What a Lot of Trash!

Grade 3: Addition and Subtraction of Numbers to 1,000

Petra Nagtegaal

Introduction

While working at Vital Grandin Catholic Elementary School in St Albert, Alberta, I was privileged to see the success of the school's Wasteless Wednesday program. In this program, students' lunch waste was collected and weighed every Wednesday, with the goal of reducing the trash produced by the school.

As part of my preservice mathematics curriculum class I was required to produce an authentic math lesson plan, and I knew I wanted to create the beginnings of a unit on waste, using Wasteless Wednesday as the starting point.

Lesson Description

After weighing the garbage produced by all the classes in the school over a (minimum) two-week period, the students will graph the total amounts of trash from each classroom and note if there is a pattern—for example, if less trash is produced on Wasteless Wednesdays. In the lesson described in this paper, each trash item (eg, apple core, juice box) will be weighed separately (anticipatory set). Students will then use the data sheet provided (with daily trash weight) and subtract from their designated class total to reach a biweekly total of 725 grams,[1] or they may use actual numbers from the data they collected. Students will decide if they will subtract more lightweight items or fewer heavy items to reach the desired total. The teacher will use a checklist throughout the activity to monitor students' understanding and the rubric to evaluate the worksheet at the end of the lesson.

Specific Outcomes (Numbers)

Students will demonstrate an understanding of addition and subtraction of numbers with answers to 1,000 concretely, pictorially and symbolically by

- using personal strategies for adding and subtracting with and without the support of manipulatives, and
- creating and solving problems in contexts that involve addition and subtraction of numbers.

Mathematical Processes

Students will

1. demonstrate understanding of addition to 1,000 by adding daily totals of trash from data collected over a two-week period (lesson 1);
2. demonstrate understanding of subtraction (on the worksheet) by taking away from the total until close to 725 grams is reached (lesson 2);
3. relate information they are learning, through literature and scientific research, about the accumulation of trash in other classes (science, social studies, art, language arts) to make connections to the theme of trash and its reduction in their community;
4. use estimation and mental math to decide which trash items will work best to get closest to the goal;
5. use their knowledge of subtraction to make a plan of how much each class must reduce its waste to reach a goal of (close to) 725 grams of trash. Students will decide to reduce by fewer heavier items and/or more lightweight items;
6. prove that by reducing a number of specific trash items, the class can meet the goal of reducing trash to close to a biweekly total of 725 grams; and
7. weigh the actual trash items to see clearly what items take up the most/least amount of space in a landfill, then use that information to show how to reduce the mass of trash.

Achievement Indicators

- Model the subtraction of two numbers using visual representation and record the process symbolically.
- Determine the difference of two numbers using personal strategies in subtracting numbers to reach a given number; for example, for 972 – 55 a student may record 972 – 50 – 5 or 970 – 50 – 5 + 2.

Materials

- Document camera or interactive whiteboard to demonstrate math procedures
- Data collected of weight of trash over two weeks for their designated class

- "How much does it weigh?" sheet (one per student—check the number of each level needed; see Appendix C)
- Activity sheet: What a lot of trash! (one per student; see Appendix D)
- Weigh scales
- Place-value mats (to 1,000)
- Base-10 blocks
- Trash (juice boxes, apple/banana peels, baggies, leftover sandwiches, and so forth) on tables around the classroom

Anticipatory Set

Students weigh trash items separately (no need to collect data, except for group 3). Discuss

- what weighed the most/least,
- whether the items weighed the previous weeks were similar,
- what items could be recycled/composted and
- the book *Dougal the Garbage Dump Bear* (Dray 2005) and the fact that it was not one bear in the landfill, but many bears.

