Moving Systems Design Project Assessments/Teacher Masters/ Visual Pack: Table of Contents

Assessments

Teacher Masters

Visual Pack

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Rubric: Forces and Motion

	Criterion A	Criterion B
	Gravity, drag, friction, lift, and thrust are forces.	**The forces of gravity, drag, friction, lift, and thrust affect the motion of objects.**
4 - Exceeds Expectations Explores content beyond the level presented in the lessons.	Understands at a secure level (see box below) how to recognize the forces of gravity, drag, friction, life, and thrust and shows interest in looking for ways they are used in everyday situations.	Understands at a secure level (see box below) and can apply their understanding to demonstrate how the forces of gravity, drag, friction, lift, and thrust affect the motion of objects.
3 - Secure (Meets Expectations) Understands content at the level presented in the lessons and does not exhibit misconceptions.	Can recognize the forces of gravity, drag, friction, lift, and thrust.	Can demonstrate and explain how the forces of gravity, drag, friction, lift, and thrust affect the motion of objects.
2 - Developing (Approaches Expectations) Shows an increasing competency with lesson content.	Recognizes some but not all of these forces.	Knows that, in general, forces affect the motion of objects, but is unable to explain how all five of these forces affect the motion of objects.
1 - Beginning Has no previous knowledge of lesson content.	Is unable to recognize any of these forces.	Doesn't know that forces affect the motion of objects.

Checklist: Demonstrating a Design

Teacher Assessment

Determine whether the following elements are evident in student's design and demonstration of their moving system. You might assign one point for each criterion the student demonstrates. You can add specific observations or comments in the space below each criterion.

Name _____ Date_____

Criteria:

_____ A. The moving system traveled at least 5 m (15 ft) across the room.

_____ B. The moving system carried at least 10 pennies.

_____ C. The moving system completed the journey in 5 seconds or less.

_____ D. The student was able to describe the forces that propelled the moving system across the room.

_____ E. The student was able to describe the forces that resisted the motion of the moving system.

Name _____ Date_____

Self-Assessment:
Planning and Implementing a Design

Think about the process of planning and building your moving system and answer the following questions.

1. How many of the project criteria did you think about when you made your design?

   All of the criteria Some of the criteria None of the criteria

2. Did you check whether your moving system met the project criteria at different points?

   Yes No

3. When you built your moving system, how did you feel about trying things out, making changes, and then trying again until your group finished it?

   Great OK, but a little frustrated Very frustrated

4. How many of the project criteria did your moving system meet?

   All of the criteria Some of the criteria None of the criteria

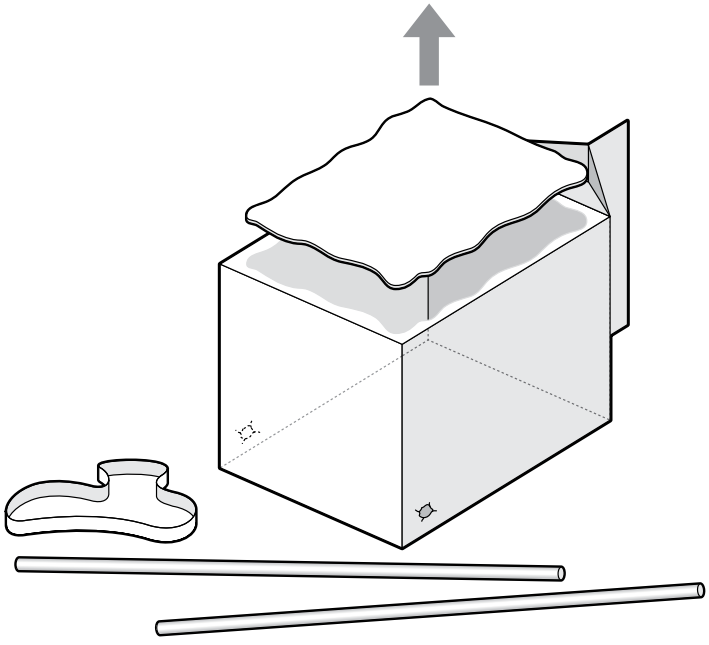
Building a Rubber Band Boat

Materials:

