

Springy Legs

Connections to the mathematics TEKS

- (5.2) Number, operation, and quantitative reasoning. The student uses fractions in problem-solving situations.

The student is expected to:

- (B) compare two fractional quantities in problem-solving situations using a variety of methods, including common denominators
- (C) use models to relate decimals to fractions that name tenths, hundredths, and thousandths

- (5.3) Number, operation, and quantitative reasoning. The student adds, subtracts, multiplies, and divides to solve meaningful problems.

The student is expected to:

- (C) use division to solve problems involving whole numbers (no more than two-digit divisors and three-digit dividends without technology)

- (5.4) Number, operation, and quantitative reasoning. The student estimates to determine reasonable results.

The student is expected to:

- (A) round whole numbers and decimals through tenths to approximate reasonable results in problem situations
- (B) estimate to solve problems where exact answers are not required

- (5.11) Measurement. The student applies measurement concepts.

The student is expected to:

- (A) measure to solve problems involving length (including perimeter), weight, capacity, time, temperature, and area

- (5.13) Probability and statistics. The student solves problems by collecting,



organizing, displaying, and interpreting sets of data.

The student is expected to:

- (B) describe characteristics of data presented in tables and graphs including the shape and spread of the data and the middle number
- (C) graph a given set of data using an appropriate graphical representation such as a picture or line

- (5.14) Underlying processes and mathematical tools. The student applies Grade 5 mathematics to solve problems connected to everyday experiences and activities in and outside of school.

The student is expected to:

- (A) identify the mathematics in everyday situations
- (B) use a problem-solving model that incorporates understanding the problem, making a plan, carrying out the plan, and evaluating the solution for reasonableness
- (C) select or develop an appropriate problem-solving strategy, including drawing a picture, looking for a pattern, systematic guessing and checking, acting it out, making a table, working a simpler problem, or working backwards to solve a problem
- (D) use tools such as real objects, manipulatives, and technology to solve problems

- (5.15) Underlying processes and mathematical tools. The student communicates about Grade 5 mathematics using informal language.

The student is expected to:

- (A) explain and record observations using objects, words, pictures, numbers, and technology
- (B) relate informal language to mathematical language and symbols

Mathematics overview

Students use ratios, fractions, and decimals to describe and compare their Springy Legs Factors, the relationship between the measurements of their body height and the



height they can jump.

Lesson Overview

Students measure their body height and the height they can jump, use these measurements to describe their Springy Legs Factors (SLF), and compare their SLFs to other people's SLFs to make decisions and solve problems.

Materials

tape measures

string

rolls of long paper

markers

calculators

large chart paper (or spreadsheet software) for class data

Lesson resources

Books, articles or websites about basketball

Set-up (to set the stage and motivate the students to participate)

1. Discuss what makes a good basketball player. Show statistics of your favorite basketball player (e.g., height 78" and jump height 48"). Discuss how high he or she can jump. (5.14A)
2. Select a pair of students to cut a piece of string to represent the player's body height and another pair to cut a piece to represent the player's jump height. Compare the lengths of the strings by seeing how many of the jump height string will fit into the player's body height. (5.11A, 5.14A, D)
3. Discuss how you can express a player's jump height as a fraction of his or her body height. Help students generate the fraction that describes the jump height / body height ratio. This fraction will be called the Springy Legs Factor (jump height/body height = SLF). (5.14D; 5.15A, B)
4. Demonstrate how to use the calculator to show the fraction as a decimal (with an F-D function or with $48 \div 78$) and discuss how the decimal and the fraction give the same information in different forms. (5.3C; 5.2C)



5. Ask students, “What part of your body height do you think you can you jump?” Discuss how you could make the same kind of fraction—jump height/body height—for any person to describe jump height as a fraction of body height. (5.14B, D)
6. Demonstrate the following procedure for how students will compute their own SLFs. Put students in small groups to complete the following steps (as the teacher demonstrates) (5.14B). Have students record their jump heights, body heights, and SLF (in both fraction and decimal form) in a class table in order to make comparisons. For example:

(Students also can enter the jump height data, body height data, and formula for the Springy Leg on a spreadsheet so that they can easily order and reorder the data, e.g., from greatest SLF to least, to make compari-

JH	BH	JH/BH (fraction)	JH/BH (decimal)

sons and conclusions based on the data.) (5.13B, 5.14C, D)

