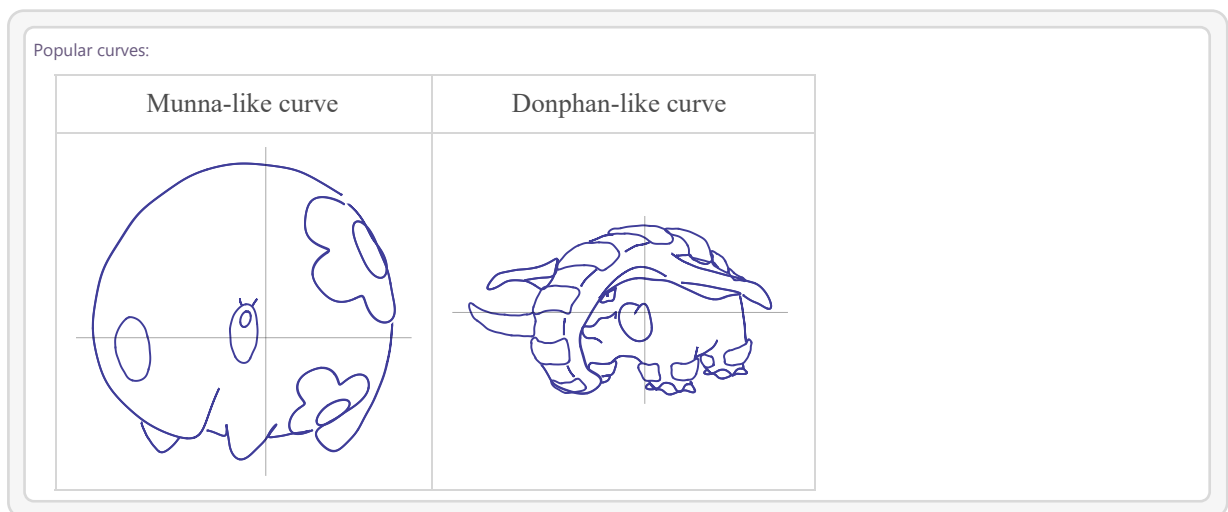


MATH:1260 Pokémath

The Mathematics of Pokémon Go[®]

Week 14 Monday, Spring 24



Plan for Today

- Module 3: To Be The Very Best!
 - Rate of Change
 - Average Rate or Change
 - Total Change

Reminders

- HW 9 (last HW!) is due Wednesday at midnight.
- Project 3 Stage 1 is due Wednesday at midnight.
- GW 12 (last GW!) on Thursday.

- Extra Credit available

Rate, Average Rate, and Total

For Pokemon, we have been looking at rate of damage, average rate of damage, and total damage.

But as with everything in mathematics, you can look at things more generally as rate of change, average rate of change, total change.

An example: Munna vs Donphan

Predictions?



Moves

Fast Moves

Munna uses Charge Beam.
Donphan uses Counter.

What is the damage per turn for each?

Fast Move	Power	Energy	Duration	STAB(1or1.2	Type Effectiv	Multiplier	unrdd damage	damage
Charge Beam	5	11	3	1	0.390625	0.5078125	1.28876702	2
Counter	8	7	2	1	0.625	0.8125	4.38590842	5

