Modeling Garbage and Recycling

Finding good topics for modeling is difficult, but garbage is a problem everywhere. We will mathematically investigate the problem of how garbage increases and how clean-up and/or recycling can help solve it.

Debbie Poss
Lassiter High School
Retired
deborah.poss@gmail.com

Suzette Hermann
Retired
Chattahoochee Technical College, Adjunct
suzette@etcmail.com

35 YEARS OF IMPAC(T³)

1

Where are you from?

35 YEARS OF IMPAC(T³)

2

What do you teach?

35 YEARS OF IMPAC(T³)

3

Modeling Garbage and Recycling

Finding good topics for modeling is difficult, but garbage is a problem everywhere. We will mathematically investigate the problem of how garbage increases and how clean-up and/or recycling can help solve it.

Debbie Poss
Lassiter High School
Retired
deborah.poss@gmail.com

Suzette Hermann
Retired
Chattahoochee Technical College, Adjunct
suzette@etcmail.com

35 YEARS OF IMPAC(T³)

4

Consider using a conversation "hook"

- Throw a ball of paper at the trash can and ask, "How much paper do you think our school trashes every day?"
- Ask, "Where does our school's (household's) garbage go? Is there a lot of garbage? Is it a problem?"

35 YEARS OF IMPAC(T³)

5

Look up some statistics

- According to https://www.treehugger.com/trash-numbers-startling-statistics-about-americans-and-their-garbage-4858558 ,
  - **4.4 pounds**: The amount of trash generated daily, on average, by every American. Packed in cubed feet it
  - would be the height of the Leaning Tower of Pisa.
  - **254 million tons**: The amount of trash that
  - Americans generate in a year.
  - **22 billion**: Plastic bottles thrown out yearly.

35 YEARS OF IMPAC(T³)

6

Let's look at a hypothetical problem…

Ann went to the park one day to find someone had dumped 100 pounds of garbage. Frustrated, Ann picked up 20 pounds, but that's all she had time to get.

If, each night, someone dumps 100 more pounds of garbage, but each day, Ann brings one more additional friend and each person picks up 20 pounds of garbage, will they ever be able to clean up the park?

35 YEARS OF IMPAC(T³)

7

Think about what happens each day…

Ann went to the park one day to find someone had **dumped 100 pounds of garbage**. Frustrated, **Ann picked up 20 pounds**, but that's all she had time to get.

- The next day someone **dumped another 100 pounds of garbage on top of the 80 pounds** from the day before, but **Ann brought a friend** to help her pick up garbage. So, by the end of **day 2**, although there was **180 pounds of garbage**, they were able to **pick up 40 pounds** of it, so **they left 140 pounds** for the next day.
- At the beginning of **day 3**, there were **240 pounds of garbage**, but **Ann brought 2 friends**, so they were able to clean up **60 pounds**.
- Each night, someone continues to **dump 100 more pounds** of garbage, but Ann continues to bring **one additional friend each day** and **each person can clean up 20 pounds of garbage.**

Take a minute or two to think about how your students might solve this problem… ☺

35 YEARS OF IMPAC(T³)

8

Based on the grade you teach, what would your students try?

- Would they look at it numerically?
- Would they use a table?
- Would they look at a graph?
- Would they make equations?
- Would they look at sequences?

35 YEARS OF IMPAC(T³)

9

Suggestions…

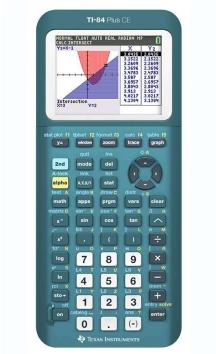
- Make a table or chart to organize the numerical data.

Day	1	2	3	4	5	6	7
Trash Dumped	100						
Daily Trash	100						
Picked up	20						
Trash left	80						

- Finish the table.
- Look for patterns…
  - Trash dumped– what is happening?
  - Picked up – what is happening?

35 YEARS OF IMPAC(T³)

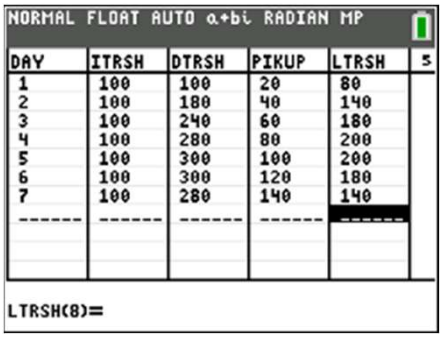
10



Let's create lists… and graph!

