

MANAGING OUR NEED FOR SPEED (LEVEL 3)

Description	Learners will explore the theme of transportation with vehicles in the sea, land and air. Learners will explore how vehicles move and related regulations, before making their own dream vehicle.
Leading Question	What's the fastest vehicle that you can make?
Total Time Required	5 hours over 5 days
Supplies Required	Tub, Water, Paper, Tube and other scrap material
Learning Outcomes	<ol style="list-style-type: none"> 1. Understanding Physics principles of gravity, thrust, lift, drag, density, force, inertia and displacement 2. Understanding scientific processes of hypothesis, evidence and conclusions 3. Being creative in designing and creating their own vehicles
Previous Learning	None

DAY 1

Today you will explore vehicles that travel through water, air and land and what helps them move.

Suggested Duration	Activity and Description
15 minutes	<ul style="list-style-type: none"> • Write and draw a list of vehicles that travel in the water, air and on land. • Organize these based on when you think they were invented. • Write and illustrate the different reasons people would use water vehicles e.g. fishing, navy, transportation, pearl diving etc.
30 minutes	<ul style="list-style-type: none"> • Explore the concept of sinking and floating on water bodies. Fill a tub with water and experiment with a few different objects based on their mass, volume, shape, and material. • First make a hypothesis (guess) on what will happen with the object, then record the result and state a conclusion.

Mass is a measurement of the amount of matter an object contains, while volume is the amount of space it occupies. In [Worksheet 1: Density & Floating](#), you will choose 8 objects based on their Volume, Mass, Shape, and Material; and try to see if these sink or float.

Mass	Material
Volume	Shape

Think about the reasons that some objects sink and float?

- Is the volume what makes an object sink? Think of boats and ships, they can be of different volumes.
- Do all heavy objects sink? Think of boats and ships which can be massive.
- For an object that sinks, can we make it float if we changed its shape? (ex: a metallic coin would sink, but what if we were able to melt it and make it in the shape of a boat?)

20 minutes

- Input: Density is how heavy an object is compared to its volume. Density is calculated by dividing the mass over the volume. If an object is denser than water, it will sink in water and if the object is less dense than water it will float.
- The key to floating is being lighter than water. If you can add surface area to an object without adding much weight, the object will be lighter relative to its size. This is why wearing a light life jacket adds size but not weight and helps people float.
- *Tip: Things float when they are positively buoyant, or less dense than the fluid in which they are sitting. This does not mean that an object has to be lighter than the fluid, as in the case of a boat; objects just need to have a greater ratio of mass to volume (including the empty space enclosed within a boat) than the fluid.*

(https://www.seaperch.org/how_things_float)

Fill out [Worksheet 2: Displacement](#) (appendix)

There is still something unexplained, why does a large and heavy ship float?

You will now learn about the Archimedes principle of displacement.

Take a piece of foil (20 cms by 20 cms) and fold in the edges to form a square to ensure that the it is strong, pull up the sides of the square to form a container and add in different small objects (e.g. uncooked chickpeas, marbles, little pebbles etc.) into the foil boat and test whether the boat sinks or floats.



Try a few different tests:

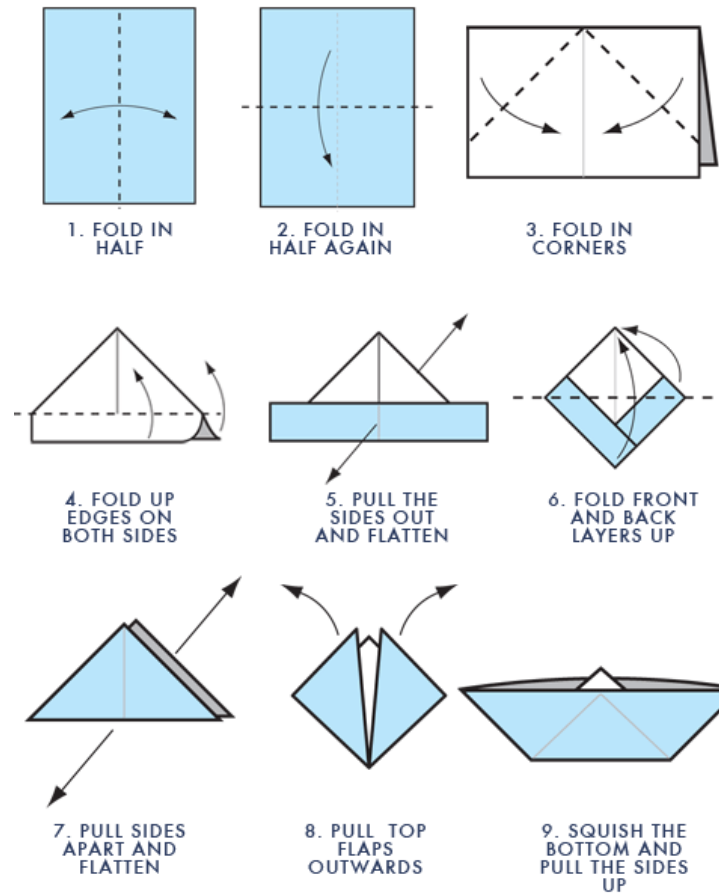
- Does it matter how much foil you use and how big the container is?
- Does it matter where in the container you place the weight?

