

Ambitious Science Teaching

Forces & Motion Unit, 9th Grade

Student FINAL Model

Name: _____

Question: How is Erik Røner able to successfully fly and safely land using helium balloons attached to a lawn chair?

- Directions:**
1. In the four drawings below, draw what is happening that you can't see that causes Erik to move at each point in time. Use dotted arrows (--->) to show motion and solid arrows (—>) to show forces in the picture.
 2. In the boxes, draw and label a force diagram showing all the forces acting on Erik.
 3. After drawing your models, use the lines to write an explanation about what is happening at each point in time.
 4. For each picture, be sure to include the ideas from the Gotta Have Checklist.
 5. After completing your model, provide evidence from one class activity that supports one of your ideas.



Gotta Have Checklist: include in every box

- ☐ Show all the forces acting on Erik using a force diagram (FORCE acting ON BY)
- ☐ Identify whether the forces are balanced or unbalanced
- ☐ Describe Erik's motion, including direction and type of motion (constant speed or acceleration)
- ☐ Describe how the forces cause any changes in motion

Provide Evidence: include for one point in time

- Look at your original model. How has your thinking changed over time? Are there any ideas you have added or removed from your model?
- Pick one class activity in which you collected data that supports a change in your thinking. Write your evidence on a sticky note and stick it to the relevant picture.

ERIK ON HIS CHAIR - GOING UP

The helium balloons in the balloons are pulling up. There is tension force in the ropes. The chair is providing normal force to hold Erik up. Moving up at a constant speed.

Force Diagram
Normal force is acting on Erik by the chair.
 F_N
Unbalanced forces
 F_g
Force gravity acting on Erik by the earth.

ERIK ON HIS CHAIR - GOING DOWN

Helium balloons are still going up. Gravity pulling Erik down. The chair is pushing on Erik. Air resistance is acting on the chair. Moving down - speeding up.

Force Diagram
Air resistance is acting on the lawn chair by the air.
 F_a
Unbalanced forces
 F_g
Gravity force is acting on Erik by the earth.

The forces acting directly on Erik are gravity pulling him to the earth and the normal force of the chair preventing him from falling by pushing up on him. The helium balloons are providing buoyant forces but the helium balloons are only directly acting on the ropes. The ropes have a tension force that is holding the chair up. Only the chair is acting directly on Erik. In the experiment with the ball and water, the ball floated on top of the water because it was lighter. Like the balloons, the ball floats on water.

The forces acting on Erik include gravity and air resistance. Gravity is pulling Erik to the earth while air resistance is pushing the lawn chair up. In this case, gravity force is stronger than the air resistance force so this allows Erik to fall down.

ERIK SEPARATES FROM HIS CHAIR - GOING DOWN

Gravity pulling him down. Air resistance pushing up. Gravity pulling Erik down. Air resistance acting on Erik. Moving down - speeding up.

Force Diagram
Air resistance acting on Erik by the air.
 F_a
Unbalanced forces
 F_g
Gravity force is acting on Erik by the earth.

The forces acting on Erik include gravity and air resistance. Gravity is pulling Erik to earth and air resistance is pushing Erik up. In this case gravity force is stronger than air resistance so this allows Erik to fall to earth.

ERIK RELEASES HIS PARACHUTE - GOING DOWN

Gravity pulling Erik and parachute to earth. Parachute providing air resistance to slow Erik down at a constant speed. Tension force. Moving down - constant speed.

Force Diagram
Tension force is acting on Erik by ropes connected to parachute.
 F_T
Gravity force is acting on Erik by earth.
 F_g

Forces acting on Erik include tension force and gravity. Gravity is pulling Erik to earth and tension force in the ropes are pulling Erik up. The parachute has lots of air resistance and slowed Erik down but because Erik is attached directly to the parachute it is the tension force in the ropes connected to Erik and the parachute that is keeping him at a slower constant speed. The force of gravity is not yet even with the force of the air resistance so he is still

in the downward moving fast, but now at a slow constant speed.

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Panel 1 of Student's Initial (Beginning Model)

ERIK ON HIS CHAIR – GOING UP

Helium in the balloons is lighter than air so it is pulling him upward

The Dude

lawn chair

Upward force

When the straps are released he is pulled upward because the helium is lighter than air and it has an upward force. There is enough helium to pull the weight of the lawn chair and his body up.

Panel 1 of Student's FINAL Model

ERIK ON HIS CHAIR – GOING UP

The helium in the balloons are pulling up

There is tension force in the ropes

The chair is providing normal force to hold Eric up.

Force Diagram

Normal force is acting on Eric by the chair.

Force gravity acting on Eric by the earth.

Unbalanced force like he is moving up at a constant speed

The forces acting directly on Eric are gravity pulling him to the earth and the normal force of the chair. The helium balloons are pulling him from falling by pushing up on him. The helium balloons are providing buoyant forces but the helium balloons are only directly acting on the ropes. The ropes have a tension force that is holding the chair up. Only the chair is acting directly on Eric. In the experiment with the ball and water, the ball floated on top of the water because it was lighter. Like the balloon, the ball has a