Procedure

1. Discuss with students the totals of trash collected for each classroom and how that will affect the landfill (see Appendix E).
2. Tell students that they will work as environmentalists to figure out how each classroom can reduce its trash to reach a goal of 725 grams biweekly.
3. Model (using the document camera) how to determine what trash items (students must use a minimum of five different items) will reduce the amount of waste to reach the goal of 725 grams. For example, show students that the total (972 grams) is far from the goal of 725 grams, and therefore a heavy item will have to be removed. Choose the sandwich (42 grams) and demonstrate 972 – 42 = 930 using the place-value mat and manipulatives. Then draw the procedure on the activity sheet. Recognizing that 930 grams is still far from the goal and knowing that five different items must be used, the teacher will choose the next heaviest item (apple core, 35 grams) and demonstrate how to subtract 35 on the place-value mat, writing the numerical algorithm on the activity sheet. Next the teacher will use mental math and estimation to demonstrate how to subtract the next heaviest item (milk carton, 15 grams) and write the algorithm on the activity sheet. Then the teacher should do an example with the students by asking, "What should we take out of the total next?"
4. Distribute "How much does it weigh?" sheet (see Appendix C) to each student:
   - Sheet 1—at-grade-level activity sheet
   - Sheet 2—simplified activity sheet
   - Sheet 3—extended task sheet
5. Distribute one activity sheet, "What a lot of trash!" to each student. Students work in pairs (students should be paired with others working on the same level of activity sheet).
6. Closure: Ask each group how they chose the items that they subtracted from the total (volume and/or mass).

Adaptations

- Simplified task: Give the student the "How much does it weigh?" sheet 2 (see Appendix C), which uses benchmark numbers 5 and 10, but has two items to help students reach close to the goal of 725 grams.
- Extended task: Students will compute the number that is half their total and use this as a goal for their class (rather than the 725 grams). Students will also use the actual weight of each trash item.

Assessment for Learning

Using a checklist (see Appendix A) and moving between each group during the activity, ask questions to assess students' understanding or to scaffold learning. Questions may include the following:

- "Tell me how you got to that number." The student should be able to verbalize personal problem-solving technique/algorithm. Scaffold: Have students show their work using manipulatives or symbols.
- "How would it change if the number were (ten more/less)?" The student should describe the benchmark of 10 and that it is a simple algorithm of adding/subtracting from the 10 place-value. Scaffold: The student should use the place-value mat to see what occurs with the addition or subtraction of 10.
- "I see that you are close to 725 grams; how are you using mental math to decide what item weight to subtract next?" The student should be able to describe how he or she uses estimation and 1s, 5s and 10s (benchmarks) to choose the approximate weight necessary. Scaffold: Ask the student if he or she is more or less than 10 away from the goal of 725 grams, and from the answer, ask questions that will have student visualize the numbers.
- "Another student (use the student's name) showed a different way of calculating that. Can you tell me how he did it?" To show a deep understanding, students should be able to describe the algorithms used by other students in the group. Scaffolding:

If the student cannot explain another's algorithm, perhaps he or she does not understand it. In this case, have one student explain the algorithm to the other. Alternatively, the student can work through the problem with the teacher.

- "Do you prefer to use manipulatives like the place-value mat, draw out the problem or use numbers to solve the problem? Why?" Scaffold: Has the student tried three ways to demonstrate understanding?

Assessment of Learning

The teacher will evaluate the performance task (activity sheet; see Appendix D) using the rubric provided (see Appendix B).

Integration with Other Subjects

See Appendix F.

Note

1. The 725-gram figure was chosen because the number must be in the 0–1,000 range to meet the learning outcomes for this grade. Weights of specified objects have been estimated, not measured.

Reference

Dray, M. 2005. *Dougal the Garbage Dump Bear*. La Jolla, Calif: Kane/Miller.

Petra Nagtegaal has been an educational assistant for 12 years. She is currently enrolled in a bachelor of education program in elementary education at the University of Alberta. She is interested in early intervention programs and special education.

