M2C3 MATH MODELING LESSON OVERVIEW

LESSON TITLE: MAKING JUMP ROPES

STANDARDS ALIGNMENT:

GRADE 3	GRADE 4	GRADE 5
3.0A: Represent and solve problems involving multiplication and division. 3.0A 3: Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities.	4.0A 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.	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.
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:**
- Four operations (addition, subtraction, multiplication and division) using numbers between 0-1000.
- Representing math ideas with pictures, symbols, and words.
- Measurement concepts (length in feet, inches)

• **Cultural/Community/Family Connections**:
- Experiences with plastic bag use and reuse in home, school, and community businesses
- Recycling and upcycling
- Environmental consciousness; justice; concern for pollution
- Braiding, crocheting experience
- Jump rope experience
- Measuring height

Language Considerations: specialized terms: *upcycling, recycling, repurposing*

TASK Variations:

Routine 1: Mathematizing World - Open Ended (10 minute) - Building background knowledge and connecting to funds of knowledge. [Show images of plastic bags in our 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 plastic bags and recycled products (jump ropes) 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?]:

- Look at these images - plastic bags and jump ropes that children have made … (use realia or slide)
- What questions do you have that you could use mathematics to answer?
- What information do you need to find out how many plastic bags it would take to make a jump rope?
- How will you use this information to figure out how many plastic bags are required to make a jump rope for everyone in the class, grade level, school?

Routine 3: **Full Modeling Task (60-90 minute) Students participate in entire modeling cycle**
In this task, students must make a jump rope set for (own class, P.E., community center or school event like a jump-a-thon. A set contains jump ropes of different lengths. In each version, students need to determine both the different LENGTHS of jump ropes that are needed (7 ft, 8 ft, 14 ft, etc), and the NUMBER of jump ropes of a given length that are needed.

The video that is included in the launch provides a) a method for making jump ropes, and b) a number of bags needed per foot if using this method (3 plastic bags makes one foot of jump rope). While it is possible to make jump ropes using other methods (which might require different numbers of bags per foot), given time constraints we recommend that students work on the task using the suggested method.

Warm Up (optional):
There are two versions of the warm up. In each version, students create a model for one jump rope. In one version they consider the number of plastic bags needed. In another version, they consider both the number of plastic bags needed *and* the amount of duct tape needed for the handles. If students will work on the extension task involving handles (see below) we recommend using the warm up task that includes handles.

You want to make one jump rope.
How many plastic bags do you need?
How much duct tape do you need? (in version of warm up that includes handles)
What do you *know* that can help you figure this out?
Draw a model of your jump rope.
Use words, numbers and equations to show:

how many plastic bags you will need to make your rope
How much duct tape you will need to make your rope (in version of warm up that includes handles)

Version A: Making Jump Ropes for our Class
We want to make a jump rope set for our class. A set contains jump ropes of different lengths. How many plastic bags will we need?

Version B: Making Jump Ropes for PE/Gym Class
We want to make a jump rope set to be used during P.E. class. A set contains jump ropes of different lengths. How many plastic bags will we need?

Version C: Making Jump Ropes for a Community Center
We want to make a jump rope set to donate to the [insert] community center.
How many plastic bags will we need?

Version D: Making Jump Ropes for a School Event
We want to make enough jump ropes so that all students at your school can participate in the school-wide

jump rope event. How many plastic bags will we need?

For ALL Versions:
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?

<u>Your plan for making the jump ropes must show:</u>
- How you know that you will have enough jump ropes for [insert context], without a lot of extra
- How many plastic bags you will need
- How others could use your plan to make jump ropes for [insert context].

Use pictures, numbers and words to show that your plan will work.

<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:

Who will jump rope: Will only students participate? Adults or other family members as well? Younger students? Older students?

How students will jump rope: For example, will students jump rope individually or with a partner? Will everyone jump at the same time? Will some students want to jump a long rope, so that two or more students can jump at the same time? Will students jump "double dutch"?