35 YEARS OF IMPAC(T³)

11

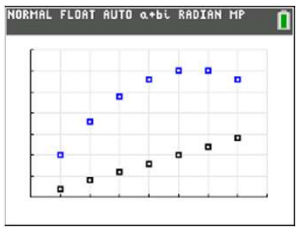


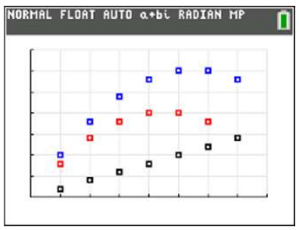
Let's see the additional lists…

35 YEARS OF IMPAC(T³)

12

Let's look at the graphs…





35 YEARS OF IMPAC(T³)

13

Can we write functions?

Day	1	2	3	4	5	6	7
Initial Trash	100	180	240	280	300	300	280
Picked up	20	40	60	80	100	120	140
Trash left	80	140	180	200	200	180	140

- Look for patterns first.
  - Initial trash – what is happening?
  - What type of function is this?
  - Picked up – what is happening?
  - What type of function is this?
  - Total trash left – what is happening?
  - What type of function is this?

35 YEARS OF IMPAC(T³)

14

How can we find these equations?

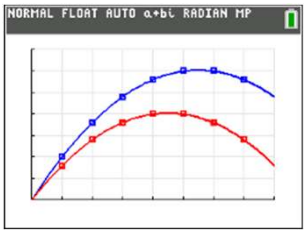
- Use the regression equation capability.
- Use Quick-Plot and Fit?
- Use the transformation APP.
- Let's look at sequences.
- Do they know the summation formula?

35 YEARS OF IMPAC(T³)

15

How well do our functions model the data…

Check to see what we notice from the graphs as compared to our data..
Look at the table – or lists.



35 YEARS OF IMPAC(T³)

16

Suggestions…

- Consider a different table… ☺

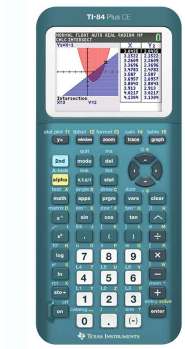
Day	1	2	3	4	5	6	7
Total trash deposited	100						
Total trash picked up	20						
Trash left	80						

- Look for patterns first.
  - Total trash deposited– what is happening?
    - What type of function is it?
  - Total trash picked up – what is happening?
    - What type of function is it?
  - Trash left – what is happening?
    - What type of function is it?

If total trash grows linearly and trash pick up grows quadratically, will we always be able to clean up the trash?

35 YEARS OF IMPAC(T³)

17

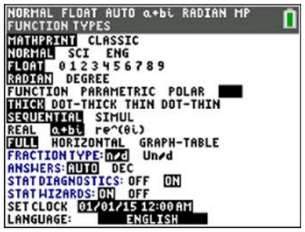


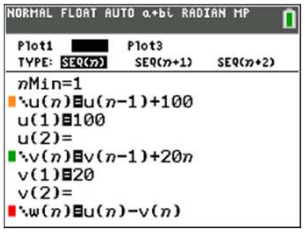
Let's look at Sequence Mode!

35 YEARS OF IMPAC(T³)

18

Let's look at the sequence mode…

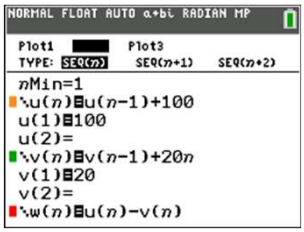


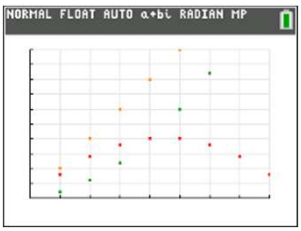


35 YEARS OF IMPAC(T³)

19

Let's look at the sequence mode…





35 YEARS OF IMPAC(T³)

20

How can we find these equations?

- Do they know the summation formula?

35 YEARS OF IMPAC(T³)

21

Remember this table…

Day	1	2	3	4	5	6	7
Total trash deposited	100	200	300	400	500	600	700
Total trash picked up	20	20+40 60	60+60 120	120+80 200	200+100 300	300+120 420	420+140 560
Trash left	80	140	180	200	200	180	140

35 YEARS OF IMPAC(T³)

22

Sum of an arithmetic sequence is

$$S_n = (first\ term + last\ term) \cdot \left(\frac{number\ of\ terms}{2}\right)$$

- Total daily trash deposited: u(n) = 100n
- Daily picked up: 20n
  - Total trash picked up v(n) = (20 + 20n)n/2 = 10n + $10n^2$
- Trash left: w(n) = u(n) – v(n) = 100n – (10n + $10n^2$) = -$10n^2$ + 90n

35 YEARS OF IMPAC(T³)

23

Extensions!

