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| **Title** | Dinner Party: Using pattern trains to demonstrate linear functions |
| **Introduction** | The purpose of this lesson plan is to give students a real life application of how to recognize and use a linear function. Too often, the experience of learning linear functions is relegated to memorizing an algorithm with little attachment to anything concrete. This abstract learning experience, disconnected from anything tangible or real, relies solely on the ability of the student to memorize the steps to solve the problem. Most struggling math learners lack the ability to retain information, unless it is connected to a concrete model or real life experience. By participating in the exploration in this lesson, students will design a linear function without realizing it! This lesson will help demystify this abstract content. |
| **Curriculum Alignment** | Algebra I NC SCOS Goal 4:  **4.01** Use linear functions or inequalities to model and solve problems; justify results.   1. Solve using tables, graphs, and algebraic properties. 2. Interpret constants and coefficients in the context of the problem.   Common Core High School Algebra I:  F.IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.  F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.  F.BF.1 Write a function that describes a relationship between two quantities.  This lesson aligns with the Common Core Standards for Practice 4: Model with mathematics.  National Coucil for Teachers of Mathematics Math Standards for Algebra:  **Grades 9–12 Expectations**: In grades 9–12 all students should–   * generalize patterns using explicitly defined and recursively defined functions; * understand relations and functions and select, convert flexibly among, and use various representations for them   There is an implied connection between algebra and geometry in this lesson. The students will develop an algebraic function using geometric shapes. |
| **Learning Outcomes** | Students will construct a linear function that models the progression of perimeters in geometric patterns.Students will create a model to describe their pattern.Students will translate the process for a different pattern of shapes. |
| **Time Required and Location** | Three 90-minute block periods |
| **Materials Needed** | Each group of four students will need   * a set of 8 or more octagon blocks * chart paper * markers * pencil and paper * exploration handouts (1 per group) * blank paper * rulers * Handouts:   + Dinner Party Activity Sheet   + Dinner Party Activity Sheet for Day 2 (New Shape)   + Dinner Party Assessment Guidelines   + Dinner Party Random List of Numbers   + Four Forms Template   + Functions and Shapes Matching Game   + Same and Different Chart   **Technology resources**  Document Camera (for student demonstration)  Overhead projector (to be used if access to a document camera is unavaible)  SMART Board and LCD projector  Computers with internet access for student journaling (1 computer per group preferable)  Computers with internet access to use online software Geogebra   * Geogebra can be accessed at geogebra.org * Without geogebra, students can draw their seating charts by hand with rulers. |
| **Safety** | Follow typical classroom safety procedures. |
| **Participant Prior Knowledge** | Students should have some background knowledge in recognizing and articulating patterns.  Students should be able to define perimeter and be able to compute the perimeter of polygons.  Students should have an understanding of the concept of a variable, and be able to recognize the unknown value in a word problem.  Students should be able to plot ordered pairs on the Cartesian Plane. |
| **Facilitator Preparations** | The teacher should prepare the classroom to be set up in groups of 4 students. There will need to be a set of at least 8 octagon blocks for each table. If blocks are not accessible, make octagons out of cardstock and have them laminated so that they can be re-used. Stock each groups table with chart paper and markers.Teachers must also cut out and mix up the cards for the function matching game. Placing them in sandwich bags would be the easiest way to distribute and manage.Students will need background knowledge of basic shapes in geometry. They will only need a superficial understanding of properties of polygons (number of sides). The student will need some experience in recognizing patterns. It may be a good idea to look at and discuss some very basic patterns before beginning this lesson. |
| **Assessment** | Using the random number list, assign each student a number. This number will represent the number of guests that the student will host at his or her dinner party. Refer to the Assessment Guidelines for the assessment instructions. Students should complete their dinner party plan and the four forms template for their function. |
| **Critical Vocabulary** | Variable - a letter used to represent a number value in an expression or an equation.  Function - a special relationship between values: Each of its input values gives back exactly one output value.  Linear relationship – a special relationship between values in which the rate of change is constant.  Rate of change – the speed at which a variable changes over an amount of time.  Independent variable – a variable in a relationship whose value determines the value of other variables.  Dependent variable – a variable in a relationship whose value is determined by the values assumed by other variables in the relationship. |
| **Alternative Assessments** | * If necessary, use the matching game as guided practice instead of independent practice, walking the whole class through the process of choosing which cards are matches. * The assessment can be done in class or in the lab to provide extra scaffolding for struggling students. |
| **Supplemental Information** | SAS Curriculum Pathways Quick Launch #5000 (sascurriculumpathways.com)  This site provides an in-depth lesson on how to calculate rate of change and write a linear function. It provides many real-world applications to this content, and provides a lot of student practice. This is a great resource for prerequisite content, or for extra practice in or out of class.  Khan Academy:   1. This video demonstrates how to, given a verbal problem, write a linear function.   <http://www.khanacademy.org/video/basic-linear-function?playlist=Algebra+I+Worked+Examples>   1. This video demonstrates how to recognize if a function is linear.   <http://www.khanacademy.org/video/recognizing-linear-functions?playlist=Algebra+I+Worked+Examples>   1. This video explores linear relationships, recognizing patterns and writing functions.   <http://www.khanacademy.org/video/exploring-linear-relationships?playlist=Algebra+I+Worked+Examples> |
| **Comments** | The amount of prerequisite knowledge that students need to have depends on the ability level of the course. I have used this lesson in algebra I and introductory math. Algebra I students can handle this without any prior talk of linear functions. In introductory math, we spend several days discussing equations of the form y = kx before completing this lesson. |
| **Author Info** | Austin James is a math teacher at Millbrook IB Magnet High School in Raleigh, NC. He has been at Millbrook since 2008. In addition to teaching algebra and pre – calculus, Austin coaches soccer and baseball for the Wildcats. He is a 2011 Kenan Fellow, and earned a BS in mathematics education and political science from NC State University and a MA Ed. from Wake Forest University. He frequently presents at regional and state conferences on teaching mathematics to students with disabilities.  This lesson was designed as part of a Kenan Fellowship geared towards equipping teachers with tools to meet the Common Core standards for 9-12 mathematics. This plan is designed for low-level algebra students, and emphasizes concrete real world application over rote memorization of procedures.  Mentor: Gregory McKnight, Department of Public Instruction Professional Development Leader |