

Compare and Contrast Functions

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Third Grade Lessons

1. **Comparing Different Functions** - The students will discuss, represent, and solve a verbal problem involving the choice between two functions.
2. **Comparing Graphs** - Students are given an hourly rate of pay and infer coordinates for (h, \$) over a range of hours. They produce a table and a graph of work-pay. Then they produce another graph for another rate of pay and discuss differences in time and pay.
3. **How Many Points?** - Students work with: (a) a context — distance as a function of time; (b) generating coordinates.
4. **Human Graph II** - Students graph the functions $k \times 2$ \$/h and $k \times 3$ \$/h. The idea is to show that for each linear function the points fall onto a straight line.
5. **Interpreting Graphs** - Students will be given two linear distance-time graphs and asked to tell a story about each graph and to compare them. They will later explore comparisons between points in each line.
6. **Rates vs Totals** - Students compare points on an hours/pay Cartesian space. The main challenge lies in recognizing that, although one student earned more, the other student was paid better, that is, at a higher rate of pay. They must indicate the difference in pay and the differences in amount worked.

Fourth Grade Lessons

1. **Comparing Functions** - This lesson is split into two days. In the first class, the students will analyze eight basic graph shapes and will represent and solve a verbal problem involving the choice between two functions. In the second one they will be asked to choose, among the eight basic graph shapes, the ones that matches specific situations.
2. **Comparing Strips of Unmeasured Lengths I** - The class is the first of a series that will focus directly upon the algebraic representation of measurements and their multiplicative relations. Children are asked to compare the lengths of strips, to describe the relationships between them in multiple ways, and to demonstrate that the relationships they represent are true.
3. **Comparing Strips of Unmeasured Lengths II** - The class is the second of the "Strips of Unmeasured Lengths" series that will focus directly upon the algebraic representation of measurements and their multiplicative relations. Children are asked to compare the lengths of strips, to use algebraic notation to describe the relationships between them, and to demonstrate that the relationships they represent are true.
4. **Comparing Strips of Unmeasured Lengths III** - This is the third lesson in the "Strips of Unmeasured Lengths" series that focuses directly upon the algebraic representation of measurements and their multiplicative relations. We will work with the relationship $B = 3S$, focusing on equations and their verbal descriptions and on true and false equations and statements.
5. **Evaluation Problem** - Students will be given a problem that asks about the amount of money each person has, based on the amount in a piggy bank. They will be given one graph and asked to draw the second graph.
6. **Fourth Grade Assessment IV** - This is a written assessment where children will compare two students. One of the students' speed can be represented linearly while the other's speed is represented by a non-linear graph.
7. **Graphing Halves and Doubles** - Children work on a problem about distance and time and compare two rates: half a meter per second and two meters per second.
8. **Graphing Thirds and Triples** - Children work on a problem about distance and time and compare two rates: one third of a meter per second and three meters per second.
9. **Intervals** - Students reason about graphs showing growth over time. They compare heights of children and heights of two animals at different time intervals.
10. **Running Race I** - Compare a race between two students: one who runs at a constant pace, the other who tires out as the race proceeds.
11. **Running Race II** - Compare a race between two students: one who runs at a constant pace and one who changes pace as the race proceeds.
12. **Swimming Pools I** - Compare how two swimming pools fill up with water over several hours.
13. **Varying Speed** - Children are asked to tell a story about a trip depicted through a graph that has varying slopes/speeds.
14. **Varying Velocity** - Children are asked to tell a story about a trip depicted through a graph that has varying slopes/velocities.
15. **Wallet Problem I** - Students compare the amounts of money two students have. The amounts are described relationally but not through precise dollar amounts.
16. **Wallet Problem II** - Students will be given a wallet problem. They will be asked to compare the amounts of money two students have. The amounts are described relationally but not through precise dollar amounts.
17. **Wallet Problem III** - Students will continue working with the wallet problem. They will be shown a graph for Mike's amounts and asked to (a) determine whether it represents Robin's or Mike's money and (b) to predict where the line for Mike would fall. Later they will plot Mike's amounts and will discuss why the lines cross.

