90 Minutes

Objective

- Students will differentiate between speed, velocity and acceleration
- Students will compare and contrast Newton's three laws.

TEKS

- 8.6A—Demonstrate and calculate how unbalanced forces change the speed or direction of an object's motion.
- 8.6C—Investigate and describe applications of Newton's law of inertia, law of force and acceleration and law of action-reaction such as sports activities, amusement park rides, Earth's tectonic activities and rocket launches
- 8.2D – Construct tables and graphs, using repeated trials and means, to organize data and identify patterns

Guiding Questions

1. Barbie and her friends are very fashion conscious and are very worried about answering the intro questions from the bungee design team. Do you think it would matter if they lie about their height or weight?
   Yes, if Barbie lied about her height or weight she could crash into the ground.

2. What precautions should be taken during this lab?
   Follow all procedures
   Use caution when standing on the table
   Other answers may vary

3. Compare and contrast potential and kinetic energy?
   Kinetic energy is energy associated with motion
   Potential energy is the energy that matter has because of its position, composition or condition

4. Discuss the pros and cons of bungee jumping.
   Answers will vary

5. What is the formula for calculating speed?
   Speed = distance/time

Materials

- Triple beam balance
- Barbie Doll
- Calculator
- Tape measure/Meter Sticks (2)
- Rubber bands

Teacher Notes

- Before you begin the lab, you will need to decide how many groups you are going to have.
- Tape two tape measures together end to end to make one large tape measure.
- Hang the double tape measure from the ceiling (this is where students will be bungee jumping Barbie)
- Review definitions of speed and velocity before doing this lab.
- For ELL draw pictures of Barbie with arrows showing forces and energy.

Teaching Procedure

- Split students into groups of four.

- Begin by going through the PowerPoint with the students.

- During the lab, make sure students are on task and being safe. Students will need to stand on cabinets or tables to reach the ceiling, so it is imperative that they are being safe.

- Students will choose a member of the team for the following jobs:
  a. Safety Sheriff—The team member responsible for making sure all safety procedures are followed during the lab
  b. Bungee Manager—The team member responsible for making sure that everyone gets a chance to bungee jump Barbie.
  c. Measure Manager—The team member responsible for making sure everyone watches Barbie bungee jump, and agrees on the same distance jumped.
  d. Equipment Manager—The team member responsible for collecting and returning the equipment, and making sure everyone on the team keeps the area tidy.

- Students will measure Barbie's mass and height and record them on your data sheet. (see figure 1)
- Students will use two rubber bands to create a double-loop around Barbie's feet. A double-loop is made by securing one rubber band to another using a slip knot (see figure 2).
- Students will then wrap the open end of the double-loop tightly around Barbie's feet as shown (see figure 3).

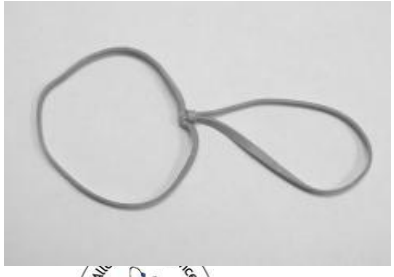


Figure 1 **Figure 2** **Figure 3**

- Students will hold Barbie upside down with her feet at the top of the tape measure.
- Students will then hold the rubber band at the top of the tape measure, and simply let Barbie drop from the head-down position. (see figure 4)
- This is the tricky part. You need to observe the LOWEST spot her head reaches during the bounce. The final resting spot is NOT the lowest spot.
- One student will drop Barbie three times each time you add a rubber band to get an accurate reading, and record the data on your data sheet.
- After three drops, the students need to rotate so everyone has a chance to bungee Barbie.
- They will calculate the average distance and record on their data sheet.
- The students will then attach a second rubber band to the first one, again using a slip knot. (see figure 5)

Figure 4

Figure 5

- With two rubber bands now attached, they will hold the end of the rubber bands at the jump line with one hand, and drop Barbie from the line with the other hand.
- Students will measure the jump distance in centimeters, and record the value on their data sheet. Make sure the students are having Barbie jump three times and calculating the average every time they add a rubber band.
- Accuracy is important—Barbie's life could depend on it!
- Have students repeatedly attach an additional rubber band for each new jump. They will need to measure the jump distance, and record the results in the data table each time.
- If your team worked with Barbie, discuss your results with a Ken team. If your team worked with Ken discuss your results with a Barbie team.

- When they have completed the data table, they will graph their results, answer the questions and complete the C.E.R.

