M2C3 MATH MODELING LESSON OVERVIEW

LESSON TITLE: CAFETERIA WASTE

STANDARDS ALIGNMENT:

GRADE 3	GRADE 4	GRADE 5
3.OA: Represent and solve problems involving multiplication and division. **3.OA 3:** Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities. **3.MD:** Solve problems involving measurement and estimation of … volumes of objects. **3.MD 2:** Measure and estimate … volumes of objects using standard units… Add, subtract, multiply or divide to solve one-step word problems involving volumes that are given in the same unites by using drawings to represent the same problem.	**4.OA:** Use the four operations with whole numbers to solve problems. Gain familiarity with factors and multiples. **4.OA 3:** Solve multistep word problems posed with whole numbers and having whole number answers using the four operations, including problems in which remainders must be interpreted...Assess the reasonableness of answers using mental computation and estimation strategies including rounding. **4.NF:** Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers **4.NF. 3.** Understand a fraction a/b with a > 1 as a sum of fractions 1/b. **4.NF. 3. a.** Understand addition and subtraction of fractions as joining and separating parts referring to the same whole. **c**. Add and subtract mixed numbers with like denominators, e.g., by replacing each mixed number with an equivalent fraction, and/or by using properties of operations and the relationship between addition and subtraction. **d.** Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using visual fraction models and equations to represent the problem. **4.NF.4:** Apply and extend previous understandings of multiplication to multiply a fraction by a whole number. **a.** Understand a fraction a/b as a multiple of 1/b. **b.** Understand a multiple of a/b as a multiple of 1/b, and use this understanding to multiply a fraction by a whole number **4. MD:** Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit. **4.MD.1:** Know relative sizes of measurement units within one system of units including km, m, cm;	**5.OA:** Write and interpret numerical expressions. **5.NBT:** Perform operations with multi-digit whole numbers and with decimals to hundredths. **5.NBT 6:** Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays and/or area models. **5.NF:** Use equivalent fractions as a strategy to add and subtract fractions. **5.NF 1**. Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. **5. MD:** Convert like measurement units within a given measurement system. **5. MD 1.** Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. **5. MD:** Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition. **5. MD 3.** Recognize volume as an attribute of solid figures and understand concepts of volume measurement.

	kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. **4.MD.2:**Use the four operations to solve word problems involving … volumes of objects, …, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.	
MP: 1 Make sense of problem and persevere in solving them. **MP: 3** Construct viable arguments and critique the reasoning of others. **MP: 4** Model with Mathematics	**MP: 1** Make sense of problem and persevere in solving them. **MP: 3** Construct viable arguments and critique the reasoning of others. **MP: 4** Model with Mathematics	**MP: 1** Make sense of problem and persevere in solving them. **MP: 3** Construct viable arguments and critique the reasoning of others. **MP: 4** Model with Mathematics

CONNECTIONS (Consider while planning):

• **Previous Math Knowledge:**

- Grade 3: Four operations (addition, subtraction, multiplication and division) using numbers between 0-1000.
- Grade 4, 5: Four operations of whole numbers and fractions.
- Representing math ideas with pictures, symbols, and words.
- Measurement concepts (length in feet, inches)
- Grade 5: Calculating volumes of objects

• **Cultural/Community/Family Connections**:

- Experiences with eating at school in cafeteria and seeing the amount of waste produced.
- Environmental consciousness; justice; concern for pollution.

Language Considerations: specialized terms: *waste, environment*

TASK Variations:

Routine 1: Mathematizing World - Open Ended (10 minute) - Building background knowledge and connecting to funds of knowledge. [Show images waste from your own school, ask students to record waste they see in their cafeteria, prior to the lesson, show waste images found in your environment and/or watch video]

- What do you notice? What do these pictures make you wonder about? Brief class discussion.
- What questions do you have? What would you need to do to answer those questions?

Routine 2: Mathematizing World - Specific Math Questions (20 minute) Sensemaking and assumption building. [Show images of garbage in your school or show the video and elicit and/or pose ***specific questions that can be answered using mathematics;*** consider using anchor chart to record "math" questions using questions stems - How much? How many? How much more/less; How big/small?]:

- Elicit questions about cafeteria waste collected from your school.
- What questions do you have that you could use mathematics to answer?
- What information do you need to find out how many bags of garbage are collected?
- Is the garbage sorted? What is recycled and what goes into the land fill.

Make a plan to answer your question. Identify the information you need to collect, how you would collect that information and how you would use mathematics to answer the question.

If your school has a cafeteria waste reduction program, you could have someone come in to talk about it or have your students talk about it. If not, you could show the video about a program used in another school.

Routine 3: **Full Modeling Task (60-90 minute) Students participate in entire modeling cycle**
In this task, students will choose one or more cafeteria waste items they identified in Routine 2 to study. The options included here are suggestions. Choose those that work for your school's cafeteria policy. If your school has a strong cafeteria waste policy, you could study it from the prospective of helping another school.

Task A: How many disposable trays do you throw out every day, month, year? How much waste is created by using disposable trays?

Questions to think about:
- What do you ***know*** that can help you figure this out?
- What do you need to ***find out***?
- What ***assumptions*** do you have to make?
- Anchor their results to a relevant measurement: Ex: How long would it take to make a pile of trays as high as this school building or How many days would it take to fill this room with trays?

<u>Your plan</u>
- List the information that you need to answer your question.
- Next to each item determine how you will find out that information. Whose help do you need? Ex: If you want to know how many trays are used you could ask the Cafeteria Manager? If you want to know how many bags of waste are created each day, could you ask the custodial staff? How will you ask them? Should you write a letter asking for an interview or send them questions?
- How will you measure the waste, by number, by volume?
- Can you make the amount relevant to others by comparing it to your school or classroom?

<u>ANTICIPATED STUDENT ASSUMPTIONS:</u>

In this task, students will have to make many decisions based on assumptions. For example, they will need to make assumptions/decisions about:

- the amount of space disposable trays take up each day.
- whether or not to consider the trays are stacked prior to putting them in the garbage.
- the number of students who use a tray each day.

<u>ANTICIPATED STUDENT STRATEGIES:</u>

- Grade 3 and 4: determine how high 25 trays are and multiply that number by the number of classes in the school, estimating that there about 25 student / class using trays. Ex: 25 trays are three inches. There are 5 classes in each grade and 6 grades in the school. 5 x 6 are 30 classes x 3

inches of trays = 90 inches of trays. 90 inches / 12 = 7 feet with 6 inches left over. Or 7 ½ feet. Of trash per day.

- Could estimate that in a month with 20 days of classes they would create 20x 7 ft 6 in = 140 ft and 120 inches or 140 ft + 10 ft = 150 ft of trays. 7 ½ ft x 20 days is 140 ft +10 ft = 150 ft. 7.5 ft x 20 days = 150ft. The could compare this length to the length of the hallway or football field to create a better understanding of the number of feet.
- Grade 5 could calculate the volume of the trays. 25 trays are 3in by 8 in by 10 in. = 240 cubic inches. 5 classes / grade x 6 grades x 240 cubic inches of trays/ class. 7200 cubic inches. A cubic foot has 12x12x12 cubic inches or 1728. 7200/1728 = 4.16 cubic feet of trays/day. This could be rounded to 4 cubic feet of trays per day. Students could determine how long it would take to fill their classroom with trays.

MATERIALS

- Cafeteria Waste_ Student Task
- Cafeteria Waste_Lesson Slides
- Realia – sample trays
- Realia – pictures your school's cafeteria waste