This is the Archimedes Principle: Things float in water because of the force of buoyancy or up-thrust. When we place the boat into the water, it pushes some water out of the way and the water pushes back on the object. If the weight of the water displaced is more than the weight of the boat then it will float because the force of the water pushing up is greater than the force of the boat pushing down.

10 minutes

- Write down the weight of the objects placed in the foil boat and the consequences of floating and sinking.
- Fill in the related science experiment sheet.
- You can estimate the weights by lifting the objects.
 - Ask a question
 - Form a hypothesis
 - Plan the procedure and conduct an experiment
 - Record data
 - State a conclusion

Explore and try out two or three different designs for your planes (you can use heavier or lighter types of papers). Here's one example of a boat that you can build by following the steps below:



DAY 2

Today you will explore how to make a fast-moving land vehicle by exploring the concept of friction, force, motion and inertia.

Suggested Duration

20 minutes

Activity and Description

- Explore the concept of friction and the importance of wheels to help most land motion.
- Friction is the resistance of motion when one object rubs against another. Anytime two objects rub against each other, they cause friction. Friction works against the motion and acts in the opposite direction – it is what causes objects to slow down unless pushed. For example, even if you rub your hands together that causes friction.

EAA welcomes feedback on its projects in order to improve, please use this link:

<https://forms.gle/LGAP9k17fMyJrKJN7>

You will do an experiment to understand friction better.

- Insert a pencil into a glass or jar full of uncooked rice or sand.
- Push the pencil in and pull it out of the rice and find how much effort is needed to pull the pencil out of uncooked rice or sand.
- Slowly compact the rice and push the air out of the jar and find the new amount of effort needed to pull out the pencil.
- The more contact there is the more friction – eventually you can hold up the jar with the pencil. The force of this friction is more than the force of gravity.



10 minutes

- Make a guess and then test whether you think a tube, or a toy car can move faster on different surfaces and roads.
- The surfaces on which the vehicle moves faster with less force have lower friction.
- Make a hypothesis, test and capture the evidence from the experiment and then write the conclusion

Surface	Hypothesis	Evidence	Conclusion
Smooth wooden or tile floor	<i>Fast – Low Friction</i>	<i>Fast – Low Friction</i>	<i>The vehicle moves faster since there is less friction or resistance</i>
Sweater on a surface (bumpy or uneven surface)			
Cement floor / Carpet			
Grass			

Dirt or Rubble			
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30 minutes

- There is another force that affects movement of an object: Inertia: All objects try to stay in one place unless a force makes them travel somewhere else.
- Hold a ball and run, while running just place the ball on the ground. Will it stay still, or will it continue moving?
- Try sitting on a carpet/mat and ask a family member to quickly pull the carpet/mat while you are sitting on it. The reason your body jerks is because of inertia. Your body tries to stay in the resting phase while the mat gets pulled and forces you to move forward. This resistance of your body to moving forward is called inertia.
- Try the magician's trick of pulling a tablecloth quickly from under cutlery and crockery (it is better to try unbreakable items). If the tablecloth is pulled in a swift motion and not at an angle, then the objects on the table will land in the same place

15 minutes

- You will now design your own rubber-band car.



- Step 1: Bore a hole in two straws that are placed in parallel lines, and insert the toothpick or small piece of wood through these two holes and secure it (this is the inner stick)



- Step 2: Bore another hole on both ends of the parallel straws and insert a larger stick (e.g. a chopstick or kebab stick) and secure this into the “tyres of the car” (this is the outer stick)
 - On the front outer stick insert and securely fasten a small piece of wood like a nail



- Step 3: Tie or fasten a rubber-band to the inner back stick and hook this to the front nail



- Step 4: Pull and release the rubber-band and see your car move forward

DAY 3

Today you will explore the concept of air travel and what makes planes fly by exploring the concept of gravity, thrust, lift and drag.

