessa so want to warn other third graders." The student includes data and fraction concepts in her/his solution. The student states, "That is important when you do data," when discussing the difference in Joel's exact and rounded populations. The student also states, "When you round down you miss people data. Eric rounded up so his town has 43 people added to the real population." The student continues by stating, "the population range is from 46,334 (Grapevine, minimum) to 190,695 (Amarillo, maximum)." The student includes fractions in her/his solution by stating, "Grapevine population is about 1/2 of College Station."</p>
<p>Representation <i>Expert</i></p>	<p>The student's use of a table to show the exact and rounded populations for all six students is appropriate to the task and accurate. The student provides all necessary labels and the entered data is correct. The student's four additional tables are appropriate and accurate. The student uses her/his "big table" to help extend thinking to data and fractions.</p>

Expert

P/S	R/P	Com	Con	Rep	A/Level
E	E	E	E	E	E

* I need to find which team has the greatest population.

* I also need to find which statements could each team write with $>$ and $<$ symbols.
My plan is to make tables.

name	Town	team	Population	rounded Population
Amy	Odessa	1	99,940	99,900
Clara	Denton	1	113,383	113,400
Joel	Richardson	2	99,203	99,200
Eric	College Station	2	93,857	93,900
Ryan	Amarillo	3	190,695	190,700
Brody	Grapevine	3	46,334	46,300

$$\begin{array}{r}
 99,900 \\
 + 113,400 \\
 \hline
 213,300
 \end{array}
 \qquad
 \begin{array}{r}
 99,200 \\
 + 93,900 \\
 \hline
 193,100
 \end{array}
 \qquad
 \begin{array}{r}
 190,700 \\
 + 46,300 \\
 \hline
 237,000
 \end{array}$$

answer number 1
team 3 has the most population sum

connections so far

* Joels population and rounded population was a difference by only 3 people so it is really the most accurate in real life. That is important when you do data.

* $99,940$ - Odessa - $99,900$ closest population
- $99,203$ - Richardson - $99,200$ of towns

* rounding to the tens place would make populations closer for each town in exact and rounding numbers.

Expert (cont.)

Exact populations

Amy	Symbol	Clara
99,940	<	113,383

answer number 2
Odessa < Denton

rounded populations

Joe	Symbol	Eric
99,200	<	93,900

answer number 3
Richardson < College Station

exact populations

Ryan	Symbol	Brody
199,695	>	46,334

answer number 4
Amarillo > Grapevine

rounded populations

Ryan	Symbol	Brody
190,700	>	46,300

answer number 5
Amarillo > Grapevine

Expert (cont.)

Connections again

* My big table got me thinking more on data,

$$\begin{array}{r} 857 \\ 867 \end{array} / 10$$
 * when you round down you miss people data

$$\begin{array}{r} 877 \\ 887 \end{array} / 20$$
 Eric rounded up so his town

$$\begin{array}{r} 897 \\ 900 \end{array} / 40$$
 has 43 people added to the

$$\begin{array}{r} 900 \\ 900 \end{array} / 43$$
 real population

* the population range is
 from 46,334 to 190,695

Grapevine to Amarillo
 minimum maximum

* Grapevine population is about
 $\frac{1}{2}$ of College Station

$$\begin{array}{r} 46,300 \\ + 46,300 \\ \hline 92,600 \end{array} \quad \begin{array}{r} 93,900 \\ - 92,600 \\ \hline 1,300 \end{array}$$

* Warning you can think Amy had
 the most population because you see
 $\square 9,940$ for Odessa but it is Ryan $\square 90,695$
 only 10 thousand Amarillo
 I almost picked Odessa so want to warn
 other third graders. 100 thousand