Follow Up

Have students review their C.E.R. with a partner, and then share as a whole group. Allow students to give any experiences they have had with real-life situations

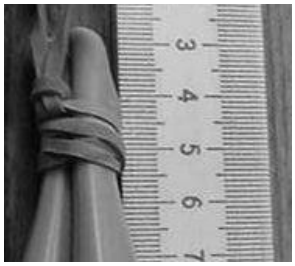
Round Name Tags

Print on cardstock and laminate, if possible.

Safety Sheriff

Barbie Manager

Measure Manager



Equipment Manager

1. What is the relationship between the number of rubber bands and jump distance?
   The more rubber bands, the further the jump.

2. Based on your data, what would you predict is the maximum number of rubber bands so that Barbie could still safely jump from 300 cm?
   Answers will vary

3. If Barbie were to bungee from a height of 150 meters and reach the bottom of the jump in 5 seconds, calculate Barbie's average speed and velocity.

   Speed=30 m/s

   Velocity=30 m/s downward

4. Barbie's friends were watching her bungee jump from the bottom, name at least two times when they saw Barbie accelerate.
   Barbie's friends saw her accelerate any time she changed direction: she jumped off the bungee platform, when she stopped coming down and started going back up, when she started coming back down again….etc

5. Describe how the Law of Inertia applies to bungee jumping.
   Barbie stayed in motion downward until the bungee cord stretched to its limit and the force pulled her upward.

6. What forces acted upon Barbie as she bungee jumped?
   Friction, air resistance, gravity

7. When bungee jumping, where did Barbie experience potential energy? Kinetic energy?
   Barbie experienced Potential Energy at the top of bungee platform, and at the point where the rubber band was stretched to its max.
   Barbie experienced Kinetic Energy when she was falling, or when she was being pulled back up by the rubber band.

Conclusion

Prompt

Barbie and her friends are very fashion conscious and are very worried about answering the introduction questions from the bungee design team. Will it matter if they lie about their height or weight?

Claim (answer the question)

Yes, if Barbie lied about her height or weight she could crash into the ground.

Evidence (give evidence from the lab)

Answers may vary

Reasoning (show your scientific reasoning)

The Law of Acceleration says that the smaller the mass, the greater the acceleration. If Barbie had lied about her weight, she could accelerate at an unsafe speed. If she had lied about her height, the bungee cord may be too long.

Barbie Bungee

Name:_____ **Date:**_____

Period:_____

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- Tape measure/meter stick (2)
- Rubber bands

Procedures

1. Choose a member of the team for the following jobs:
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   d. Equipment Manager—The team member responsible for collecting and returning the equipment, and making sure everyone on the team keeps the area tidy.

2. Measure Barbie's mass and height and record them on your data sheet. (see figure 1)

3. Use two rubber bands to create a double-loop around Barbie's feet. A double-loop is made by securing one rubber band to another using a slip knot. (see figure 2)

4. Wrap the open end of the double-loop tightly around Barbie's feet, as shown. (see figure 3)

Figure 1

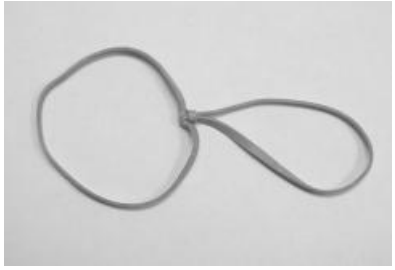


Figure 2

Figure 3

5. Hold Barbie upside down with her feet at the top of the tape measure.

6. Hold the rubber band at the top of the tape measure, and simply let Barbie drop from the head-down position. (see figure 4)

7. This is the tricky part. You need to observe the LOWEST spot her head reaches during the bounce. The final resting spot is NOT the lowest spot.

8. You will drop Barbie three times each time you add a rubber band to get an accurate reading, and record the data on your data sheet.

9. Calculate the average distance and record on your data sheet.

10. Attach a second rubber band to the first one, again using a slip knot. (see figure 5)

11. With two rubber bands now attached, hold the end of the rubber bands at the jump line with one hand, and drop Barbie from the line with the other hand.

12. Measure the jump distance in centimeters, and record the value on your data sheet. Make sure Barbie jumps three times every time you add a rubber band.

13. Accuracy is important—Barbie's life could depend on it!

14. Repeatedly attach an additional rubber band for each new jump. Measure the jump distance, and record the results in the data table.