**Suggested
Duration**

Activity and Description

15 minutes

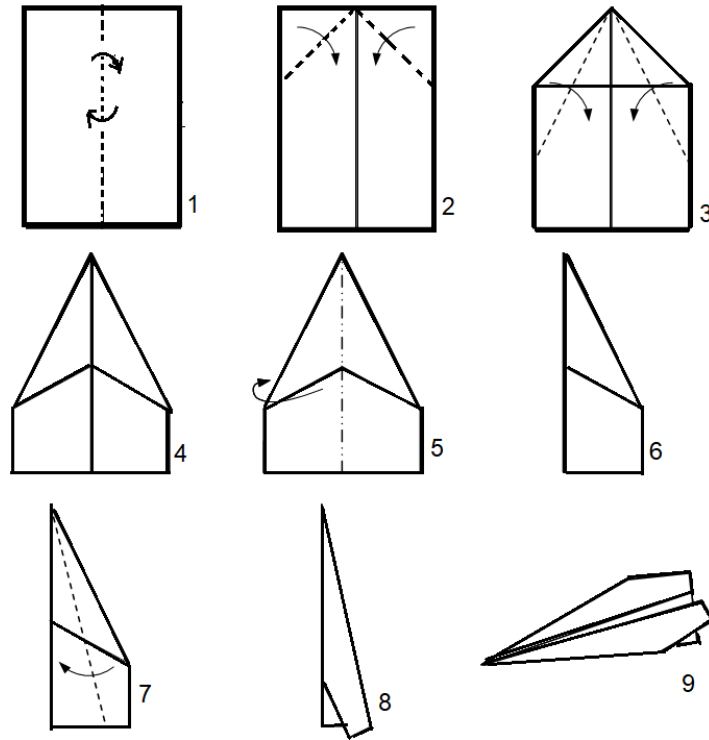
- You will now explore the concept of gravity. Any object that is left in mid-air will fall to the ground because of a force of the earth called gravity.
- Gravity is defined as a force which tries to pull two objects toward each other. Anything which has mass also has a gravitational pull.
- Earth's gravity is what keeps you on the ground and what causes objects to fall.
- Explore the speed and force of a gravitational pull by trying objects of different mass and seeing what falls faster and slower to the ground.
- Use any 5 household objects that are unbreakable and time the fall. Make a hypothesis on what objects are faster and slower and make a conclusion.

Object	Hypothesis	Speed after the Experiment

- The more massive an object is, the stronger its gravitational pull is.

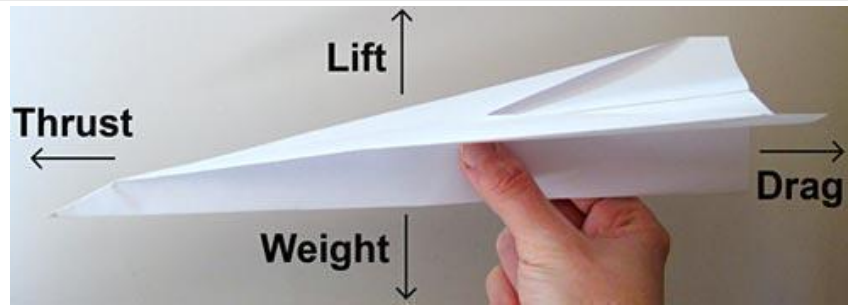
45 minutes

- Make your own paper plane.
- Try creating two or three different designs for your planes (you can use heavier or lighter types of papers). Here's one example of a plane that you can build by following the steps below:

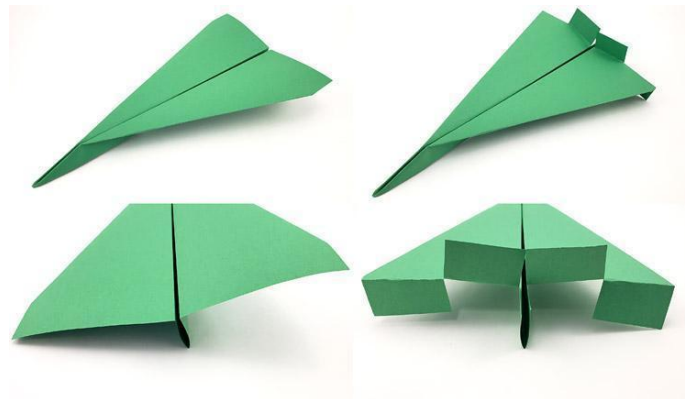


- Try 3 experiments to see what helps the plane fly the longest:
 - Lift is the force that opposes the weight of the plane to help the plane stay up
 - Drag is the force, which delays or slows the forward movement of an airplane through the air. Drag opposes thrust which is the force that helps the plane move forward
 - Mass and Lift that creates more mass and increases the force of gravity
- Create an observation sheet for the three experiments:

Concept	Distance	Conclusion
Flight 1: Thrust		
Flight 2: Drag		
Flight 3: Mass and Lift		



- To test thrust: Throw the plane forward and see it take flight.
- When you throw a paper plane in the air, you are giving the plane a push to move forward. That push is a type of force called thrust. Thrust can also be achieved by a rotating fan or the flapping wings of a bird. Measure the distance of flight 1.
- Now you will create drag, in order to do this the more surface area exposed to rushing air, the greater the drag.
- Cut four flaps at the back of the paper airplane, two of these will be folded up and two will be folded down; this will cause more surface area to the air and create more drag.
- Measure the distance of flight 2.



