NAME: _____ **DATE:** _____

STUDENT #: _____ **TEACHER:** _____

Simulation Data, Section 1

Complete the tables with data obtained from the simulation.

1.2 Parts A & B
Sim Investigation #1: How does height affect maximum speed?
Sim Investigation #2: How does height effect percentage of damage?

LOWEST ----------> HIGHEST

	Position A	Position B	Position C	Position D	Position E
Sim #1 Skater's Max Speed (m/s)	**0.9**	**1.8**	**2.7**	**3.5**	**4.4**
Sim #2 Percent of Damage (%)	**3%**	**12%**	**26%**	**46%**	**73%**

Answers are approximate. Computer or tablet processors affect sim results, but small variation will not affect the clear trend in data.

Answer after Sim #1
What trend do you see when you compared height to maximum speed?

As height increased, max speed increases

(over→)

Answer 2-4 ONLY after Sim #2

2. What trend do you see when you compared height to pumpkin damage?

As height increased, Percent of Damage increases

3. What, in your opinion, is causing these trends? Why do you think we see these changes in speed and pumpkin damage as height increases?

When asked, students should be able to state that as the starting position moves up the arc, the speed and percent of pumpkin damage increases. Understanding of relationship between speed and damage should not be expected.

Avoid providing the answers. Let student ideas stand and germinate a bit. Misconceptions can be better confronted after future investigations. Do not introduce "energy".

4. Thinking about helmets, what thoughts have these two investigations provided? What impact do the results suggest about skaters worrying about speed?

Skaters might increase their risk of head injury as they move higher up the ramp because of increased speed.

Avoid providing the answers. Let student ideas stand and germinate a bit. Misconceptions can be better confronted after future investigations. Do not introduce "energy".

NAME: _____ **DATE:** _____

STUDENT #: _____ **TEACHER:** _____

Simulation Data, Section 3

Complete the tables with data obtained from the simulation.

3.1 and 3.3
Sim Investigation #3: How does height affect kinetic energy?
Sim Investigation #4: How do helmets affect the transfer of kinetic energy?

LOWEST ----------> HIGHEST

	Position A	Position B	Position C	Position D	Position E
Sim #3 Skater's Max Kinetic Energy (Joules)	**1**	**3**	**7**	**13**	**20**
Sim #4 Kinetic Energy Transfer with Helmet (Joules)	**0**	**1**	**5**	**11**	**18**

Answer after Sim #3
What trend do you see when you compared height to kinetic energy?

As height increased, kinetic energy increases

(over→)

Answer 2-4 ONLY after Sim #4

2. What trend do you see when you add a helmet to the pumpkin?

As height increased, kinetic energy still increases, but at lower levels

3. How do the pumpkin-with-helmet results compare to the pumpkin-with-NO-helmet results?

At every position, the helmet led to a reduction 2 Joules of energy being transferred to the pumpkin.

4. What, in your opinion, is causing the trend you see in Question 3?

The helmet absorbs or deflects some of the energy the pumpkin experiences during impact.

NAME: _____ **DATE:** _____

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Speed & Kinetic Energy Analysis

3.5 Return to the Challenge

Use the data from the Simulated Data, Section1 and Simulated Data, Section 3 sheets. Calculate how much the max speed and kinetic energy changes when the skater moves from one position up to the next position. For example, we can calculate the change in max speed when moving from Position A to Position B. We simply subtract Position A speed data from Position B speed data:

Position B – Position A = (1.8 m/s) – (0.9 m/s) = **0.9**

So, a skater increases their max speed by +0.9 m/s when they move from Position A to Position B

Complete the table below for both max speed and kinetic energy using the data from your Simulated Data sheets.

LOWEST ----------> HIGHEST

Change in Position	From A to B	From B to C	From C to D	From D to E
Change in Speed (m/s)	+ 0.9	+ 0.9	+ 0.9	+ 0.9
Change in Kinetic Energy, No Helmet (Joules)	+ 2 J	+ 4 J	+ 6 J	+ 7 J

(over→)

1. From the Section 1 table, we see that each time the skater moves up to the next position, their max speed increases. According to your calculations here, is the increase in speed a consistent, uniform increase? Why or why not?

The Max Speed consistently increases by 0.9 m/s with each change in position.

2. From the Section 3 table, we see that each time the skater moves up to the next position, their max kinetic energy increases. According to your calculations here, is the increase in kinetic energy a consistent, uniform increase? Why or why not?

