**Lesson Title:** Break Even T-Shirts

**Unit Title:** Linear Functions

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**Subject, Grade Level, and Date:**

* 8th grade Mathematics (Introduction to Algebra course)
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**Placement of Lesson in Sequence and Lesson Rationale**

* Placement of this lesson in this unit is an extended lesson plan that may take up to 3 days to fully complete the lesson. The first day will introducing the lesson concepts and mathematical language that students will be required to use at the end of the lesson. For added efficiency, students will have homework to research the different prices of their shirts and return for the second day with the researched prices. The second day, the students will combine as groups to begin to create function that reflects predictions of which t-shirt cost will maximize their profits, the maximum number of t-shirts to sell is 100. The final day of the lesson is dedicated to the group presentations to share with the class their predictions and thought process, as well as reflect on what they learned and how they can apply the new skills to future situations.

**Central Focus and Purpose**

* The focus of this lesson is to provide students with the experience of how the linear relationships are created and use these new skills to apply to their own ‘small business’. The purpose of the modeling activities - selling t-shirts - is one way students will be able to use their new skills to predict how successful their group business can be and reflect on the actual outcome with the class using the mathematical language of the lesson, which is linked to the common core standards. The common core standards are generally about constructing linear functions.

**CCSS.MATH Content and Practice Standards**

* **CCSS.MATH.CONTENT.8.F.B.4** - Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (*x, y*) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
* **CCSS.MATH.CONTENT.8.F.B.5** - Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.
* **CCSS.MATH.PRACTICE.MP4** - Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

**Prior Content Knowledge and Pre-Assessment:**

* All students are at grade level and can write a linear equation when given a table or graph and can graph a line when give an equation.

**Learning Target(s) and Plan for Clarifying Intending Learning**

* **LT-1…** I can develop a general linear function formula from information provided.
* **LT-2…** I can analyze data collected and describe the relationship between the number of shirts sold at the different prices, as determined by my group**.**
* **LT-3…** I can predict which shirt price will be more successful and how I can apply these skills for similar situations.
* **Plan for clarifying intending learning…**

Students will begin by writing down the learning targets in their journals. Next, they will find a cross-town buddy and discuss the learning targets and write down any questions they have.

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| **Strategy for using assessments to guide student learning** |
| The students will need to be able to use proper academic language to explain their predictions of the shirt costs and the group's overall success a business.  |
| **Success Criteria** (criteria for interpreting student success of the learning target) | **Plan for providing feedback and students’ monitoring of their own learning** |
| Student success will be measured by a rubric, listing the clear expectations of the students and how it relates to the learning targets and common core standards. | Feedback will be provided throughout the course of the 3 day lesson by the teacher and fellow peers. The pace of the lesson will be planned by the teacher, but it is the knowledge of the students that the teacher used a reference during the planning process. Students will monitor their own progress by referring to the learning targets.  |

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| **Academic Language Demands** |
| **Language Function** | **Vocabulary & Symbols** | **Secondary Language Demand** |
| * Students will explain how they developed their formulas
* Students will be able to justify that their final chosen price of their selling shirt is best compared to other prices.
 | * Special terms: profit, cost, revenue, break even point, and loss
* Independent (x) and dependent (y) variables
* Linear equation formulas
* Rate of change/slope formula
* Axis labels: X axis and Y axis
 | **Mathematical Precision:*** Initial cost to buy shirts
* Price they will sell their shirts for
* Know how many shirts they need to sell before they start making profit

**Syntax:** In their formulas they must include the starting cost to buy the beginning 100 shirts, and the price they are selling each shirt for. **Discourse:** They will be separated into small groups which they will do their research and project with together.  |

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| **Language Support** (instructional and assessment strategies) |
| **Language Instruction**  | **Guided Practice**  | **Independent Practice**  |
| Teacher will model the lesson with a ‘business’ venture situations that students will need to predict whether or not the business is a successful or not. Use in terms of learning targets. | Students will be asked to determine the success of a ‘business’ venture situation and calculate the revenue profit and loss and explain during class discourse. | Students will be assessed on their understanding of their t-shirt ‘business’ by researching different shirt costs and how the different shirt costs reflect on the success of the business. A rubric will be provided for the final student group presentations. |

**Differentiation, Cultural Responsiveness, and Accommodation for Individual Differences**

* To accommodate the different cultural and individual differences and learning abilities, the students have the opportunities to work in groups where they will all contribute and help put together the final project/presentation. Throughout this lesson and activity, the students will be actively participating in the Five E’s. They will be engaged in the relatable topic, exploring different research online, explaining what they individually come up with, elaborating with their group on what to present, and finally evaluating their final product before they present.