Appendix A
Assessment for Learning Checklist

Student	Models subtracting two numbers using visual representation	Records algorithms symbolically	Determines the difference of two numbers using a personal strategy	Notes

Appendix B
Assessment of Learning Rubric

Demonstrates an understanding of addition and subtraction of numbers with answers to 1,000 by	4	3	2	1
Using personal strategies for adding and subtracting with and without the support of manipulatives	Uses personal strategies for adding and subtracting with and without the support of manipulatives	Uses personal strategies for adding and subtracting with the support of manipulatives	Relies on one personal strategy for adding and one for subtracting	Is not able to use a personal strategy but can follow the steps of a procedure when given
Creating and solving problems in context that involve addition and subtraction of numbers	Rephrases the solution and there are few, if any, errors in procedure; student is flexible about the strategy and revises it as necessary	Solution is correct, thought there may be minor procedural errors; student revises the strategy as necessary	Solution is faulty due to several errors in procedure; student is hesitant to change strategies	Solution is seriously flawed due to major errors in procedure; student gives up if strategy does not work

Adapted from Small, M. 2009. *Making Math Meaningful to Canadian Students, K–8*. Toronto: Nelson, 613.

Appendix C

(1 of 3)

HOW MUCH DOES IT WEIGH? (#1)

17 grams

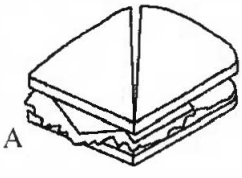
27 grams

35 grams

15 grams

55 grams

5 grams



A

42 grams

11 grams

Appendix C

(2 of 3)

HOW MUCH DOES IT WEIGH? (#2)

15 grams

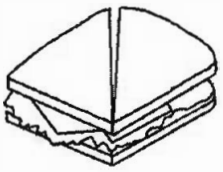
25 grams

35 grams

10 grams

50 grams

3 grams



100 grams

11 grams

Appendix C

(3 of 3)

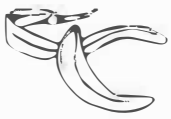
HOW MUCH DOES IT WEIGH? (#2)

_____ grams

_____ grams

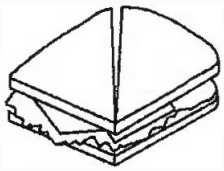
_____ grams

_____ grams



_____ grams

_____ grams



_____ grams

_____ grams

Appendix D

Name: _____

Activity sheet: What a lot of trash!

My group will study the trash weigh from Grade _____.

The total trash collected in the two weeks was _____ grams. This is WAY too much trash!

Each class has a goal to reduce its trash to 725 grams every two weeks.

Use the base-10 blocks to find out how much LESS trash the grade you studied will have to produce. Show your algorithm pictorially, using base-10 blocks:

Explain, using numbers (symbolically), the algorithm you used:

_____

_____

_____

You, as the environmentalist, will figure out how to help the class meet this goal by subtracting the weight of the trash items (see attached sheet) until you get as close as possible to 725 grams.

This will tell the class how much less of each item they need to throw out to get as close as possible to the goal of 725 grams.