Charge Moves

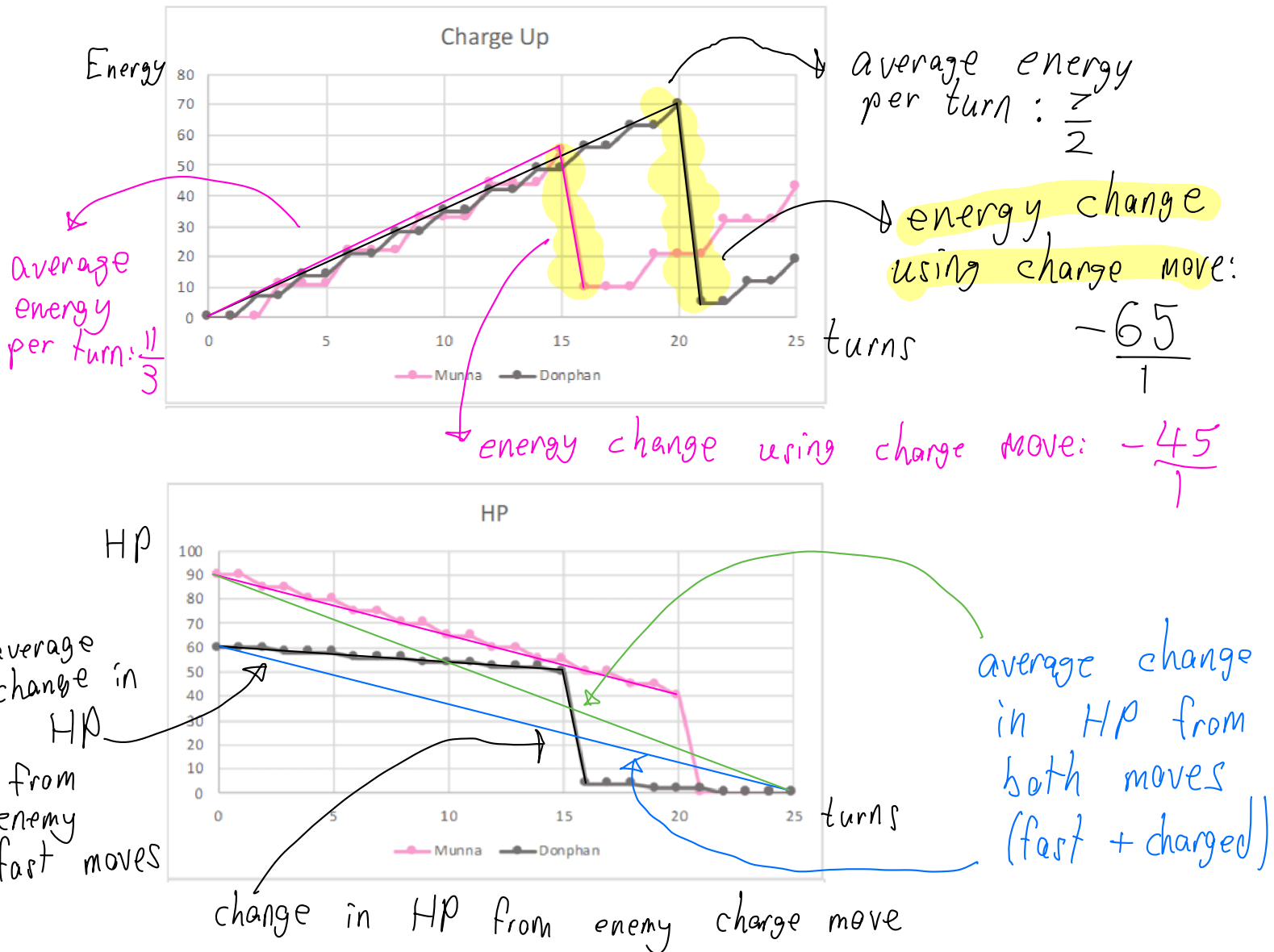
Munna uses Psyshock.
Donphan uses Earthquake.

Charge Move	power	energy	STAB(1or1.2	Type Effectiv	Multiplier	unrdd max d	max damag
Psyshock	70	45	1.2	1	1.56	55.4272922	56
Earthquake	120	65	1.2	1	1.56	126.314163	127

No Shields!

Suppose both have no shields. And that Munna's trainer doesn't quite hit enough bubbles to win, 25.
(this will make the battle more interesting.)

What slopes are present in these two graphs? What do those slopes represent?

