

3-PS2-1	Gr. Level: <u>3rd</u>	Creation Date: <u>9-15-15</u>	Edit Date/Time: <u>11/6/2015 11:48 AM</u>	Writer(s): 1
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## Title: Balanced and Unbalanced Forces

### Objective:

Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object: 3-PS2-2 Make observations and or measurements of an object's motion to provide ....

### Preloading:

Vocabulary: Academic Language - force, gravity, balanced, unbalanced, motion  
 Scientific Language - evidence, model

### English-Learner Scaffolding Focus:

Wait time - remember to give students enough time to find meaning in your question. (often, Language Learners are translating question and answer from and back to English)  
Sentence Frames - Use these to provide context for the learner to insert academic language.  
Hands-on, active participation—create an experiential opportunity parallel to language

### Engagement (5 minutes):

Whole Group—one HSE addressing the whole class

***Hi boys and girls.*** Introduce yourself and your team

***Today we are going to have some fun with forces and motion.***

***Does everyone know what the game tug of war is?*** (model 2 HSEs on each side of a rope with fabric in the middle) Explain quickly if necessary.

***Who is the winner of the contest?*** Whoever is in the direction the scarf goes in

Queue up video of horse vs. people tug of war. Pause at first part before any movement.  
<https://www.youtube.com/watch?v=-srzT2oIJ2Q>

***First I want you to take a look at this picture. Use what you already know to predict who will win the tug-of-war game.***

Give them a few moments, then ask: ***Who would like to share their prediction?*** (after they give a prediction ask why and what information they knew already to help come up with the prediction)

Remember to use posted questioning prompts.

Try to interject the word force into your conversation, “By stronger are you saying that the people have more pulling force?” .....etc.

Show the remaining video of horse vs. people.

### Engagement (cont.):

*Wow, did you see that horse! Do you think that the humans' pulling force was as hard as the horse?*

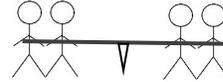
*So we would say the force was unbalanced or not balanced since the human and horse pulling force was not the same.*

*Tell your neighbor how we know this? Call on a person or two to give you their idea. (the peo-*

### Exploration 1 (5 minutes): Whole Group

*Okay, great now we should talk about two things "balanced" and "unbalanced" or not balanced forces.*

Have HSE's square up for another tug-of-war demonstration.



**Our game has two on each side. Look at the scarf is it moving much one way or the other?**

**So what do we know about the amount of pulling force that each side is doing? SAME**

*When the forces are the same, but pulling in opposite directions we have a balanced force.*

Use your arms to model a balance with two equal or balanced weights.

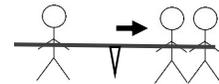
*Do you have any movement or motion with a balanced force?*



If necessary, *is our scarf moving much?*

*Now I'm going to ask one player to let go of the rope.*

*Do you think the scarf will move now? Which direction?*



HSE's will demonstrate what happens when an unbalanced force is in play.

*Tell your neighbor if the forces are still balanced. How do you know this?*

*Using the word force, tell your neighbor why the scarf is now in motion?*

Display sentence frame to help.....

The scarf is in motion because the pulling forces from opposite directions are \_\_\_\_\_.

Discuss several responses, use questioning from poster when appropriate.

We want to use the terminology unbalanced force to describe when the pulling force was not the same during the tug-of-war model.

## Exploration 2 (10-15 min.): Small Groups

*Now we are going to break up into our groups, Group A go with.....*

[Have an aircart set up on their track on each table]

One HSE addressing their small group

*Now that we have learned about balanced and unbalanced forces, I have a challenge for you.*

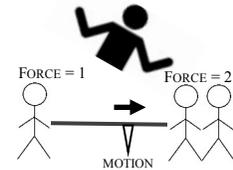
**1) First, I'd like to challenge you to build an aircart with UNBALANCED forces.**

*You will have a cart, 2 fans, a block of wood, and a track for the activity.*

*If the aircart has unbalanced forces, how would you describe the motion of the cart?*

It would move in the direction of the larger force, spend time here if they are unclear.

*Yes, remember there would be movement or motion in the direction of the greater or larger force. Just like in the tug-of-war game.*



*Before you begin, I want your group to plan what you will do. Be sure the recorder writes your plan.*

Give them a few minutes to discuss and record the plan. If they are struggling.....ask them *how will each opposite force compare to the other if they are unbalanced? How can your group plan for these forces?*

*Great plan! Let's have the doer and materials manager work to build your plan. Everyone else watch to be sure the plan is followed.*

Monitor closely for safety reasons. Do not allow them to turn on motors until the plan is built. They may only turn on motors with you CLOSELY monitoring.

*Nice, your model seems to follow your plan.*

*Okay data collector, get ready, your job is to measure how long it takes the cart to pass between the first two points on the track and the second two points.* Have students measure the distance between the two sets of points. *Recorder, you need to record these distances.*

*We're ready, doer turn on the motor(s).* HSE have students do one trial measuring time between first two points. Another for the second two points.

*Were our forces unbalanced? How do we know that?* We had motion.

*Was the cart moving as fast between the first two points as the second two points?* Have kids look at their data to answer this. If a struggle, ask....*What does it mean if it takes less time to go the same distance?*

*How do we know this?* It took less time to go between the second two points than the first.

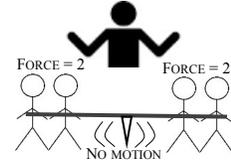
### Exploration 3 (15-20 minutes): Small Groups

2) Now, I'd like to challenge you to build an aircart with **BALANCED** forces.