- Basin to hold water
- Empty milk carton, pint-size
- 2 chopsticks
- Scissors
- Tape
- Rubber bands, assorted sizes

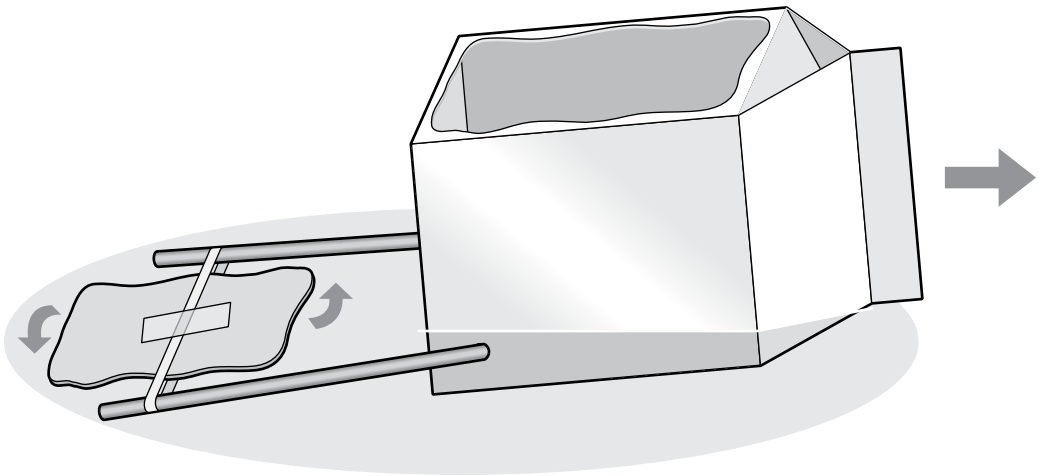
Directions:

1. Make a watertight seal by taping the top of the milk carton shut so it looks unopened.
2. Lay the carton on its side. The taped edge of its top should be vertical.
3. Cut out the side of the carton facing up so you have a large rectangular opening. Save the cut-out piece for a paddle.
4. Make a small hole in the lower back corner of one of the sides of the carton. Make it 1 cm (1/2 in) from the bottom and 1 cm (1/2 in) from the side and slightly smaller than the diameter of the chopstick.



Building a Rubber Band Boat

5. Make a second hole on the opposite side of the carton that mirrors the location of the first hole.
6. Working from the outside of the boat, put a chopstick into each of the holes until they hit the front of the boat and can't move any further.
7. Loop the rubber band around the two ends of the chopsticks sticking out of the carton. Make sure the rubber band is large enough—the chopsticks should stick straight out from the back of the boat and be parallel to one another.
8. Cut the rectangular piece of milk carton you saved to make a paddle. Make it wide enough to move the water, but not so wide that it hits the chopsticks when it spins between them.
9. Put the paddle inside the stretched rubber band and tape it in place as shown.



Operating the Boat:

1. Fill a basin halfway with water.
2. Twist the upper part of the paddle away from the milk carton a few times to wind up the paddle.
3. Hold the paddle so it doesn't spin back in the other direction while you put the boat in the water at one end of the basin. Let go of the paddle and watch the boat go.

Force and Motion Stations

Station	Activity Description	Materials
Land	Roll a marble down a ramp. Vary the angle of the ramp. Vary the thrust on the marble.	Ramp (3 ring binder), marble, books
Land	Walk across the room. Vary walking speed.	Students
Water	Wind up the rubber band boat and let it go in a basin of water. Vary the thrust by changing the amount of winding.	Basin filled with water, wind up rubber band boat
Air	Hold a piece of paper between the palms of each hand. Extend the arms outward and hold the paper at a slight angle to the horizontal. Spin around in circles to generate lift on the piece of paper.	Several pieces of paper
Air	Hold a piece of cardboard vertically. Spin around in circles to generate drag on the piece of cardboard.	Several pieces of cardboard