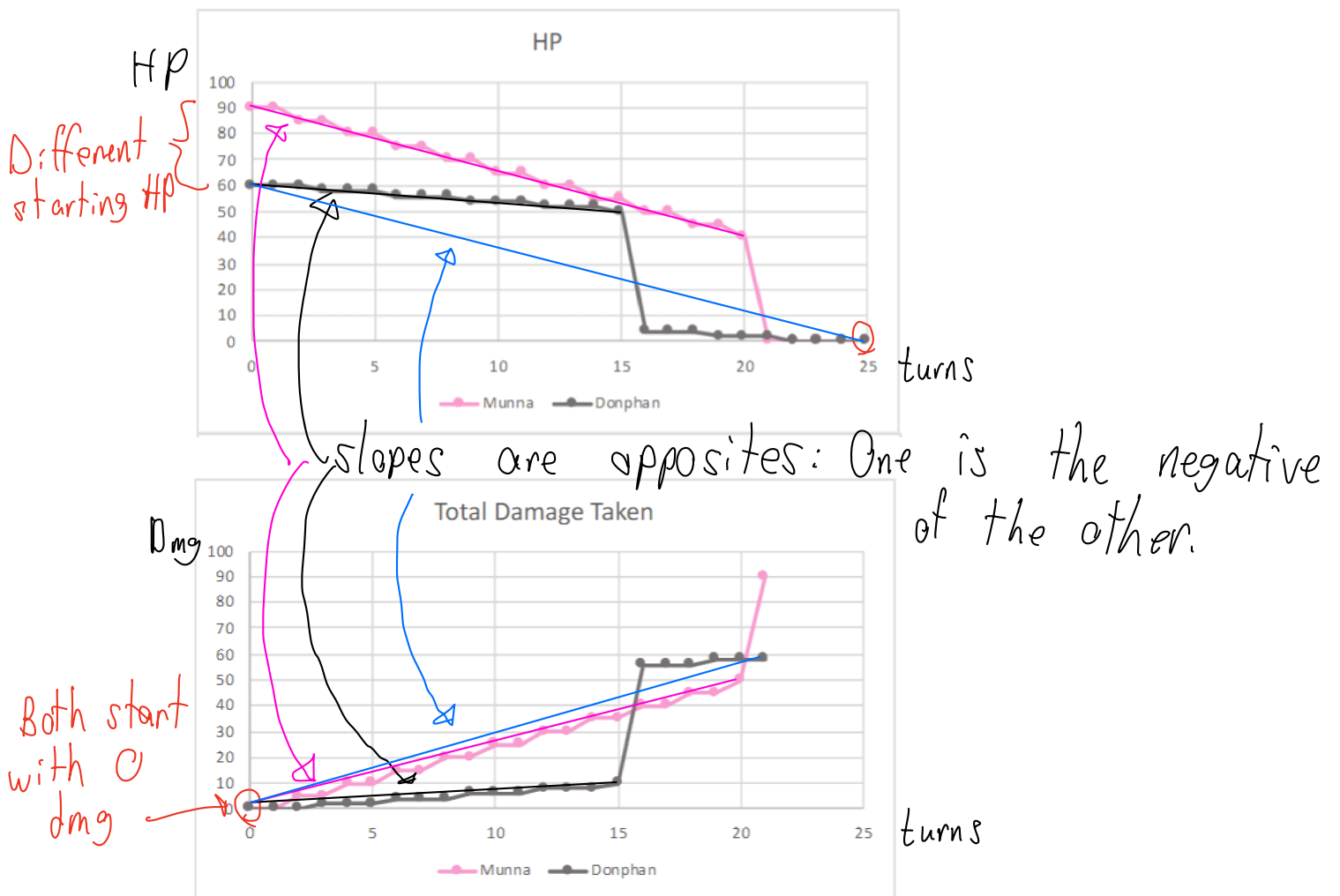


Damage and HP

Damage is a **reduction** in HP. So it is negative.

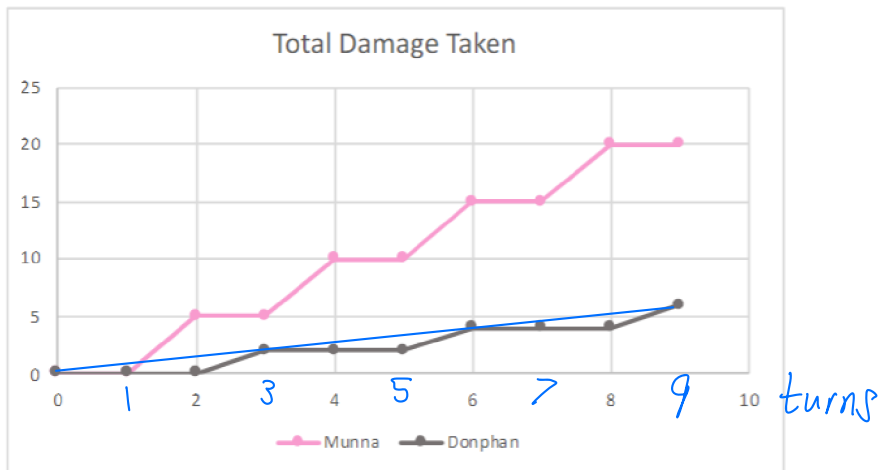
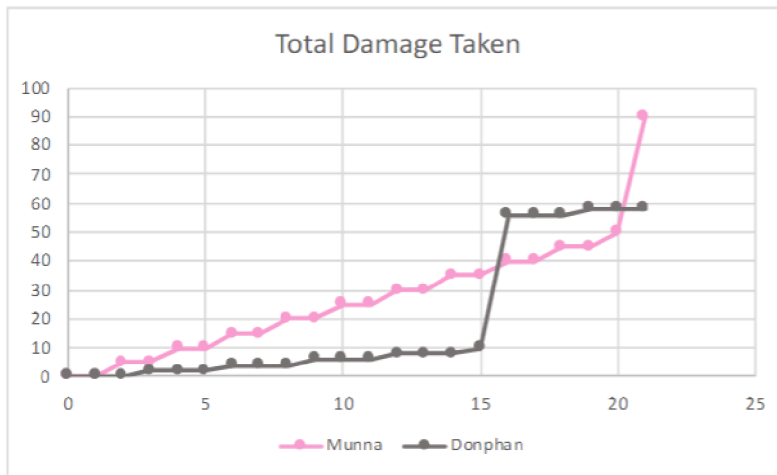
If we want to represent damage as a positive number, we can instead make a graph of “total damage taken” by each Pokemon.

