

# Integrating Spreadsheets in Middle School Mathematics Algebra: Curriculum Outline

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## Introduction

This set of curriculum materials have developed around eight (8) major concepts that are typically considered in a first year algebra course in the middle grades. The activities in each concept area have been purposefully designed to guide students in building skills with spreadsheets so that they are learning to use spreadsheets as mathematical learning tools. Some key spreadsheet concepts and ideas include:

1. Charting of data in the spreadsheet helps students in visualizing the ideas and in communicating their results.
2. Spreadsheets can be used to explore multiple connected representations – tables of data that are created by entering formulas (symbolic representations) that are then dynamically connected with charts. Students are able to make connections among the various representations and see how a change in the table, dynamically updates the chart as they explore particular mathematical ideas.
3. In designing spreadsheet to solve mathematics problems, plan to use this solution beyond the specific problem. Design the spreadsheet to be dependable for extending the knowledge for the problem.
4. Design dynamic spreadsheets that are descriptive of the more general situation so that the spreadsheets can be used to model different cases. For example, create a spreadsheet that can be used to explore multiple linear function problems.
5. Using the ROUND function to two decimal places causes the computer to change the internal value to have only those two decimal places; alternatively, formatting the cell to display two decimal places only changes the visual presentation. The internal value for future calculation is unchanged.
6. Designing spreadsheets that are dependable under changes in the data and key variables in the model.
  - o Use spreadsheet **built-in formulas** rather than relying on user-defined formulas since these formulas typically ignore blank cells. On the other hand, user-defined formulas often assume a blank cell contains the value of zero (0).
  - o Create formulas that **reference cell names** rather than embedding particular numeric values.

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Avoid formulas that embed the values like the 8 in this formula:

$$= \text{SUM}(\text{B2:B10})/8$$

Refer to values by the cell names in which the values are stored. Spreadsheet uses the values in cells B2 through B10 and B1 in computing the value

$$= \text{SUM}(\text{B2:B10})/\text{B1}$$

- Spreadsheets rely on **relative referencing** when copied to other cells. If A2 have the formula =B2-C 3and this formula is copied to D2, the formula changes to =E2-F3, and if this formula is copied to M4 the formula becomes =N4-O5 to reference the row and column shifts.
  - Use **absolute referencing** to maintain a cell reference when copying the formula. If A2 has the formula =\$B\$2 – C3 is copied to D2, the formula in D2 becomes =\$B\$2 – C3 and if copied to M4, the formula is =\$B\$2 – O5. The dollar sign (\$) before the column letter means maintain that and do not change it when copying to another cell; the dollar sign (\$) before the row number means maintain that number and do not change it when copying to another cell.
6. Test the spreadsheet with different data is as important as “checking a solution” done by hand. Try different values to assure that the formulas return the desired results.

### Introduction to the Curricular Ideas

Each topic and each general idea within the topics is presented by a **Resource Card**, specific **Worksheets** and **Spreadsheets** that can be used in incorporating the activity in the class. The Resource Cards provide a general description of how to use the Worksheets. The Spreadsheets may either be ones that are provided for students to work with as they work on the presented problem. All of these spreadsheets contain solutions that are hidden that can be displayed using these actions:

Format→Sheet→Unhide→<solution files>

The solutions are one method to provide an idea of the intent of the activity. Some spreadsheets are simply solution spreadsheets and not intended to be given to the students. The students are expected to design the spreadsheet on their own.

The presentation of the activities has been purposefully designed to build student skills with spreadsheets as mathematical exploration and problem solving tools. The ideas for the problems are a combination of problems and data found in the *Connected Mathematics Algebra 6-7-8* by Lappen, Fey, Fitzgerald, Friel, and Phillips and published by Dale Seymour Publications, 2002. These problems that we have designed provide ideas for how you might incorporate spreadsheets with the problems you find in these books. We have often embedded them within the context of Dash, Violet and their Incredible parents. Feel free to make changes in these names to better suit your students.

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✦ **If your students have never used spreadsheets before you might consider beginning with this activity:**

*4\_M&M\_activity.doc* (an activity in the **Rational numbers: Ratio, Decimal and Percents** of the section **4. Numbers** provides an introductory unit to spreadsheets, where students are able to learn about the basic features available in spreadsheets while also investigating the difference between theoretical and experimental probability. Detailed descriptions are provided in this activity the integrates learning about spreadsheets within a mathematical context.