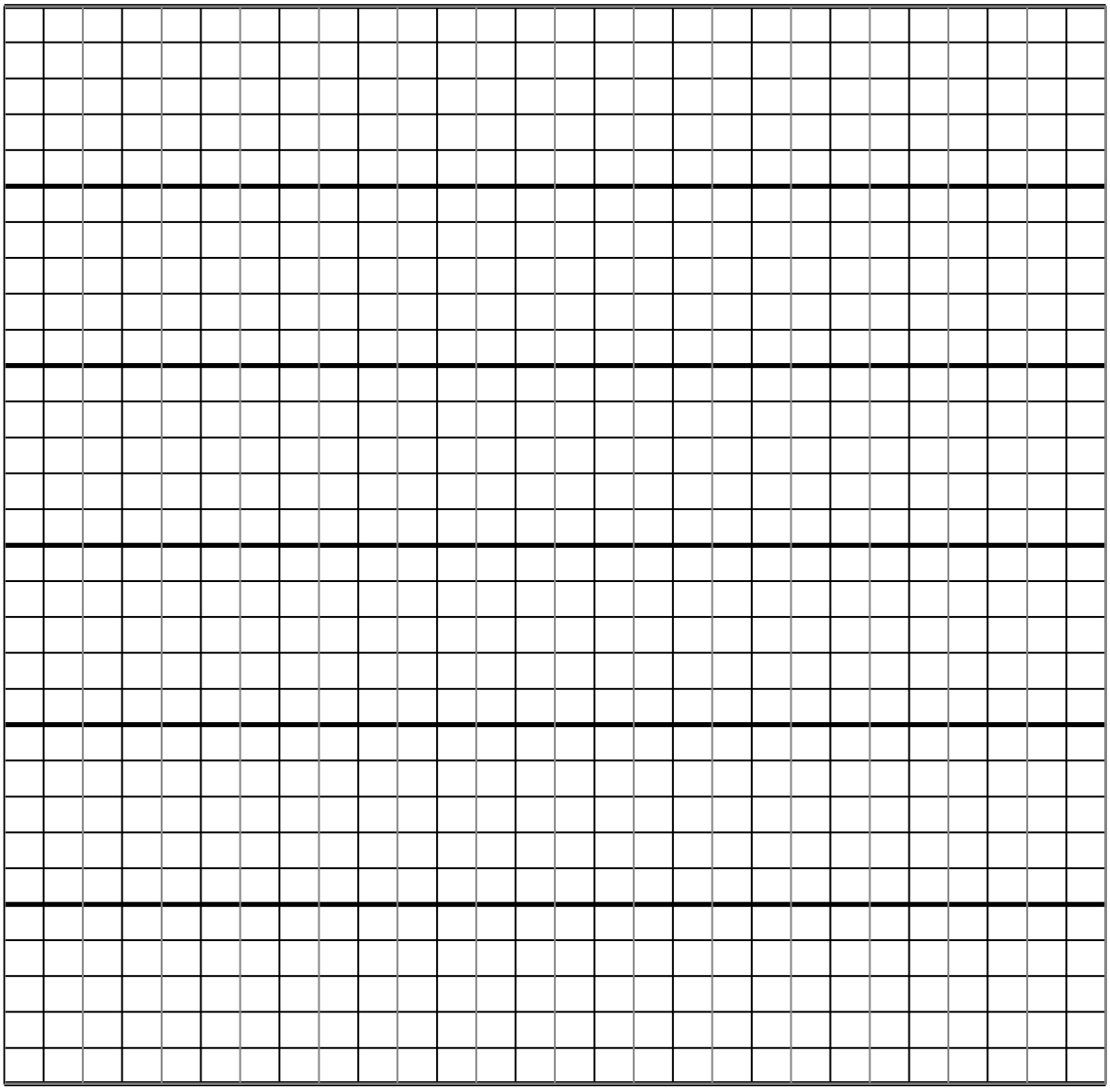
15. When you have completed the data table, graph your results, answer the questions and complete the C.E.R.

Figure 4

Figure 5

Barbie's Mass: _____ Barbie's Height: _____

Number of Rubber Bands (X)	Jump 1 (in cm)	Jump 2 (in cm)	Jump 3 (in cm)	Average Distance of jump (in cm)
0				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				



1. What is the relationship between the number of rubber bands and jump distance?

2. Based on your data, what would you predict is the maximum number of rubber bands so that Barbie could still safely jump from 300 cm?

3. If Barbie were to bungee from a height of 150 meters and reach the bottom of the jump in 3 seconds, calculate Barbie's average speed and velocity.

   Speed=

   Velocity=

4. Barbie's friends were watching her bungee jump from the bottom, name two times when they saw Barbie accelerate.

5. Describe how the Law of Inertia applies to bungee jumping.

6. What forces acted upon Barbie as she bungee jumped?

7. When bungee jumping, where did Barbie experience potential energy? Kinetic energy?

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