SEESAW BALANCES

Performance Standard 8D.F

Determine how the weights of 7 objects on a seesaw can vary and still be in balance and write equations in algebraic terms accordingly:

- *Mathematical knowledge*: know how to change 3 variables in an equation expressed in algebraic terms to obtain the correct solution for two problems,
- *Strategic knowledge*: use manipulatives (e.g., beansticks) or other strategies appropriately to determine how the weights of objects on a seesaw can vary and still be in balance, and
- *Explanation*: explain completely and clearly what was done and why it was done.

Procedures

1. ***In order to use algebraic concepts and procedures to represent and solve problems (8D),*** students should experience sufficient learning opportunities to develop the following:
   - Create, model, and solve equations using concrete materials.
2. Provide students with a copy of the "Seesaw Balance" task sheet (i.e., rules for solving problems) and the rubric. Have students review and discuss the task to be completed and how the rubric will be used to evaluate it. The seesaw has 4 robots on one side and 3 on the other side. Problem 1: If the robots on the seesaw weigh 28 pounds all together, what could each kind of robot weigh? Problem 2: If the robots on the seesaw weight 34 pounds all together, what could each kind of robot weigh? The rules for solving the problems are:
   a. The seesaws must balance.
   b. Robots that look the same have the same weight.
   c. Robots that are different have different weights.
   d. All robots weigh more than zero.
   e. There are many solutions to these problems.
   f. Manipulatives may be used.
   g. Calculators may be used to check your computation.
   h. The weight of each robot may be a whole number but it could also be a decimal or a mixed number.
   i. Find 3 solutions for each problem and in writing explain how you found your solutions.
   j. Express each solution as an equation using variables.
3. Watch for students who put 28 pounds on each side. This often happens. Remind the students that the total weight of all seven robots is 28 pounds. Students must then begin putting together combinations of 14. Two whole number solutions are generally found rather quickly. Solution #1 is circles weigh 4 pounds each, triangles weigh 5 pounds and the hexagon weighs 1 pound. Solution #2 is circles weigh 2 pounds each triangles 6 pounds each and the hexagon weighs 4 pounds. Students recognize that the circles must be even whole numbers less than 6 pounds for the left side not to be overweight and follow the rules. If the circles were 6 pounds each, the triangle and hexagon would have to weigh 1 pound each. That's against the rules. If the circles are odd numbers then the right side will not come out correctly. Subtracting an odd number from the 14 pounds on the right side leaves an odd number of pounds and there are two triangles that must weigh the same. These observations should be included in their writing. By requiring three solutions the students must now explore solutions with decimals and/or mixed numbers. There are many other solutions once fractional parts are used by increasing and decreasing weights by fractions of a pound. A third possible solution is circles weigh 1 ½ or 1.5 pounds, triangles weigh 6 ¼ or 6.25 pounds and the hexagon weighs 4 ¾ or 4.75 pounds. Another observation that needs to be included in the writing is the importance of the hexagon. Its weight can be manipulated easily to make up for any fraction of a pound needed.
4. Students can express the equation using variables. The circles can be "c", the triangles "t" and the hexagon "h". The equations would be 2c+t+h=c+2t. For solution #1, c=4, t=5, and h=1. For solution #2, c=2, t=6, and h=4. For solution #3, c=1 1/2, t=6 1/4, and h=4 ¾. This is very powerful for studnenst to see the equation is the same but the variables really do vary.
5. Possible solutions for Problem #2: for this problem each side must equal 17 pounds. Students will observe and note in their writing that this time the circles must be an odd number of pounds less than 7 so that the two triangles on the right side can be an even number of pounds. There are three whole number solutions. The equation is the same: 2c+t+h=c+2t. Solution #1 c=5, t=6, h=1 Solution #2 c=3, t=7, h=4 Solution #3 c=a, t=8, h=7

6. Evaluate each student's work using the rubric and its guide to determine the performance level. Students who use manipulatives will start out by putting 14 units on each side of the balance. They will begin to assign weights to the robots until they find one way to make it balance. They should then determine what the variable is and write an equation to match the weights they have determined. They will continue to move the manipulatives around until they find another combination. After several combinations are found and equations written, the student will begin to see a pattern. Some students will see that increasing one robot's weight by a fraction of a pound and lowering another's by a corresponding amount will achieve the same balance. Once this pattern is discovered, the solutions are almost limitless.

Examples of Student Work not available

Time Requirements

- One class period

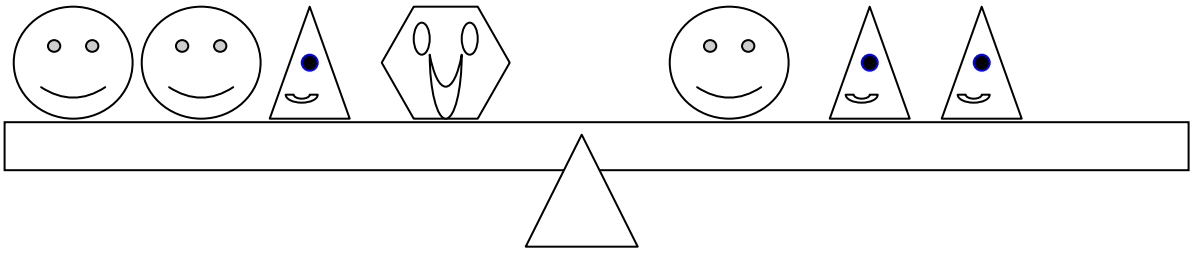
Resources

- Copies of the "Seesaw Balance" task sheet
- Pencil
- Calculator
- Rainbow cubes
- Other manipulatives as needed
- Mathematics Rubric

NAME _____ DATE _____

Seesaw Balances

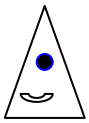
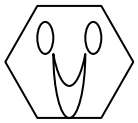
Student Task Sheet



Rules:
Balance the seesaw.
Robots that look the same have the same weight.
Robots that are different have different weights.
All robots weigh more than zero.

There are many solutions to these problems.
Manipulatives may be used.
Calculators may be used to check your computation.

1. If the robots on the seesaw weigh 28 pounds all together, what could each kind of robot weigh? Explain your solutions.

2. If the robots on the seesaw weigh 34 pounds all together, what could each kind of robot weigh? Explain your solutions.