Length of jump ropes: Does the height of a person matter in selecting a jump rope? How tall is the person jumping? Do we need some ropes for primary grade students, and some for intermediate grade students? What about adults at the school, will they also participate? What length ropes will adults need?

Method of making the jump ropes and number of bags needed: *S*tudents will also need to agree on a method for making the jump ropes, and according to the method selected, they will need to determine how many bags are needed to make a specific length of rope jump. For example: How many bags will be needed to make 1 foot of rope? In the upcycling jump rope task, this information is given: 3 plastic bags per 1 foot.

<u>ANTICIPATED STUDENT STRATEGIES:</u>

Strategies for Task Versions A, B, C, D:

Students might decide on the number of plastic bags required for one rope (of a specific length) and then multiply by the number of jump ropes of that specific length that are needed (e.g. (21 bags for each 7ft rope) x (10 ropes of this length). Students will repeat this process for ropes of different lengths, and then add the together the quantities needed. A final "model" might look something like this:

> (3 long ropes, 15 feet each) x (45 bags per rope)] + [(12 short ropes, 7 feet each) x (21 bags per rope)] + [(8 medium ropes, 8 feet each) x (24 bags per rope)] = Total number of bags needed.

Or in generalizable terms:

> (# long ropes) x (45 bags per rope)] + [(# short ropes) x (21 bags per rope)] + [(# medium ropes) x (24 bags per rope)] = Total number of bags needed.

Conceptual confusions/misconceptions
- Students might forget to include the rate information: 3 bags per foot.

- Students might multiply the length of the rope x number of students.

VARIATIONS and EXTENSIONS

Extension A: Jump Rope HANDLES (good extension for 4th and 5th student students):

- You will use duct tape to make the jump rope handles.
- How much duct tape will you need for all the jump ropes included in your plan?

Students figure out how much duct tape they will need to make the handles for all the jump ropes in their plan. Students can estimate the amount of duct tape needed for one handle (e.g., 6 inches, 10 inches, etc), and then use this to estimate the amount of duct tape needed for all the jump ropes in their plan (i.e., (8 inches per handle) x (2 handles per rope) x (28 ropes) = 448 inches total, or 37 ⅓ feet, or 2 10-yard rolls)

(See Making Jump Ropes_Warm-Up B_Handles Included; Making Jump Rope_Extension A_Handles)

Strategies for Extension Task A: Jump Rope Handles
Students might estimate the amount of duct tape needed for one handle, and then double this number to find the amount of duct tape (length) needed for one rope (e.g., 10 inches per handle, x 2 handles). Students can then multiply the amount of duct tape needed for one jump rope by the number of ropes in the plan. In all calculations are in inches, students can convert to feet and inches at the end.

Extension B: HOW MANY JUMP ROPES with a given number of plastic bags:

Students calculate the number of jump ropes that they could make (of various sizes) with a given number of bags. The number of bags can be determined via an estimate of how many bags they could collect in a class-wide, grade-level-wide, or school-wide plastic bag “upcycling” drive [see Extension 2 above], or it might be based on data from other schools who have completed similar plastic bag collection drives.

- Let’s say we can collect ___________ plastic bags. Come up with a plan to use these jump ropes to make jump ropes of different lengths for your school. How many jump ropes can we make? (See Making Jump Rope_Extension B_How many ropes?)

Strategies for Extension Task B: How many jump ropes with a given number of plastic bags:
Students might divide the total number of bags by 3. This gives you the number of feet of jump rope that can be made with a given number of bags. Then students can divide by 8 (or another length) to find number of jump ropes of a given length that can be made. Students might also decompose the total length possible into groups, to allow for sets of jump ropes of different sizes. For example, 140 feet would produce 10 jump ropes that are 14 feet each; or 400 feet could produce 50 jump ropes that are 8 feet each. These strategies will require that students consider factors and multiples. Some decisions may lead to a remainder (i.e., there are 18 bags left, or enough to make 6 feet of jump rope) and students will have to reason about the meaning of the remainder in this context. Example: Number of total bags divided by 3 (3 bags per foot of jump rope), and then partition by different lengths of jump ropes 7, 8 or 14.

