Balanced or Unbalanced?

Student Data Page Activity 4B (MS) Part 2

Activity Materials: (Per Group):

- 30 cm cardboard ramp
- Meter stick
- Table
- Ring stand with 1 clamp
- *Pom-Pom Granny* model from Part 1 of this activity
- Stopwatch
- 1 copy of *Student Data Page Part 2* (Per student)

Procedure:

❒ 1. You will work in a group of four, so first, decide upon group roles. For this activity, there will be a *Builder*, *Reader, Driver*, and *Measure Master*. See the *task cards* for details on the duties of each group member. Roles are summarized below.

a. The *Builder* will gather the materials and organize the construction of your test ramp as shown in *Figure 1 Setting up the Test Ramp*. The Builder will also work the stopwatch.

b. The *Reader* will read all the instructions to the rest of the team, making sure that the rest of the team knows their jobs, and clarifying any questions that arise during the activity. The *Reader* will also make sure to check off each step as it is completed. In addition to that, the *Reader* gets to make sure that everyone stays on task and work effectively as a team.

c. The *Driver* will be responsible for running *Pom-Pom Granny* down the ramp and changing the height of the ramp between runs.

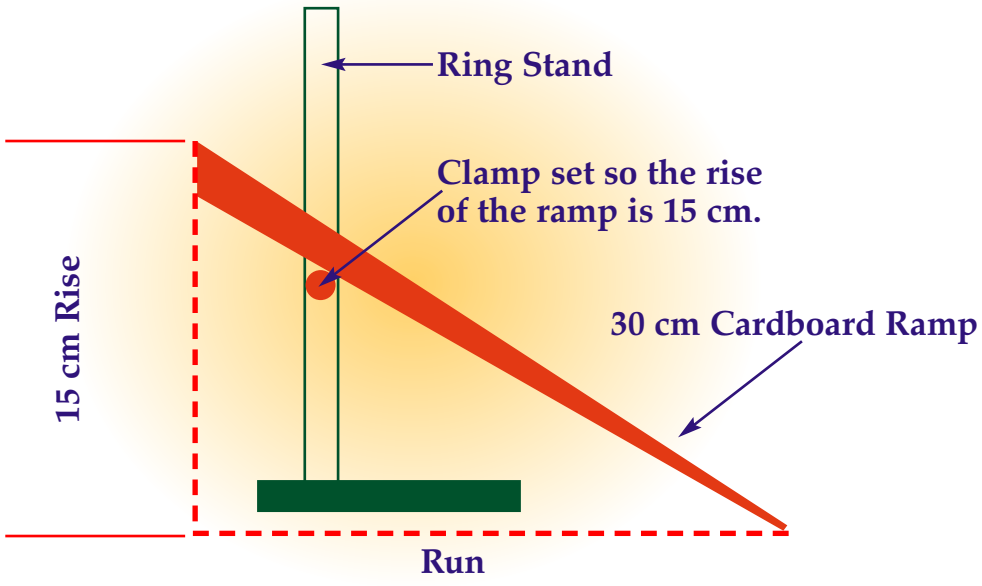
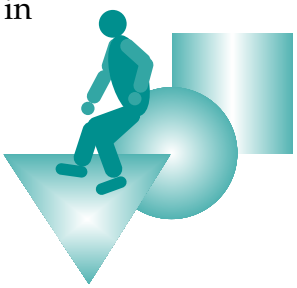
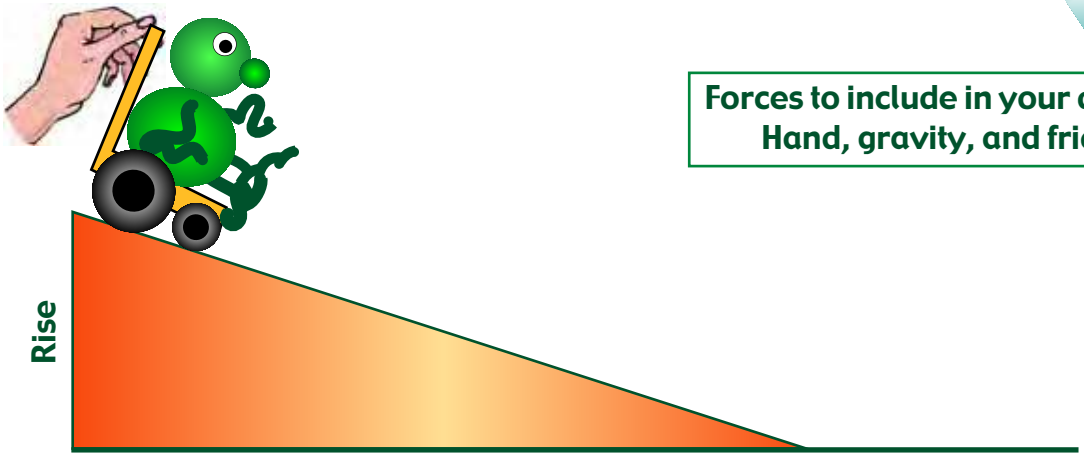