Effects of Forces

Station	Activity	Force	Effect of Force
Land	Rolling marble down ramp	**Gravity**—Earth's mass pulls straight down on the marble. Some of that force pulls the marble down the ramp. **Thrust**—fingers push the marble. **Friction**—marble touches ramp surface. **Drag**—air pushes against the rolling marble.	**Gravity**—causes the marble to roll down ramp. **Thrust**—causes the marble to roll faster. **Friction**—resists downward motion of the marble. **Drag**—resists downward motion of the marble.
Land	Walking across room	**Gravity**—Earth's mass pulls straight down on the student. **Thrust**—leg muscles push on the floor. **Friction**—shoes touch the floor. **Drag**—air pushes against the walking student.	**Gravity**—keeps the student on the floor. **Thrust**—causes the student to move. **Friction**—student can walk without slipping. **Drag**—resists motion of the student.
Water	Rubber Band Boat	**Gravity**—Earth's mass pulls straight down on the boat. **Thrust**—paddle pushes against the water. **Drag**—water pushes against moving boat.	**Gravity**—keeps boat on the surface of the water. **Thrust**—causes boat to move forward. **Drag**—resists motion of boat.

Effects of Forces

Station	Activity	Force	Effect of Force
Air	Spinning with paper	**Gravity**—Earth's mass pulls straight down on the paper. **Thrust**—hand muscles push against the paper. **Friction**—paper touches the hand. **Drag**—air pushes against the spinning paper. **Lift**—pressure difference between top and bottom of the paper causes force to push up on bottom of the paper.	**Gravity**—pulls the paper toward the floor. **Thrust**—causes the paper to spin around. **Friction**—resists sideways movement of the paper. **Drag**—resists motion of the paper. **Lift**—resists force of gravity and prevents the paper from falling to the floor.
Air	Spinning with cardboard	**Gravity**—Earth's mass pulls straight down on the cardboard . **Thrust**—hand muscles push against cardboard. **Friction**—cardboard touches the hand. **Drag**—air pushes against cardboard surface.	**Gravity**—pulls the cardboard toward the floor. **Thrust**—resists force of gravity and prevents the cardboard from falling to the floor. **Friction**—resists downward movement of the cardboard. **Drag**—resists force of gravity and prevents the cardboard from falling to the floor.

Name: _____ **Date:** _____

Force and Motion Observations

Draw the setup of one exploration at this station. In the drawing, label the forces and draw arrows that show the direction of the forces.

Describe a force you changed and explain how that change affected the object's motion.

Forces on Moving Objects

Visual	Photo	Force and its Effect
Land 1	Car moving uphill	**Gravity**—resists uphill motion of the car. **Thrust**—from engine through tires. Propels car uphill. **Friction**—keeps the tires from slipping when thrust is applied. Keeps the tires from sliding sideways. Resists motion as the tires roll along the road surface. **Drag**—resists motion of the car.
Land 2	Train moving downhill	**Gravity**—propels train downhill. **Thrust**—from engine through wheels. Propels train downhill. **Friction**—keeps the train wheels from slipping when thrust is applied. Resists motion as the wheels roll along the tracks. **Drag**—resists motion of the train.
Land 3	Motorcycle moving on the flat	**Gravity**—keeps motorcycle on road. **Thrust**—from motorcycle engine. Propels the motorcycle. **Friction**—keeps the tires from slipping when thrust is applied. Keeps the tires from sliding sideways. Resists motion as the tires roll along the road surface. **Drag**—resists motion of the motorcycle.
Land 4	Bus moving uphill	**Gravity**—resists uphill motion of the bus. **Thrust**—from bus engine. Propels the car up the hill. **Friction**—keeps the tires from slipping when thrust is applied. Keeps the tires from sliding sideways. Resists motion as the tires roll along the road surface. **Drag**—resists motion of the bus.
Land 5	Skateboard moving downhill	**Gravity**—propels skateboard downhill. **Friction**—keeps the wheels from sliding sideways. Resists motion as the wheels roll along the road surface. **Drag**—resists motion of the skateboard.
Land 6	Bicycle moving uphill	**Gravity**—resists uphill motion of the bicycle. **Thrust**—from bicyclist's legs. Propels the bicycle uphill. **Friction**—keeps the tires from slipping when thrust is applied. keeps the tires from sliding sideways. Resists motion as the tires roll along the road surface. **Drag**—resists motion of the bicycle.

