

Getting Started with the *CandyBot* Educational Game

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Purpose of *CandyBot*

Introduction

CandyBot is an educational game designed to support students' learning about fractions and functions. Players program a robot by creating units and defining three kinds of functions: an addition function, a multiplication function, and a division function. The main goal of the game is to train the robot to efficiently satisfy customer orders for various numbers candy bars.

Background & Purpose

CandyBot is third in a series of transformative apps designed to enhance mathematics education for middle school students. The first in the series, *CandyFactory*, focuses on understanding and manipulating fractions. The second in the series, *CandyDepot*, focuses on the critical pre-algebraic mental activity of coordinating units. *CandyBot* focuses more directly on algebraic reasoning, especially students' understanding of functions. This new game invites players to automatize work done at the *CandyFactory* and the *CandyDepot* by programming a robot. Players must program the robot to satisfy ever more complicated customer orders, which include improper fractions and mixed numbers.

This game can be used as a class activity for students. Once students download the game, it can be played anywhere—even in areas lacking an Internet connection. The game is designed to be played again and again so students can develop fractions knowledge and algebraic reasoning. It is expected that players will be able to master the game in one or two hours, should they choose to play end-to-end. However, players can continue playing the game to find more and more efficient and sophisticated solutions to problems. Each time the player initiates the game, new orders are generated to prevent redundancy and maintain a prescribed level of challenge.

Learning Objectives

CandyBot is targeted to middle school students, who can coordinate at least two levels of units (the focus of *CandyDepot*) and have constructed measurement conceptions for fractions (the focus of *CandyFactory*). The game will enable target players to practice and potentially improve their algebraic reasoning. *CandyBot* requires minimal reading as the game emphasizes visuals, animations, and actions to convey the game's story. Therefore, players will be required minimal requisite reading skills at the middle school level.

CandyBot should help teachers and students meet the following learning objectives:

1. Students will learn to coordinate various kinds of units, including composite units and unit fractions, to produce fractions and mixed numbers.
2. Students will learn to symbolize mathematical activities, such as adding, multiplying, and dividing unknown quantities.
3. Students will learn to transform units from the input to units of the output—supporting an emerging understanding of functions.

***CandyBot* Learning Progression**

Game Narrative

Upon entering the game, the benevolent President Carmelo fast tracks you for promotion. She informs you that you are now responsible for automating production by programming the company's new robot, which you can name. To be successful, you must program the robot to slice and bundle various units to complete a wider and wider array of customer orders.

Game Play and Educational Considerations

- *CandyBot* incorporates slicing and bundling (from the *CandyFactory* and *CandyDepot* games, respectively) to mediate partitioning and iterating actions.
- *CandyBot* involves coordinating various kinds of units, including composite units and unit fractions.
- Game play is enhanced through the use of trophies for correctness, speed, and efficiency, which encourage students to master concepts.
- *CandyBot* features a colorful interface with large gaming elements to enhance game interaction.
- Simple game gestures (physics) are incorporated in an effort to satisfy universal design considerations.

Mapping the Common Core State Standards for Mathematics to *CandyBot*

Grade 5

- Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

5.NF.3: Interpret a fraction as division of the numerator by the denominator ($a/b = a \div b$). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem.

5.NF.6: Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.

Grade 6

- Apply and extend previous understandings of arithmetic to algebraic expressions.
- Reason about and solve one-variable equations and inequalities.

6.EE.2: Write, read, and evaluate expressions in which letters stand for numbers. Write expressions that record operations with numbers and with letters standing for numbers. For example, express the calculation “Subtract y from 5” as $5 - y$.

6.EE.6: Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.

6.EE.7: Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p , q and x are all nonnegative rational numbers.

Grade 7

- Develop understanding of operations with rational numbers and working with expressions and linear equations
- Analyze proportional relationships and use them to solve real-world and mathematical problems
- Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers

7.RP.2: Recognize and represent proportional relationships between quantities.

- a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.
- c. Represent proportional relationships by equations. For example, if total cost t is proportional to the number n of items purchased at a constant price p , the relationship between the total cost and the number of items can be expressed as $t=pn$.

7.NS.3: Solve real-world and mathematical problems involving the four operations with rational numbers.

7.EE.4: Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

Grade 8

- Formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation
- Grasping the concept of a function and using functions to describe quantitative relationships

8.EE.7b: Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

8.F.1: Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output

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Related Research

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