Figure 1 Ring Stand Ramp

❒ 2. In this activity, you will examine the forces acting on ***Pom-Pom Granny*** in her wheelchair as you hold her in place at the top of the ramp.



❒ 3. *On the picture of **Pom-Pom Granny**, draw and label all of the forces that are acting on her. Be sure to include arrows that show which direction the force is acting.*



Forces to include in your drawing: Hand, gravity, and friction

Explain why Pom-Pom Granny is not moving down the ramp?

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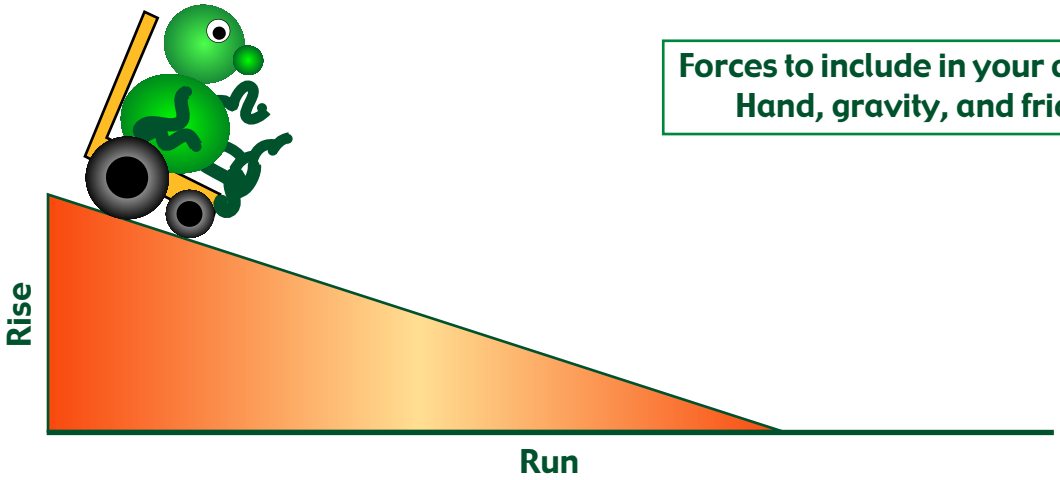
❒ 4. Again place Pom-Pom Granny at the top of the ramp, holding her in place so all the forces acting upon her are balanced. Now, release your hold on her.

❒ 5. On the picture of Pom-Pom Granny, draw and label all of the forces that are acting on her. Be sure to include arrows that show which direction the force is acting.



Forces to include in your drawing: Hand, gravity, and friction

Why does she begin moving down the ramp?

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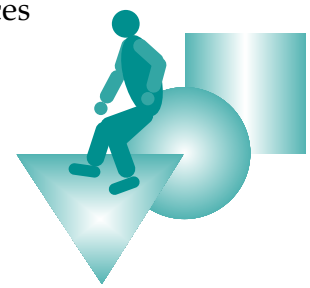
What does the direction of her movement tell you about the unbalanced forces acting upon her?



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☐ 6. Next, you will observe what happens to ***Pom-Pom Granny*** as she moves down ramps of various heights. When ***Pom-Pom Granny*** is at the top of the ramp, she has ***potential energy***. Once the forces acting on her are unbalanced and she begins to move, the ***potential energy*** is converted to ***kinetic energy***. Once her kinetic energy is used up and all forces acting on her are balanced, she will stop moving and will stay that way until an unbalanced force acts on her again.