Fifth Grade Lessons

1. **Basic Function Shapes** - In this lesson, the students will (a) discuss, represent, and solve a verbal problem involving the choice between two functions; (b) choose, among 8 basic graphs (7 distinct shapes), the one that matches specific situations; and (c) write stories to match a specific graph shape.
2. **Equations and Graphs** - Students will further compare two linear functions in the context of evaluating two plans for shoveling snow. One plan has two parts: a basic charge plus a charge based on the number of square meters cleared. The other plan has no basic charge; it only charges according to the number of square meters cleared. However the per-meter charge is higher than in the other plan. Students are asked to determine the circumstances in which the bill from each plan would be the same. They then examine the graph of the two functions and discuss how equations and inequalities relate to the graph.
3. **Fifth Grade Assessment III** - This assessment will focus on writing equations to solve verbal problems and on solving equations using the syntactic rules of algebra.
4. **Phone Plans** - Students will compare two linear functions in the context of evaluating phone plans. One plan has two parts: a basic charge plus a charge based upon the number of minutes used. The other plan has no basic charge; it only charges according to the minutes used. However the per-minute charge is higher than in the other plan. Students are asked to determine the circumstances in which the monthly bill from each plan would be the same. They then examine the graph of the two functions and discuss how equations and inequalities relate to the graph.
5. **Train Crash** - Students will compare two linear functions represented in a graph. They reason about the problem using (a) the word problem and two diagrams; (b) a graph of position vs. time; (c) a table of values (d) making expressions for each position function; and (e) solving the equation algebraically.
6. **Two Phone Plans I** - Students compare two phone plans, one of which has a lower rate, but a monthly basic charge; the other has a higher rate but no basic charge.

7. **Two Phone Plans II** - Students will work on the comparison between two phone plans (also used in the lesson "Two Phone Plans I"), one of which has a lower rate, but a monthly basic charge, the other has a higher rate but no basic charge.
8. **Varying Rates of Change** - Students will compare three functions, two of which are nonlinear, that tell the story of three cousins who all save \$1,000 in one year. One saves a lot the first day and less and less each day as time goes on; one saves very little the first day and more and more each day throughout the year; the last cousin saves the same amount each day. Students will be asked to predict the shape of the graph for each function and, later, to look at and describe graphs of all three cousins' savings.

Middle School Lessons

1. **Compare and Contrast** - Students will identify the y-intercept and slope using equations and then use that data to create corresponding tables and graphs.
2. **Contrasting Equations** - Students write equations for three graphs and examine their slopes by comparing and contrasting the graphs. Students also look at the same functions graphed on differently scaled coordinate planes.
3. **Coupon Activity** - Students will create graphs, tables and equations to explain their stories and look at how a graph changes depending on the y-intercept.
4. **Graphing Equations - Nonlinear Functions** - Students write equations for three graphs and examine their slopes by comparing and contrasting the graphs. Students also look at the same functions graphed on differently scaled coordinate planes.
5. **Phone Plans** - Students will compare two linear functions in the context of evaluating phone plans. One plan has two parts: a basic charge plus a charge based upon the number of minutes used. The other plan has no basic charge; it only charges according to the minutes used. However the per-minute charge is higher than in the other plan. Students are asked to determine the circumstances in which the monthly bill from each plan would be the same. They then examine the graph of the two functions and discuss how equations and inequalities relate to the graph.
6. **Relating Graphs and Equations - Linear and Quadratic Functions** - Students will generate graphs from given equations and equations from given graphs.
7. **Same and Different** - Students will compare graphs of linear functions, looking for similarities and differences, and will produce algebraic expressions, again identifying what is the same and what is different about each one.
8. **x^2 and x** - Students will generate tables and graphs from quadratic and cubic equations with different multipliers on the highest degree term.