### Table of Contents

1. **Variables: Independent versus dependent; linear functions**
  - **Resource card:** Variables: R-Mars-and-Earth.doc
  - **Worksheets:**
    - 1\_Mars-and-Earth.doc
    - 2\_Mars-Earth-Grahpical\_representation.doc
  - **Spreadsheets and solutions:**
    - 1\_Mars-and-Earth.xls
    - 2\_Mars-and-Earth\_representation.xls
  
2. **Change**
  - a. **Change Activity 1: Change and Slope**
    - **Resource card:** R-Change-and-Slope.doc
    - **Worksheets:**
      - 1\_Dash-FundRaiser.doc (*Connected Mathematics-7, Graphing Change, p.18-20*)
      - 2\_Incredible-kids-go-sporting.doc
    - **Spreadsheets and solutions:**
      - 1\_Dash-FundRaiser.xls
      - 2\_Incredible-kids-go-sporting.xls
  - b. **Change Activity 2: Modeling, rates and proportion**
    - **Resource card:** R-Change-Modeling, Ratios\_Proportions.doc
    - **Worksheets:**
      - 1\_Incredible-Kids-Get-Rusty.doc (*Connected Mathematics-7,Ratio, Proportion Percent, p. 50*)
      - 2\_Kids-on-WeekendLife.doc (*Connected Mathematics-6, Number and Operations, p. 10*)
      - 3\_Dash's-neighborhood-water-project.doc (*Connected Mathematics-7,Ratio, Proportion Percent, p. 76*)

## **Integrating Spreadsheets in Middle School Mathematics Algebra: Curriculum Outline**

- 4\_Violet-and-LeakingFaucet.doc (*Connected Mathematics-7*, Linear Relationships, p.5-6)
- 5\_Incredibles-buy-a-car.doc (*Connected Mathematics-7*, Ratio, Proportion Percent, p. 38-42)
- 6\_Dash-does-population-research.doc (*Connected Mathematics-7*, Ratio, Proportion Percent, p. 52-58)
- **Spreadsheets and solutions:**
  - 1\_Incredible-Kids-Get-Rusty.xls
  - 2\_Kids-on-WeekendLife.xls
  - 3\_Dash's-neighborhood-water-project.xls
  - 4\_Violet-and-LeakingFaucet.xls
  - 5\_Incredibles-buy-a-car.xls
  - 6\_Dash-does-population-research.xls
- c. **Change Activity 3: Motion of objects**
  - **Resource card:** Change: Motion of Objectives
  - **Worksheets:**
    - 1\_Dash-and-BouncingBall.doc (*Connected Mathematics-7*, Linear Relationships, p. 7-9)
    - 2\_Incredible-Family-Trip.doc (*Connected Mathematics-7*, Linear Relationships, p. 10)
  - **Spreadsheets and solutions:**
    - 1\_Dash-and-BouncingBall.xls
    - 2\_Incredible-Family-Trip.xls

### **3. Patterns: Numerical and Graphical**

- **Resource card:** Patterns: Numerical and Graphical
- **Worksheets:**
  - 1\_Incredible-Family-Business.doc (*Connected Mathematics-7-Introducing Algebra*, p. 38)
  - 2\_Incredible-Family-Profits.doc (*Connected Mathematics-7-Introducing Algebra*, p. 40-41, 53)
  - 3\_Incredible-Kids-Compete.doc (*Connected Mathematics-8-Introducing Algebra*, p. 45)
  - 4\_Incredible-Kids-Compete-Again.doc (*Connected Mathematics-8-Introducing Algebra*, p. 43)
- **Spreadsheets and solutions:**
  - 1\_Incredible-Family-Business.xls
  - 2\_Incredible-Family-Profits.xls
  - 2\_Quotient\_exploration.xls
  - 3\_Incredible-Kids-Compete.xls
  - 4\_Incredible-Kids-Compete-Again.xls

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### 4. Numbers

#### a. Integers

- **Resource card:** Patterns: Numbers: Integers
- **Worksheets:**
  - 1\_SuperBrains.doc (*Connected Mathematics-7-Integers*, p. 17b)
  - 2\_Elastigirl-does-Accounting.doc (*Connected Mathematics-7-Integers*, p. 15)
  - 3\_Violet's-Science-Test.doc (*Connected Mathematics-7-Integers*, p. 14)
- **Spreadsheets and solutions:**
  - 1\_SuperBrains.xls
  - 2\_Elastigirl-does-Accounting.xls
  - 3\_Violet's-Science-Test.xls

#### b. Rational numbers: Ratio, Decimal and Percents

- **Resource card:** Rational Numbers: Ratios, Decimal, and Percent
- **Worksheets:**
  - 1\_Incredibles-square-away.doc
  - 2\_Dash-Sports-America.doc (*Connected Mathematics-7-Ratio, Proportion, and Percent*, p. 17)
  - 3\_Violet's-jar-of-beans.doc (*Connected Mathematics-7-Ratio, Proportion, and Percent*, p. 62)
  - 4\_M&M\_activity.doc
- **Spreadsheets and solutions:**
  - 1\_Incredibles-square-away.xls
  - 2\_Dash-Sports-America.xls
  - 3\_Violet's-jar-of-beans.xls
  - 4\_M&M\_Experiment.xls

### 5. Algebraic Expressions

- **Resource card:** R-Expressions-Order-of-Operations.doc
- **Worksheets:**
  - 1\_Violet-and-order-of-operations.doc
  - 2\_IncredibleKids-Hit-the-Target.doc
- **Spreadsheets and solutions:**
  - 1\_Violet-and-order-of-operations.xls
  - 2\_IncredibleKids-Hit-the-Target.xls

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### 6. Functions and Equations