- a. Hold the marker in one hand and stand close to the wall, facing the long piece of paper. With your feet flat on the floor, reach up and make a mark on the paper as high as you can.
 - b. Still facing the wall, jump straight up and make another mark as high as you can.
 - c. Measure the distance between the two marks. This length is your jump height (JH). Record it in the data table.
 - d. Next, measure your body height (BH)—head to toe—and record it. (The JH and BH for each person can be recorded in an ordered pair, (BH,JH).)
 - e. Record the fraction, JH/BH, use the calculator to change it to a decimal, and record it. These numbers represent your Springy Legs Factor (SLF).
7. Make a large coordinate grid for the class data, with the x-axis representing body height and the y-axis representing jump height, and have each student mark the point that represents his or her data. (Students may need to discuss appropriate rounding procedures.) Have the class discuss the shape and spread of the data. (5.13B, C)



Guiding Questions (to engage students in mathematical thinking during the lesson)

- Are you holding your marker the same way each time you mark the paper? Will it make a difference in your results? (5.11A, 5.14B)
- What other aspects of your measuring techniques are important? (5.11A)
- Does it matter if you use inches or centimeters when measuring? (Try it each way and see what happens with your SLF.) (5.11A)
- Who do you think can jump the highest? Will that predict which student has the greatest SLF? (5.2B)
- Do the tallest people have the greatest SLF? Do the shortest people have the smallest SLF? How can you tell? (5.2B)
- Once you measure JH and BH, can you predict who will have the highest and lowest SLF? Why or why not? (5.2B)
- How is this decimal like this fraction? (5.2C)
- How can you tell which SLF is greatest in fraction form? In decimal form? (5.2B)

Teacher notes (to personalize the lesson for your classroom)

Summary Questions (to direct students' attention to the key mathematics in the lesson)

To assess students' abilities to compare fractions and decimals, ask questions such as:

- What determines the size of the SLF? (Comparison of jump height to body height. The person who can jump a greater fraction of his body height will have a higher SLF than someone who jumps a smaller fraction of his body height.) (5.15A, B)
- Who has the greatest SLF? How do you know? (5.2B)
- What procedures can you use to compare two SLFs? (5.2B, 5.2C, 5.3C)



To highlight the use of lists, tables, and graphs to organize information, ask questions such as:

- Let's line up in order of body height (tallest to shortest), now jump height (highest to lowest), and now SLF (highest to lowest). How are the orders alike? How are they different? (These orderings also can be represented on a spreadsheet.)
- Do people with the same jump height have the same SLF? (5.13B, 5.14D, 5.15A)
- Do people with the same body height have the same SLF? (5.13B, 5.14D, 5.15A)
- Does the tallest person have the highest SLF? Does the shortest person have the lowest SLF? (5.2B, 5.13B, 5.14D, 5.15A)
- Is it possible to predict, by looking at your classmates, who will have the highest SLF? Why or why not? What factors influenced your decision? (5.2B, 5.13B, 5.14D, 5.15A)
- Using the tallest person and the person with the highest SLF, cut strings to show their body height and jump height and compare the two. Whose jump height is a greater portion of their body height? (5.2B, 5.14D)
- Look at the coordinate graph that compares body height and jump height. What does the shape and spread of the data tell us? (5.13B, 5.15A)
- Let's make a new graph that compares body height and SLF (or jump height and SLF). What does the shape and the spread of the data on this graph tell us? (5.13B, 5.15A)

Teacher notes (to personalize the lesson for your classroom)

Assessment Tasks (to identify the mathematics students have learned in the lesson)

- Have students pick a winning basketball team from class members and specify what criteria they used.
- Give students the JH and BH of two different students. Have students predict who they think will have the highest SLF, then calculate it and compare it to their predictions.



- Have students make a true statement about information on the class graph.
- Have students write what they have discovered about the Springy Legs Factor, telling how it is determined and what influences it.

Teacher notes (to personalize the lesson for your classroom)

Extensions (to lead students to connect the mathematics learned to other situations, both within and outside the classroom)

- Students can cut a piece of string the length of their BH and the length of their JH and compare the two. Is their JH more than half of their BH?
- Students can determine, out of their group members, whose JH is a greater portion of their BH and rank all four members' strings using this comparison (lowest to highest). Students then can rank their group according to SLF from lowest to highest. Are the rankings similar?
- Students can suppose they grew to be 78" tall but kept their same SLF. How high would they be able to jump?
- Students can collect data on famous basketball players and determine their SLFs. How do they compare to each other?
- Students can use the ordered pairs and graphs find a way to record a relationship between JH, BH, and SLF.
- Students can investigate whether other measurements (arm length, foot length, leg length) are related to the size of the SLF. They can discuss their findings with other students and prepare a statement for the class.

Teacher notes (to personalize the lesson for your classroom)