*If the aircart has balanced forces, how would you describe the motion of the cart?*

No motion, spend a bit of time here if they are not clear why....

*Yes, remember there would be no motion if the cart had balanced forces since there is an equal amount of force going in opposite directions.*



*Before you begin I want your group to plan what you will do. Be sure the recorder writes down your plan.*

Give them a few minutes to discuss and record the plan. If they are struggling.....ask them *how will each opposite force be if they are balanced? How can your group plan for these forces?*

Welcome out of the box thinking—for example, using gravity to balance opposing force.

*Okay group your plan looks interesting!*

*Let's have the doer and materials manager work to build your plan. Everyone else watch carefully to be sure they are following the plan.*

Monitor closely for safety reasons. Do not allow them to turn on motors until the plan is built. They may only turn on motors with you CLOSELY monitoring.

*Nice, your model seems to follow your plan.*

*Okay data collector, get ready, your job is to measure how long it takes the cart to pass between the first two points on the track and the second two points.* Have students record the movement or lack thereof. *Recorder, you need to record these distances.*

*We're ready, doer turn on the motor(s).*

*Were our forces balanced? How do we know that?* We had no or very little motion.

*Reporter review for us how your plan made balanced forces.*

3) Now you have created models showing what happens when unbalanced and balanced forces are acting on each other.

**One final challenge I'd like to give your group is to make a model showing balanced forces, BUT WITH ONLY ONE FAN!**

*Think about this as a group, discuss it, and record your plan.*

If they are struggling....Ask, What do we know about motion when we have balanced forces? What would be the forces acting on the cart with this plan? Are there forces acting on the cart other than fans? Encourage movement of fan, movement of track, so on if necessary.

*Okay, let's try your plan! Remember only one fan with balanced forces means what about motion?* No motion

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## Exploration (cont.)

If they are struggling creating the balanced model, offer advice.....*Is there another force we can use to balance out the fan? Is there a force that is always pulling us towards the middle of the Earth?*

*You guys did some great challenge work here.*

*Our reporter should be ready with our recording sheet as we rejoin the class.*

Go back to Whole Group - one HSE speaking to whole class

## Explanation (5 minutes) Whole Group

**I saw some pretty amazing work from your groups.**

**I'd like the reporters to share their group's plan on the balanced forces model using one fan.**

Rotate through the groups have the reporter stand and review their model. Ask-was your group able to make a balanced model with one fan? Have them describe it and the results.

*Ask the audience, how was this model different than the balanced model using two fans?*

After all groups report...

*Yes, so we know that the opposite force to the one fan did not need to be another fan, it could be gravity, that force that pulls objects down to Earth.*

*I have a question, if these forces kept on happening, could you predict how the cart would behave in the future?* It would not move in the future.

*What if only one of the forces changed, would you still have balanced forces? Why or why not?*

Pause for interaction....

*Could you predict how the cart would behave if this happened?* It would begin to move.

*Great! Oh I have a good one. Pretend you had unbalanced opposite forces. Could you predict how the cart would behave in a year if the forces stayed unbalanced for a year?*

Pause for interaction....

I hope you have a great day at Discovery Zone today. As you leave I want you to be thinking about balanced and unbalanced force between a video of two dogs. It's really funny!

Show video on exit. On website lesson slideshow OR [https://www.youtube.com/watch?v=WFa\\_ms4qVI0](https://www.youtube.com/watch?v=WFa_ms4qVI0)

**Assessment (in regular classroom):**

Name \_\_\_\_\_

### Student Sheet

Carefully read or listen to the questions. Be sure you read and think about all choices before picking one.

**1. Two dogs were trying to pull a chew toy in opposite directions. The toy didn't move at all. What kind of force was the toy experiencing?**

- Pushing
- Unbalanced
- Balanced
- Pulling



**2. The fact that the cart passed through the first area in more time than the second area meant the speed of the cart was \_\_\_\_\_.**



**This must mean that the forces acting on the aircart were \_\_\_\_\_.**

- Balanced or the same
- Unbalanced or not the same
- Balanced or not equal
- Unbalanced or equal

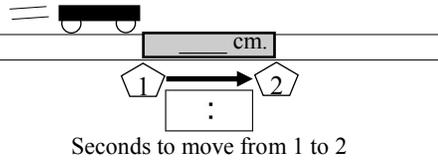
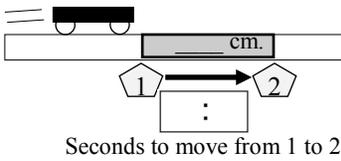
**3. What forces could cause the aircart to experience unbalanced forces?**

- Both fans running at same strength
- One fan running and the track tipped so the force of gravity was equal.
- One fan running and one fan off
- Both fans off on a flat track

Name: \_\_\_\_\_

**Data—UNBALANCED Forces**

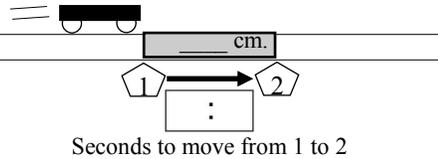
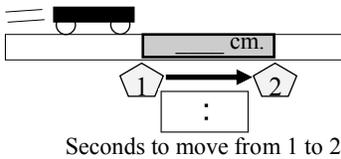
Draw a picture or write about your group's plan to make an aircart with unbalanced forces:

UNBALANCED Forces

**Data—BALANCED Forces**

Draw a picture or write about your group's plan to make an aircart with unbalanced forces:

BALANCED Forces

**Data—BALANCED Forces WITH ONLY ONE FAN!**

Draw a picture or write about your group's plan to make an aircart with balanced forces with only one fan:


BALANCED with ONE fan