**Materials – Instructional and Technological Needs**

* graph paper
* internet access for research
* word/excel
* course notebook - for thought process notes
* Calculators
* Poster board for final group explanations
* Markers, pencils, scissors, and glue
* Lesson rubric: added to the end of this lesson plan

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| **Instructional Plan: Day 1**  |
| **Pacing** | **Teacher Activities** | **Student Activities** |
| Before class starts | TW greet students at the door, and ask them questions about their day | SW come into the classroom and get ready to learn. If they need an extra pencil or paper, they can sign out the supplies and return them at the end of class. |
| 10 minutes | Entry Task will be posted on the board | SW begin their entry task. Their task is to answer the questions written on the board. Q1 is to write a linear equation from the graph that is given.(Source: <https://www.ixl.com/math/grade-8/write-a-linear-equation-from-a-graph>) Q2 is to have the students make a graph from an equation that is given.(Source: <http://www.mathworksheets4kids.com/function/graphing-linear2.pdf>) Q3: Write down at least two stores that you like to buy clothes from.Connection Question: How do you judge a business as a success or failure? What is cost? Profit? And revenue?  |
| 10 minutes | Teacher led class discussion/informal interview | SW volunteer the answers that they knowWhat do you know about businesses?What does profit mean?What does revenue mean?What are some ways that a business can earn revenue? |
| 10 minute  | Lecture: TW go over new information such as vocabulary and other procedures such as graphing cost and revenue. | SW take notes in their math journals and ask questions when they need clarification |
| 5 minutes | Hook: TW show the students a video on how much companies “rip us off”( <https://youtu.be/tvMsraTXx_c> ) | SW be required to listen and write questions that peaked their curiosity for further class discourse |
| 5 minutes | TW introduce the t-shirt business activity and pass out the rubrics. | SW be able to ask clarifying questions about what they will will be doing. |
| 15 minutes - end of class | TW show the students their assigned groups and assign the home research task to discuss with their groups upon return to classTW also let the students know that they need to bring in a poster board to class tomorrow. They will only need one poster board per group.  | SW be asked to research the cost of shirts either online, in store, or estimation (only 3-5 prices per student)Each SW work with one combination of costs and profit so that each group has a total of 3 to compare with each other in their final presentation. |

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| **Instructional Plan: Day 2**  |
| **Pacing** | **Teacher Activities** | **Student Activities** |
| 10 minutes | TW post entry task -Kate | SW (warm-up questions) (group's shirt price decision-only 3 needed for activity) |
| 5 minutes | TW allow the students to find a cross town buddy and then set a timer for one minute while the students play the game “Talk A Mile A Minute”. Then when the second student plays, the TW set the timer for one more minute. | SW play the game “Talk A Mile A Minute” and quiz each other on the vocabulary learned yesterday. To play they will find a crosstown buddy. The first buddy will define the following terms (without saying the actual word): cost, break even point, and rate of change, while their partner will try to name the term that they are describing. Then they will switch places and the second person will describe the words profit, revenue, and loss. |
| 2 minutes | TW post the list of groups on the board again and instruct them to sit together and work on their project. | SW meet with their groups |
| 30 minutes | TW go around to each group to monitor how the students are doing. TW make announcements to the class if there are repeating questions that the students ask.TW also mark down which members of the group are doing a good job participating and give them participation points for the day. | SW make a prediction of which shirt price will be best for their business. The will then begin to construct a formula to represent the cost of the t-shirts, and a formula to represent the revenue. They will compare formulas with their group before graphing the functions. They will include important information on their graphs such a title, labels for x and y axis, scales for each axis, and label their break even point. They will then answer the following questions on a separate piece of paper: Q1: Why did you chose this formula to represent the cost of your t-shirts?Q2: Why did you chose this formula to represent the revenue?Q3: What equation would represent the total profit that your business makes?Q4: Is your break even point labeled on your graph? What amount is it? What does this number represent?Q5: Which shirt price is the most successful? Does this match your prediction? Why do you think this is?SW check in with their groups each step of the way to maximize student growth. |
| Approx. 3 minutes | TW instruct the class to wrap up the assignment clean up. If they have any work leftover, they should finish it as homework but most students should be done with their work. | SW finish their work and clean up their area. |
| 1 minute- end of class | TW remind the students that if they didn’t bring in their poster board today, they need to bring it in tomorrow for their presentations. | SW write in their planners if they need to finish up any of their work and/or bring in a poster board. |

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| **Instructional Plan: Day 3** |
| **Pacing** | **Teacher Activities** | **Student Activities** |
| Before class starts | TW greet students at the door, and ask them questions about their day | SW come into the classroom and get ready to learn. If they need an extra pencil or paper, they can sign out the supplies and return them at the end of class. |
| 20 minutes | TW have posted on the board that the students have 20 minutes to paste their finished work onto their poster board | SW meet with their groups and begin pasting together their project onto the poster boards. They will also assign who will present each part. |
| 25 minutes | TW grade students based on the rubrics they were given. | Each group of students will present their business and tell the class their mathematical process, and results for which prices gave them the best profit.  |
| 5 minutes | TW lead the class in a discussion about how this assignment connected to the CCSS Standard. | SW offer their ideas and ask any questions that they have. |
| 1minute- end of class | TW pass out sticky notes for exit slips. | SW write on Exit Notes how they can use these skills in the real world as well as something that they liked and disliked about the activity. When they are finished, they will stick the Post-It on the door as they leave the classroom. |

**Group Assignments:**

Group 1:

Victoria

Becky

Charley

Group 2:

Chandler

Monica

Ross

Group 3:

Harry

Ron

Hermione

Group 4:

Bella

Eddy

Jake

Group 5:

Jaimie

Jennifer

Billy

Group 6:

Ash

Pika

James

Group 7:

Rhonda

Cody

Daniel

Group 8:

Ryc

Stephany

Amanda

**Small Business Rubric**

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|  |  Unsatisfactory1 point |  Competent2 points | Proficient3 points | Distinguished4 points |
| Technique / Concepts |  Work lacks understanding of concepts, materials, and skills. |  Work shows understanding of concepts, materials, and skills. |  Work reflects understanding of  concepts and materials, as well as use of skills discussed in class. |  Work shows a mastery of skills andreflects a deep understanding ofconcepts and materials. |
| Habits of Mind | Student passively attempts to fulfillassignment without much thought or exploration of possibilities. Student refuses to explore more than one idea. |  Developing exploration of possiblesolutions and innovative thinking.Student has more than one idea but does not pursue. |  Student explores multiple solutionsand innovative thinking developsand expands during project. |  Consistently displays willingness totry multiple solutions and askthought provoking questions,leading to deeper, more distinctiveresults. Student fully exploresmultiple ideas and iterations. |
| Reflection & Understanding |  Student shows little awareness oftheir process. The work does not demonstrate understanding ofcontent. |  Student demonstrates some self-awareness. Work shows someunderstanding of content, but student cannot justify all of theirdecisions. |  Student shows self-awareness.Work demonstrates understandingof content and most decisions areconscious and justified. |  Work reflects a deep understandingof the complexities of the content.Every decision is purposeful andthoughtful. |
| Craftsmanship |  Work is messy and craftsmanshipdetracts from overall presentation. |  Work is somewhat messy andcraftsmanship detracts somewhatfrom overall presentation. | Work is neat and craftsmanshipIs solid. |  Work is impeccable and showsextreme care and thoughtfulness inits craftsmanship. |
|  Effort | Work is not completed in asatisfactory manner. Student showsminimal effort. Student does notuse class time effectively. |  Work complete but it lacks finishingtouches or can be improved with alittle effort. Student does justenough to meet requirements. |  Completed work in an above average manner, yet more could have been done. Student needs to go one step further to achieve excellence. |  Completed work with excellenceand exceeded teacher expectations. Student exhibitedexemplary commitment to theproject. |
| **TOTAL:** |  |  |  | **20 points** |

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|  |  Insatisfactorio1 punto | Competente2 puntos | Competente3 puntos | Distinguido4 puntos |
| Technique / Conceptos | El trabajo carece de comprensión de los conceptos , materiales y habilidades . | El trabajo muestra que comprende conceptos , materiales y habilidades . |  El trabajo refleja la comprensión de conceptos y materiales , así como Uso de habilidades discutidos en clase . |  Su trabajo muestra un dominio de las habilidades yrefleja una profunda comprensión deconceptos y materiales. |
| Hábitos de la mente | El estudiante intenta de forma pasiva para cumplircesión sin mucho pensamiento o la exploración de posibilidades . Estudiante se niega a explorar más de una idea . |  El desarrollo de exploración de posiblessoluciones e ideas innovadoras .El estudiante tiene más de una ideapero no persigue . | Estudiante explora múltiples solucionesy el pensamiento innovador desarrollay se expande durante el proyecto. |  Consistentemente muestra voluntad detratar múltiples soluciones y pedirpensado preguntas provocadoras ,dando lugar a más profunda, más distintivaresultados. Estudiante explora plenamentemúltiples ideas y iteraciones . |
| Reflexión y Entendimiento |  Alumno muestra poca conciencia desu proceso . El trabajo no lo hacedemostrar comprensión decontenido. | El estudiante demuestra un poco de autoconciencia. El trabajo muestra algunosla comprensión del contenido , peroEl estudiante no puede justificar la totalidad de sudecisiones . | El estudiante muestra la auto-conciencia .El trabajo demuestra la comprensióndel contenido y la mayoría de las decisiones sonconsciente y justificada. | El trabajo refleja una comprensión profundade las complejidades del contenido.Cada decisión es un propósito ypensativo. |
| Artesanía Esfuerzo | El trabajo es complicado y la artesaníaresta valor a la presentación general . | El trabajo es un tanto complicado yartesanía resta un tantode presentación general . | El trabajo es limpio y la artesaníaEs sólido. | El trabajo es impecable y espectáculosextremo cuidado y consideración ensu artesanía . |
| Esfuerzo | El trabajo no se termina en unade manera satisfactoria. demostraciones estudiantilesel mínimo esfuerzo. El estudiante no lo haceutilizar eficazmente el tiempo de clase . |  Obra completa pero carece de acabadotoca o se puede mejorar con unapequeño esfuerzo. El estudiante hace justosuficiente para cumplir con los requisitos . | Completado el trabajo de una manera superior a la media , pero más se podría haber hecho . El estudiante necesita dar un paso más para alcanzar la excelencia . | Completado el trabajo con excelenciay superó el maestroesperanzas de heredar. estudiante exhibidocompromiso ejemplar con laproyecto. |
| **TOTAL:** |  |  |  | **20 puntos** |