#### a. Functions and Equations Activity 1: Linear Function

- **Resource card:** R-Functions-Linear.doc
- **Worksheets:**
  - 1\_Dash-knows-cricket.doc (*Connected Mathematics-7*, Linear Relationships, p.60)
  - 2\_IncredibleKids-bikeshop.doc (*Connected Mathematics-8*, Algebraic Reasoning)
  - 3\_Violet-learns-speed-and-distance.doc (*Connected Mathematics-8*, Algebraic Reasoning)
- **Spreadsheets and solutions:**
  - 1\_Dash-knows-cricket.xls
  - 2\_IncredibleKids-bikeshop.xls
  - 2\_IncredibelKids-bikeshop-solution.doc
  - 3\_Violet-learns-speed-and-distance.xls

#### b. Functions and Equations Activity 2: Quadratic Functions

- **Resource card:** R-Change-Modeling, Ratios\_Proportions.doc
- **Worksheets:**
  - 1\_Incredible-Dash-discovery.doc (*Connected Mathematics-8*, Quadratic Relationship, p. 8)
  - 2\_Dash-knows-gravity.doc (*Connected Mathematics-8*, Quadratic Relationship, p. 53)
  - 3\_Dash's-neighborhood-water-project.doc (*Connected Mathematics-8*, Quadratic Relationship, p. 61)
- **Spreadsheets and solutions:**
  - 1\_Incredible-Dash-discovery.xls
  - 1\_Incredible-Dash-discovery-Solution.doc
  - 2\_Dash-knows-gravity.xls
  - 3\_Violet-knows-platform-diving.xls

#### c. Functions and Equations Activity 2: Systems of Equations

- **Resource card:** R-Funcions-Systems-of-Equations.doc
- **Worksheets:**
  - 1\_Dog-Pouncing-the-Cat.doc (*Connected Mathematics-8*, Linear Relationships)
  - 2\_MrIncredible-PrintingCompany-deal.doc. (*Connected Mathematics7*, *Introducing Algebra*)
  - 3\_Violet's-skating-party.doc (*Connected Mathematics-8*, Linear Relationships, p. 42)
  - 4\_Dash-knows-theater-charges.doc (*Connected Mathematics-8*, Linear Relationships)

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- **Spreadsheets and solutions:**
  - 1\_Dog-pouncing-the-cat.xls
  - 1\_Dog-pouncing-the-cat-Solution.doc
  - 2\_MrIncredible-PrintingCompany-deal.xls
  - 3\_Violet's-skating-party.xls
  - 4\_Dash-knows-theater-charges.xls

### 7. Exponential Relationship

#### a. Exponential Growth

- **Resource card:** R-Exponential-Growth.doc
- **Worksheets:**
  - 1\_Violet-counts-cut-ballots.doc (*Connected Mathematics-8, Exponential Relationships, p. 6*)
  - 2\_Violet-counts-amoebas.doc (*Connected Mathematics-8, Exponential Relationships, p.11*)
  - 3\_Violet-and-rabbit-population.doc (*Connected Mathematics-8, Exponential Relationships, p. 32*)
- **Spreadsheets and solutions:**
  - 1\_Violet-counts-cut-ballots.xls
  - 2\_Violet-counts-amoebas.xls
  - 3\_Violet-and-rabbit-population.xls

#### b. Exponential Decay

- **Resource card:** R-Exponential-Decay.doc
- **Worksheets:**
  - 1\_IncredibleKids-fight-PetFleas.doc (*Connected Mathematics-8, Exponential Relationships, p. 48*)
  - 2\_IncredibleKids-and-coffee.doc (*Connected Mathematics-8, Exponential Relationships, p. 54*)
- **Spreadsheets and solutions:**
  - 1\_IncredibleKids-fight-PetFleas\_Solution.xls
  - 2\_IncredibleKids-and-coffeeSolution.xls

### 8. Modeling

#### a. Linear: Activity 1

- **Resource card:** R-Modeling-Linear.doc
- **Worksheets:**
  - 1\_Dash-does-BridgeWork.doc (*Connected Mathematics-8, Exponential Relationships, p. 6*)
  - 2\_Violet-investigates-concert.doc (*Connected Mathematics-8, Exponential Relationships, p. 16*)
  - 3\_Dash-investigates-TallBuildings.doc (*Connected Mathematics-8, Exponential Relationships, p. 23*)

## **Integrating Spreadsheets in Middle School Mathematics Algebra: Curriculum Outline**

- **Spreadsheets and solutions:**
  - 1\_Dash-does-BridgeWork\_Solution.xls
  - 2\_Violet-investigates-concert\_Solution.xls
  - 3\_Dash-investigates-TallBuildings\_Solution.xls

### **b. Non-linear: Activity 2**

- **Resource card:** R-Modeling-Linear.doc
- **Worksheets:**
  - 1\_Dash-and-construction-cranes.doc (*Connected Mathematics-8, Representing Relationships*, p. 31)
  - 2\_Violet-visits-CanCompany.doc (*Connected Mathematics-8, Exponential Relationships*, p. 56)
- **Spreadsheets and solutions:**
  - **1\_Dash-and-construction-cranes\_Solution.xls**
  - **2\_Violet-visits-CanCompany\_Solution.xls**