Students might also use a multiply up strategy. Example:
(Number of Ropes multiplied by rope length (of Type A) multiplied by 3 bags/foot) +
(Number of Ropes multiplied by rope length (of Type B)... [for each type of rope]. if Students use a multiply up strategy, consider if you’d want to prompt to try another way with division.

Extension C: TIME REQUIRED to collect the needed plastic bags:

How long will it take us to collect the plastic bags we need? Students figure out how long it might take them to collect the plastic bags needed to make the jump ropes in their plan. They consider information such as the average family uses about 15 plastic bags each time they go to the grocery store and compare this to their own family's use of plastic bags. They also consider ways to collect data to inform their model. For example, if students ask everyone in their class to bring in plastic bags that they have at home, the can use this amount to estimate how many bags could be collected via a school-wide plastic bag recycling drive.

(See Making Jump Rope_Extension C_Time to collect bags)

Strategies for Extension Task C: Time needed to collect the bags

Once they determined the total number of bags needed, students might use information on how many bags an "average family" uses per visit to grocery store (15 bags). Or, they might try to figure out a number of bags that would represent an average visit to the grocery store based on their experience.
(#bags per visit) x (number of visits per amount of time (week)) x (number of families) = total amount of bags collected in a given amount of time (week). Students might have to adjust something in the model to reach the total bags specified in their plan.

Students could also estimate the time required to collect the needed bags through a bag collection drive. They could first determine how many bags their class could collect in a given time period (week).
Example: # bags per student x # students = total number of bags collected that week. Using information from their own class, students could estimate how many bags all classes in their school could collect in a given time period (week), and then reason about how many weeks would be needed to collect the desired number of bags.

MATERIALS

- Task sheet(s)
- Launch slides
- Realia (jump rope made of plastic bags)
- If doing school/community center versions: Class/school information about number of students in classes, number of classes per grade and in school.

LESSON CONSIDERATIONS

In developing your lesson plan, consider: How will you launch this task? How will students record their models? What scaffolds/supports are needed to support student engagement and learning? Where will you step in and where will you hold back? How might students "test" or verify their models? How will you "wrap up" the lesson?

Extra Optional Videos

Katie and the Plastic Bag (1 minute 40 sec)
https://www.youtube.com/watch?v=5Kb5Y_YU9oo

Plastic bag challenge (4 minute)
https://www.youtube.com/watch?v=wyQCFBIs_a8

20 awesome ways to reuse plastic bags (2 minutes)
https://www.youtube.com/watch?v=f08mVqyUQdI

The plastic bag problem: 5th grade (TedTalk) (11 min)
https://www.youtube.com/watch?v=L_9hUlfpOGw

Girl scout video: How to make your own plastic jump rope (out of plastic bags)
https://www.youtube.com/watch?v=h0ExVd9WlMY

DIY Recycled Plastic Jump rope
https://www.youtube.com/watch?v=dTJEcqAxra0

Extra Optional Information

Washington Specific Info

Bag your Bags, and bring them back: Elementary school collect plastic bags to recycle and fill a school bus
https://www.youtube.com/watch?v=2b_SKXUz7tE

Green Schools Washington State
https://www.youtube.com/watch?v=M50H-taZohk

Videos for recycling in WA: Cedar Hills Landfill (4 min)
https://www.youtube.com/watch?v=YP_myvStGEw

Tucson Specific Info

City of Tucson Plastic Bag Ordinance
https://www.tucsonaz.gov/es/tucsons-plastic-bag-ordinance

Problem of plastic bags still an issue in Arizona (recent news report, from Feb 2018)
http://www.tucsonnewsnow.com/story/37462932/phoenix-recycling-officials-plastic-bags-contribute-to-lost-time-worth-about-1-million
https://www.kgun9.com/news/local-news/recycling-in-tucson-are-we-doing-enough-
http://tucson.com/news/local/steller-mesa-lawmaker-bullies-bisbee-over-plastic-bag-ban/article_3de46860-a881-5cfe-8fdb-2ce51099c01b.html