Forces on Moving Objects

Visual	Photo	Force and its Effect
Water 1	Power Boat	**Gravity**—keeps boat on water's surface. **Thrust**—from engine through propeller. **Drag**—resists motion of the boat.
Water 2	Submarine	**Gravity**—forces submarine toward the sea floor. **Thrust**—from engine through propeller. **Drag**—resists motion of the submarine.
Water 3	Sailboat	**Gravity**—keeps boat on water's surface. **Thrust**—from wind through the sails. **Friction**—between boat surface and water surface. Resists motion of the boat. **Drag**—resists motion of the boat.
Water 4	Fish	**Gravity**—forces fish toward the sea floor. **Thrust**—from movement of fins. **Drag**—resists motion of the fish.
Water 5	Swimmer	**Gravity**—forces person toward the bottom of the pool. **Thrust**—from kicking feet and paddling arms. **Drag**—resists motion of the swimmer.
Water 6	Duck	**Gravity**—forces person toward the bottom of the lake. **Thrust**—from kicking/paddling feet. **Drag**—resists motion of the duck.

* Teacher Note: Students may mention that buoyancy plays an important role in keeping these objects from being pulled deeper into the water by gravity. This is true, but buoyancy is not explicitly addressed by this project.

Forces on Moving Objects

Visual	Photo	Force and its Effect
Air 1	Propeller airplane	**Gravity**—forces airplane toward the earth. **Thrust**—from engine through propeller. **Drag**—resists motion of the airplane. **Lift**—from air flowing over wings. Keeps plane in the air.
Air 2	Jet airplane	**Gravity**—forces airplane toward the earth. **Thrust**—from engine through jets. **Drag**—resists motion of the airplane. **Lift**—from air flowing over wings. Keeps plane in the air.
Air 3	Rocket	**Gravity**—forces rocket towards the earth. **Thrust**—from engine through jets. **Drag**—resists motion of the rocket.
Air 4	Person with parachute	**Gravity**—forces person and parachute toward the earth. **Drag**—resists motion of the person and parachute. **Lift**—from air flowing over parachute. Keeps person in the air.
Air 5	Skydivers	**Gravity**—forces people toward the earth. **Drag**—resists motion of the people.
Air 6	Eagle	**Gravity**—forces eagle toward the earth. **Thrust**—from flapping of eagle's wings. **Drag**—resists motion of the eagle. **Lift**—from air flowing over eagle's wings. Keeps eagle in the air.

Moving System Criteria

The moving system the students design, build, test, and demonstrate must satisfy the following criteria:

1. It must make a journey of at least 5 m (15 ft) across the room.
2. It must be able to carry at least 10 pennies on the journey.
3. It must complete the journey in 5 seconds or less.

In addition to the above criteria, students must be able to describe the forces that:

- propel the moving system across the room.
- resist the motion of the moving system.

Name: _____ **Date:** _____

Moving System Description

Describe your moving system.

Describe the forces that will propel the moving system across the room.

Describe the forces that will resist the motion of your moving system.

Name: _____ **Date:** _____

Moving System Description

Draw a sketch of your moving system. Label its parts, as well as the force(s) propelling the moving system and the force(s) resisting its motion.

Name: _____ **Date:** _____

Moving System Refinement

Describe your moving system.

Describe the forces that will propel the moving system across the room.

Describe the forces that will resist the motion of your moving system.

Name: _____ **Date:** _____

Moving System Refinement

Draw a sketch of your moving system. Label its parts, as well as the force(s) propelling the moving system and the force(s) resisting its motion.

Moving on Land

Overhead Transparency: Moving on Land (Session 3)
Moving Systems Visual 1

Moving in Water

Overhead Transparency: Moving in Water (Session 3)
Moving Systems Visual 2

Moving in Air

Overhead Transparency: Moving in Air (Session 3)
Moving Systems Visual 3