What is similar between these graphs? What is different?



Let's focus on damage taken by Donphan

We want to look at the “Damage per Turn” or “Rate of Damage”.



On turn 1: Donphan takes 0 damage from Charge Beam

On turn 2: Donphan takes 0 damage

On turn 3: Donphan takes 2 damage

On turn 4: Donphan takes 0 damage

On turn 5: Donphan takes 0 damage

$$\frac{0+0+2+0+0+2+0+0+2}{9}$$

$$= \frac{6}{9} = \frac{2}{3} \text{ avg dmg per turn}$$

On turn 6: Donphan takes 2 damage

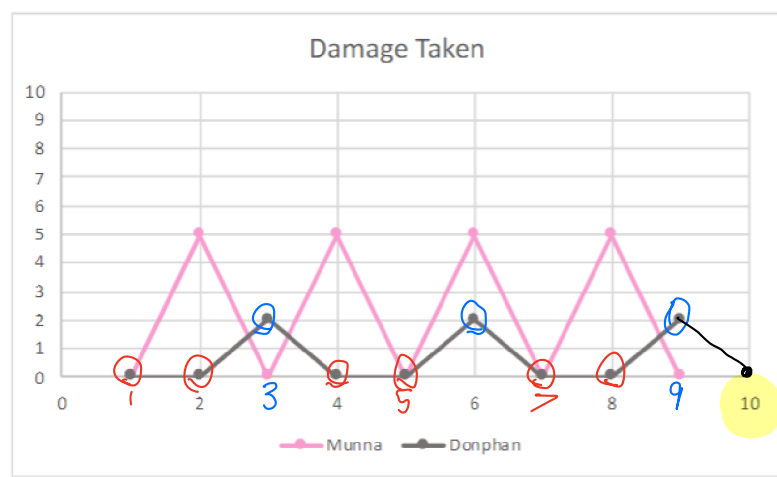
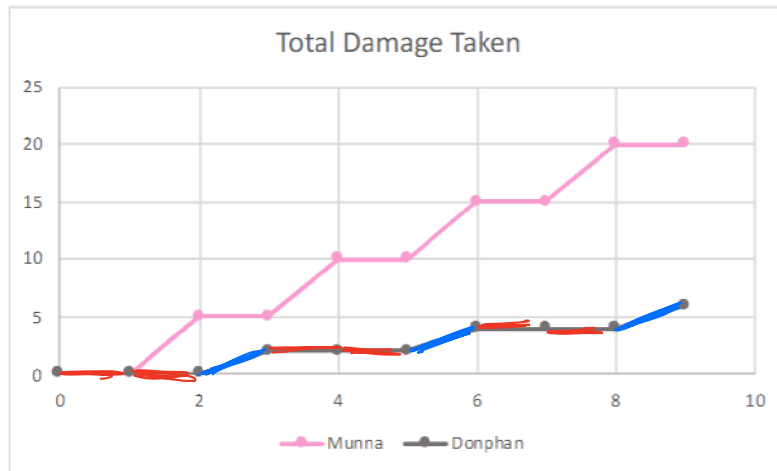
On turn 7: Donphan takes 0 damage

On turn 8: Donphan takes 0 damage

On turn 9: Donphan takes 2 damage

New Graph

Let's try something a little strange. Let's graph the **slope** of total damage taken as its own y-value.