☐ 7. By changing the position of the ring stand clamp, see ***Figure 1***, the ***Builder*** will set the rise of the ramp to equal 3 cm. The ramp length will be 30 cm.

☐ 8. The ***Driver*** will place ***Pom-Pom Granny*** at the top of the ramp and hold her in place.

☐ 9. The ***Measure Master*** will call **"Go"** to signal the ***Driver*** to release his or her hold on ***Pom-Pom Granny***.

☐ 10. The ***Reader*** will make sure everyone is following the procedures and that no one interferes with ***Pom-Pom Granny's*** trip down the ramp.

☐ 11. When ***Pom-Pom Granny*** comes to a complete stop, the ***Measure Master*** will measure the distance ***Pom-Pom Granny*** traveled ***from the end of the ramp to her final stopping point***. Record the data in ***Table 1***.

☐ 12. Repeat steps 7-11 two more times and find the average distance traveled by ***Pom-Pom Granny***.

☐ 13. The ***Builder*** will increase the rise of the ramp to 6 cm as in step 7.

☐ 14. Repeat steps 7-12.

☐ 15. The ***Builder*** will continue increasing the rise by 3 cm until a rise of 21 cm has been tested.

*Predict the effect of rise on the distance traveled by **Pom-Pom Granny**.*

Table 1 The Effect of Rise on Distance Traveled by Pom-Pom Granny

Rise (cm)	*Distance Traveled (cm)*			
	Trial 1	*Trial 2*	*Trial 3*	*Average*
3				
6				
9				
12				
15				
18				
21				

What do you notice about the relationship between the ***rise*** of the ramp and the distance traveled by ***Pom-Pom Granny***?

In terms of ***balanced*** and ***unbalanced*** forces, explain why these results happened.

In terms of ***potential*** and ***kinetic energy***, explain why these results happened.

Design Challenge

1. All groups will set the ring stand clamp at 20 cm rise. Be creative and design ***Pom-Pom Granny's*** ramp so that she will travel farther than ***Pom-Pom Granny*** from any other group.

2. You must consider all of the forces acting on her and must reduce the forces that will cause her to stop short, such as friction.

3. You must also design her ramp so that she has the maximum amount of ***potential energy*** at the start. *This will give her the potential to travel the farther than any other* ***Pom-Pom Granny***. <u>You may not push her down the ramp</u>; only release your hold on her.

4. You will have 15 minutes to design the test ramp for your group. At the end of 15 minutes, the contest will begin!

5. To conduct the test, you will hold ***Pom-Pom Granny*** in place at the top of the ramp. When the teacher says "go", release her and allow her to move until she comes to a stop ***on her own***. Measure the distance from the end of the ramp to her stopping point. Record the distance she traveled in ***Table 2 Design Challenge***.

6. Repeat two more times and find the average distance traveled by ***Pom-Pom Granny***.

Table 2 Design Challenge

Ramp Length(cm)	*Run (cm)*	*Rise (cm)*	*Distance Traveled (cm)*			
			Trial 1	*Trial 2*	*Trial 3*	*Average*
		20 cm				

7. Each group will report the average distance traveled by ***Pom-Pom Granny***. Once the winner is determined, the group will report on their winning strategy. Be sure you can identify the factors they adjusted in order to win.

Processing Out:

1. Where is *Pom-Pom Granny's* potential energy the greatest?

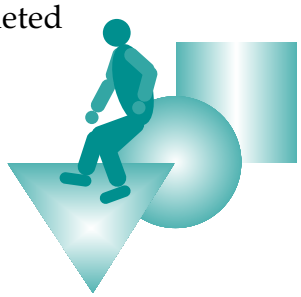
2. When is her potential energy the least?

3. Describe the forces acting on *Pom-Pom Granny* as you hold her at the top of the ramp.

4. Why is she not moving at this point?

5. Why will she begin moving when you release your hold on her?

6. What factors affected the distance ***Pom-Pom Granny*** traveled as she completed her trip down the ramp?



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7. How could you redesign the ramp so that ***Pom-Pom Granny*** would **NOT** travel as far?

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8. Why might it be important to redesign the ramp so ***Pom-Pom Granny*** would NOT travel as far?

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