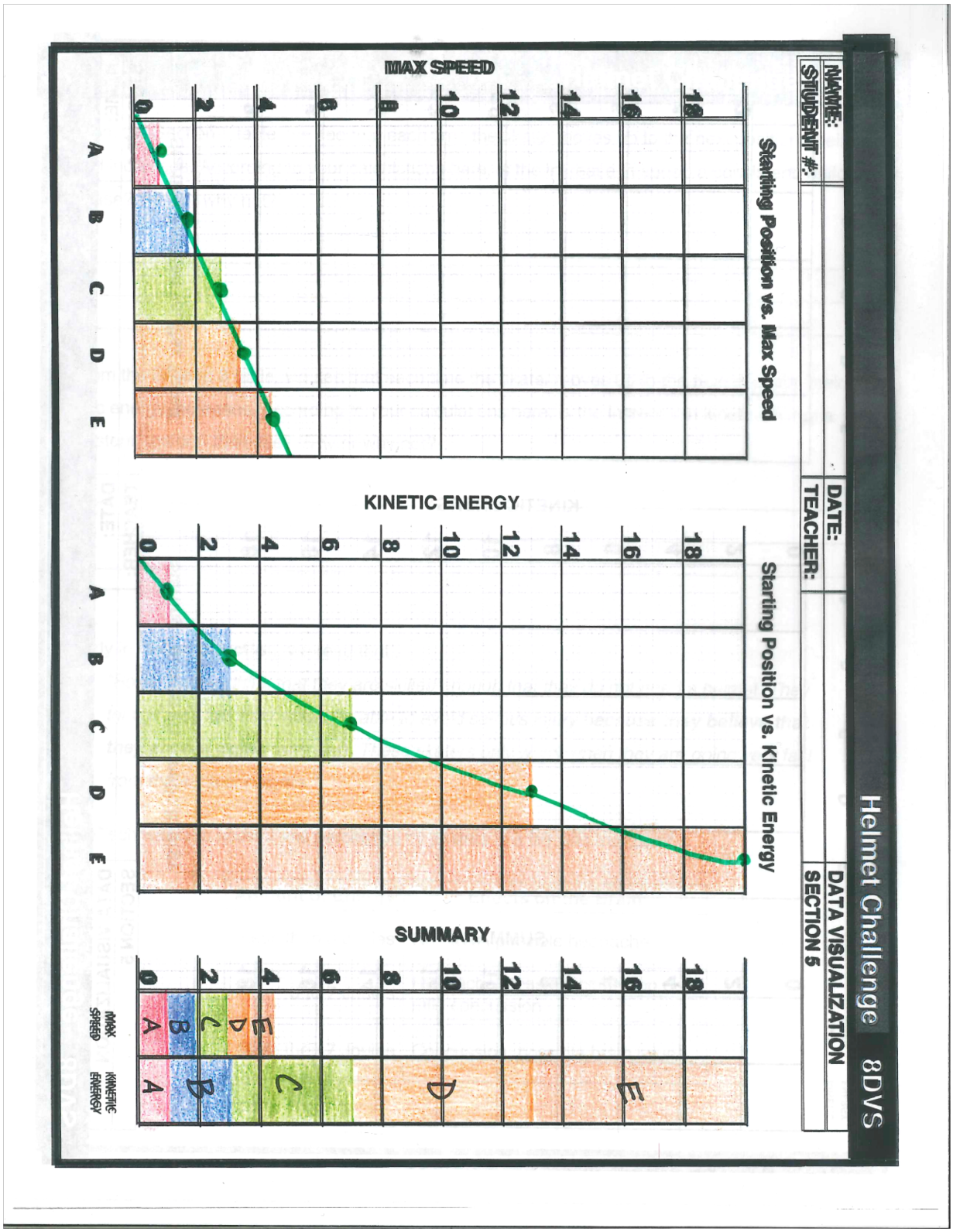
The kinetic energy DOES NOT have a consistent increase. With every change in position higher, the kinetic energy grows larger (+2, +4, +6, +7, etc)

3. Early in the **Introduction,** we read that...

> *"Some skaters think that they are skilled enough that they do not need a helmet. They think if they fall, they would be able to avoid serious injury* ***because they believe that they are not going very fast****. These skaters only worry when they are going very fast from the highest heights."*

Do you think this perception by skaters is a fair and true point? Support your answer with evidence.

Amount of Energy	Effects on the Brain
Less than 3 Joules	No effect, possible headache
3 to 7 Joules	Headache, possible confusion or mild concussion
More than 7 Joules	Concussion, possible brain injury


Helmet Challenge 8DVS
NAME:
STUDENT #:
DATE:
TEACHER:
DATA VISUALIZATION
SECTION 5
MAX SPEED
Starting Position vs. Max Speed
KINETIC ENERGY
Starting Position vs. Kinetic Energy
SUMMARY
MAX SPEED
KINETIC ENERGY
A B C D E
0 2 4 6 8 10 12 14 16 18