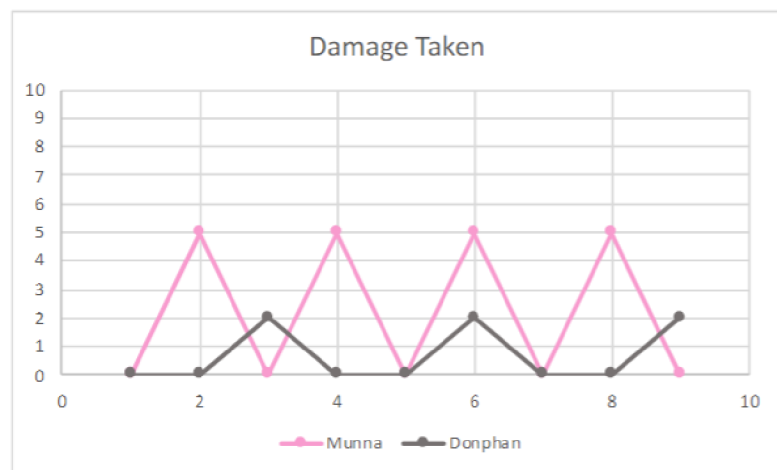
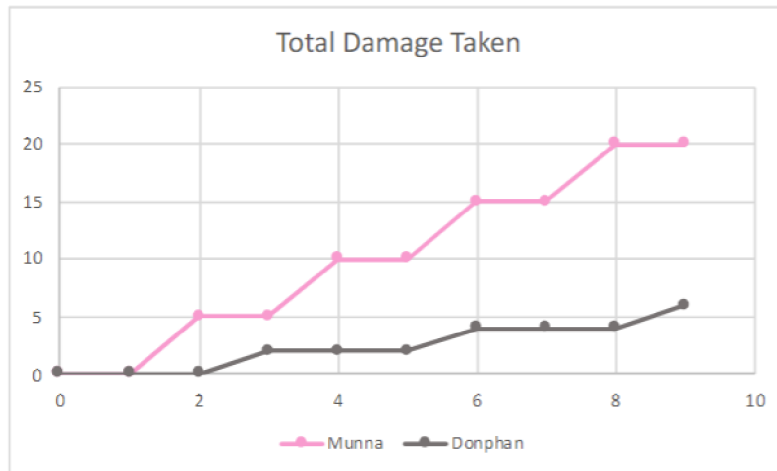


What do the points on the "Damage Taken" graph represent? *Dmg taken on a specific turn.*

Top Hat: Based on the shape of this graph, how much damage will Donphan take on turn 10? *0*

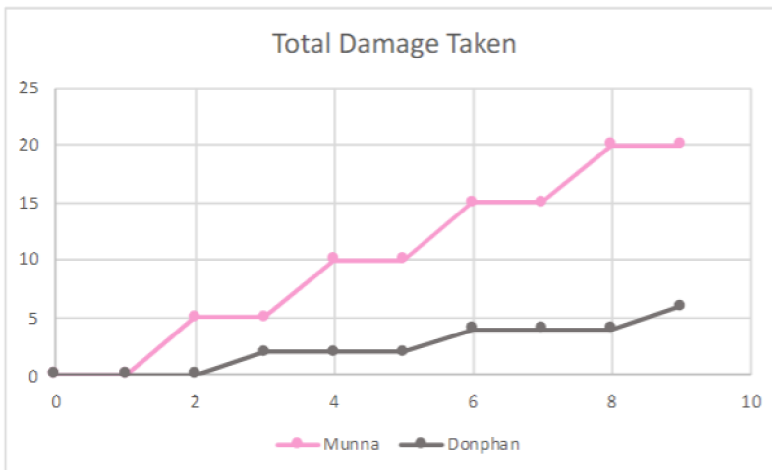
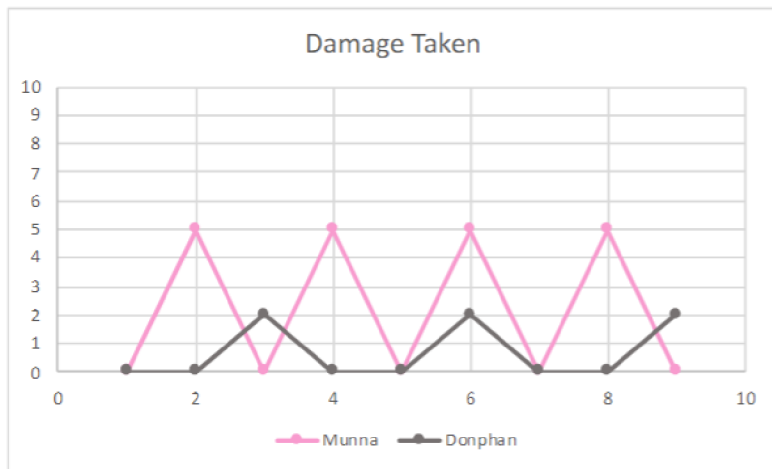
Generalization

There's a non-Pokemon version of the concept we just explored. It is called the Fundamental Theorem of Calculus II. It says that the slope of a cumulative sum is the rate of change of that sum.



Generalization

You can also go backwards! This is called the Fundamental Theorem of Calculus I. It says if you add up all of the rates of change, you get the total change.



More Generalizations

This idea gets really complicated when the real world is involved...