1. What if someone was dumping 200 pounds of garbage each day instead of 100 pounds? Will the group be able to clean the park? How long will it take?
2. What if someone dumped 500 pounds of garbage a day instead of 100 pounds?
3. *Look at this in functional notation and explain why this happens.

Follow up with student's project. They research and find data about a particular garbage problem they find interesting – perhaps the Pacific garbage dump, your county's garbage problem, the amount of tires, mattresses, clothes, straws, phones, computers, etc. being trashed every day, year. They should then create a model to help solve or at least lessen the problem and use mathematics to determine/predict the effect of that model.

35 YEARS OF IMPAC(T³)

24

Extensions!

4. What if the garbage dumpers started with 100 pounds of garbage, but instead of dumping the same amount each day, they dumped 10% more garbage than they had dumped the day before? Will Ann ever be able to clean up the park? If so, how many days will it take?

5. What if the garbage dumpers started with 100 pounds of garbage, but dumped only 5% more garbage than the day before? Will Ann ever be able to clean up the park? If so, how many days will it take?

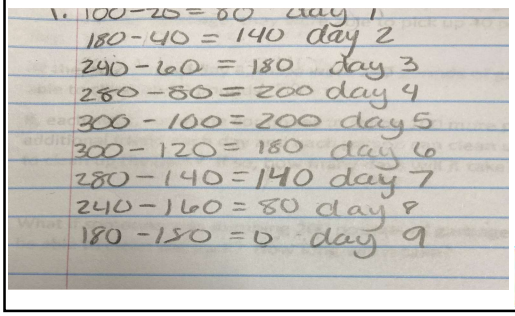
6. *Look at the functional notation here and explain why these results are different.

**Follow up with student's project. They research and find data about a particular garbage problem they find interesting – perhaps the Pacific garbage dump, your county's garbage problem, the amount of tires, mattresses, clothes, straws, phones, computers, etc. being trashed every day, year. They should then create a model to help solve or at least lessen

35 YEARS OF IMPAC(T³)

25

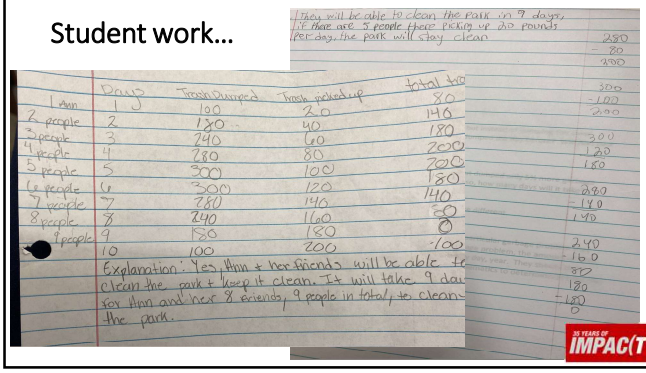
Let's look at student work...



35 YEARS OF IMPAC(T³)

26

Student work...



35 YEARS OF IMPAC(T³)

27

Modeling Garbage and Recycling

Finding good topics for modeling is difficult, but garbage is a problem everywhere. We will mathematically investigate the problem of how garbage increases and how clean-up and/or recycling can help solve it.

Debbie Poss
Lassiter High School
Retired
deborah.poss@gmail.com

Suzette Hermann
Retired
Chattahoochee Technical College, Adjunct
suzette@etcmail.com

35 YEARS OF IMPAC(T³)

28

Make a table or chart…

- Use named lists.☺

Day	1	2	3	4	5	6	7
Initial Trash	100	180	240	280	300	300	280
Picked up	20	40	60	80	100	120	140
Trash left	80	140	180	200	200	180	140

- Finish the table.
- Look for patterns first.
  - Initial trash – what is happening?
  - Picked up – what is happening?
  - Insert actual calculator table.

29

Let's look at a hypothetical problem…

Ann went to the park one day to find someone had dumped 100 pounds of garbage. Frustrated, Ann picked up 20 pounds, but that's all she had time to get.

- The next day someone dumped another 100 pounds of garbage on top of the 80 pounds from the day before, but Ann brought a friend to help her pick up garbage. So, by the end of day 2, although there was 180 pounds of garbage, they were able to pick up 40 pounds of it, so they left 140 pounds for the next day.
- At the beginning of day 3, there were 240 pounds of garbage, but Ann brought 2 friends, so they were able to clean up 60 pounds.
- If, each night, someone continues to dump 100 more pounds of garbage, but Ann continues to bring one additional friend each day and each person can clean up 20 pounds of garbage, will they ever be able to clean up the park? If so, how many days will it take? Will they be able to keep the park clean?

35 YEARS OF IMPAC(T³)

30