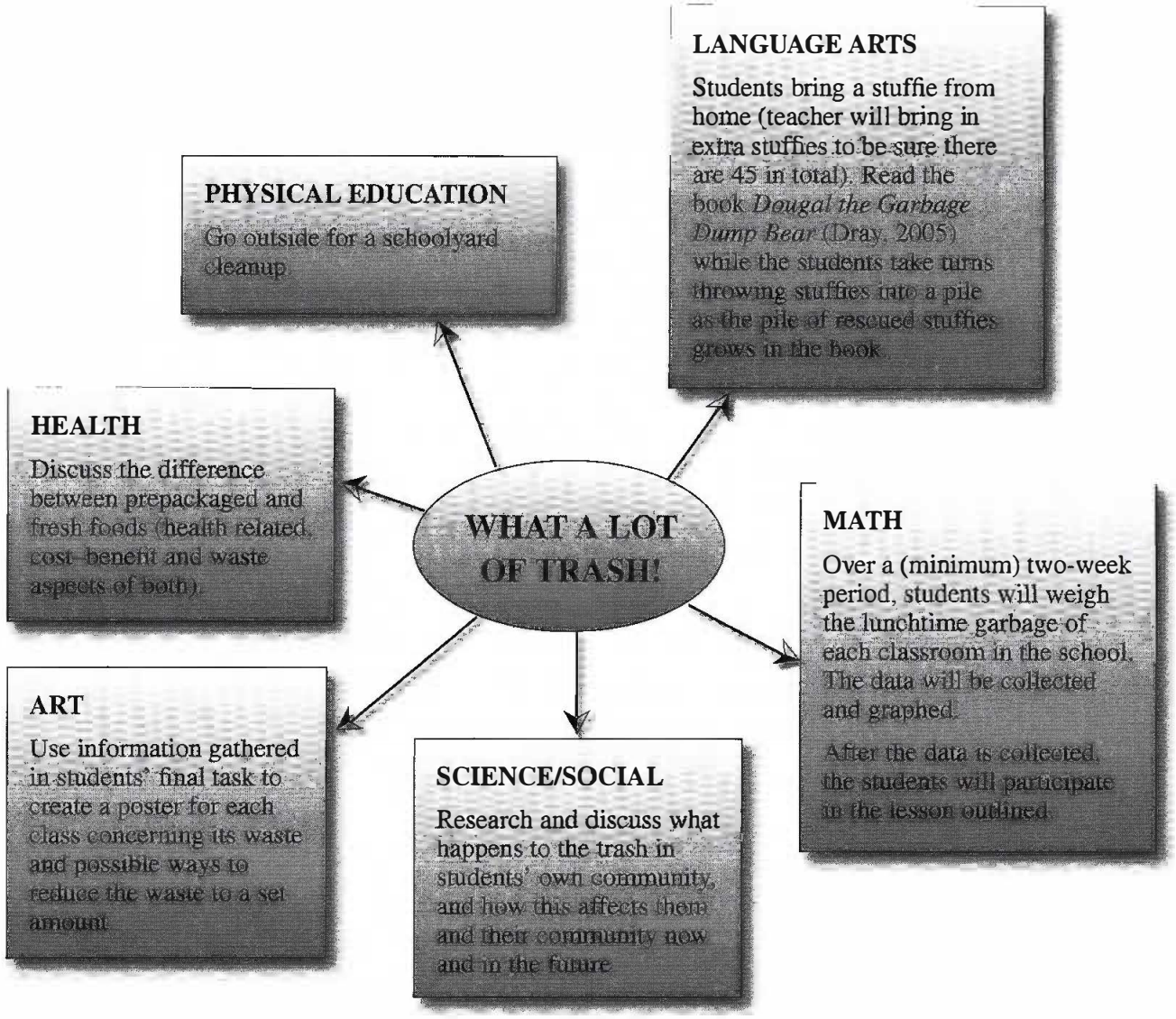
You must use at least five different items to reduce the number to 725 grams. Some items will have to be used more than once.

Show your work.

Appendix E

DATE	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6
04-Apr	162	121	186	73	132	212
05-Apr	64	153	83	186	167	88
06-Apr	8	12	16	22	12	5
07-Apr	124	179	131	117	118	128
08-Apr	162	165	190	155	137	123
11-Apr	14	43	110	109	96	147
12-Apr	142	91	87	97	114	43
13-Apr	18	21	14	32	6	19
14-Apr	191	168	105	102	98	138
15-Apr	112	46	70	97	95	92

Appendix F


WHAT A LOT OF TRASH!
LANGUAGE ARTS
Students bring a stuffie from home (teacher will bring in extra stuffies to be sure there are 45 in total). Read the book *Dougal the Garbage Dump Bear* (Dray, 2005) while the students take turns throwing stuffies into a pile as the pile of rescued stuffies grows in the book.
PHYSICAL EDUCATION
Go outside for a schoolyard cleanup.
HEALTH
Discuss the difference between prepackaged and fresh foods (health related, cost–benefit and waste aspects of both).
MATH
Over a (minimum) two-week period, students will weigh the lunchtime garbage of each classroom in the school. The data will be collected and graphed.
After the data is collected, the students will participate in the lesson outlined.
ART
Use information gathered in students' final task to create a poster for each class concerning its waste and possible ways to reduce the waste to a set amount.
SCIENCE/SOCIAL
Research and discuss what happens to the trash in students' own community, and how this affects them and their community now and in the future.