- Now change the type of paper of the plane to a thicker paper or add a small object on the top to increase the weight and the force of gravity and decrease the lift. Measure the distance of flight 3.
- Numeracy extension: Measure the average distance covered by the flight on the ground and create a bar graph. Label the x-axis the flight attempts and the y-axis the distance. (If you do not have tools to measure distance, you can measure with the number of footsteps etc.)
- Calculate the speed with the following formula $\text{Speed} = \text{Distance} / \text{Time}$. To calculate this, measure the distance the plane flies in each event and divide it by the time it took.

DAY 4

Today you will learn about the rules and regulations for transportation.

Suggested Duration	Activity and Description
40 minutes	<ul style="list-style-type: none"> ● Imagine that you are the road safety department or traffic police. <ul style="list-style-type: none"> - Can you write a report to the government with specific policies and laws that can be implemented to reduce the number of accidents? ● It is important to consider that the report needs to: <ul style="list-style-type: none"> - Grab the attention of the government official reading it - Identify the major reasons for car accidents (if you do not have access to information on this, you can think of reasons by discussing these with family members) - Suggest clear policies or laws - Give an implementation plan
20 minutes	<ul style="list-style-type: none"> ● Can you write and illustrate an advertisement banner to convince drivers to be more careful? ● It is important to consider that the advertisement campaign should: <ul style="list-style-type: none"> - Be “catchy” so people look at it and remember it - Have a clear and actionable message - Be simple and easy to do <p>Present your report on car accidents (including reasons for car accidents , suggested policies or laws and implementation plan to family members. Present the advertisement banner to the family members.</p> <p>Family members feedback will include:</p> <ul style="list-style-type: none"> - Questions of clarification - What they appreciate about the report - Some concerns or puzzles - Suggestions for improvement <p>Use the feedback to revise your car accidents report and advertisement banner.</p>

DAY 5

Today you will use all the principles that you have learnt to design and create your own super vehicle.

Suggested Duration	Activity and Description
1 hour	<p>Use all the principles that you have learnt to design and create your own super vehicle.</p> <p>You will need to:</p> <ul style="list-style-type: none"> - Think of the purpose of the vehicle - Determine whether this is a land, water and / or air vehicle or a combination of the above - Identify how the works based on the principles learnt –you can explain How will the vehicle work with relation to gravity, thrust, displacement, density, friction and inertia to move efficiently and fast? etc. - Create measures to ensure safety and security

ASSESSMENT CRITERIA

- Creativity and thoughtfulness in designing and creating their own vehicle
- Attractiveness of and clarity of the messaging of the ad campaign and government report
- Understanding and applying the physics principles of gravity, thrust, lift, drag, density, force, inertia and displacement
- Working on a scientific process of hypothesis, experiments and conclusions

ADDITIONAL ENRICHMENT ACTIVITIES

- Exploring Newton’s Third Law of Motion by designing a boat’s rowing oar as a fulcrum

WORKSHEET 1: DENSITY & FLOATING

Worksheet 1: Density

Definition: Density is the mass of an object compared to its volume, if an object is denser than water it will sink in water and if it is not it will float

Example

Object 1: Coin

Mass: High / Low

Volume: Large / Small

Shape: compact flat disc

Material: metal

Hypothesis: It will float

Evidence from the Experiment: Sank

Conclusion: The density of the coin is more than the density of water.

Object 1: _____

Mass: High / Low

Volume: Large / Small

Shape: _____

Material: _____

Hypothesis: _____

Evidence from the Experiment: _____

Conclusion: _____

Object 2: _____

Mass: High / Low

Volume: Large / Small

Shape: _____

Material: _____

Hypothesis: _____

Evidence from the Experiment: _____

Conclusion: _____

Object 3: _____

Mass: High / Low

Volume: Large / Small

Shape: _____

Material: _____

Hypothesis: _____

Evidence from the Experiment: _____

Conclusion: _____

Object 4: _____

Mass: High / Low

Volume: Large / Small
Shape: _____
Material: _____
Hypothesis: _____
Evidence from the Experiment: _____
Conclusion: _____

Object 5: _____
Mass: High / Low
Volume: Large / Small
Shape: _____
Material: _____
Hypothesis: _____
Evidence from the Experiment: _____
Conclusion: _____

Object 6: _____
Mass: High / Low
Volume: Large / Small
Shape: _____
Material: _____
Hypothesis: _____
Evidence from the Experiment: _____
Conclusion: _____

Object 7: _____
Mass: High / Low
Volume: Large / Small
Shape: _____
Material: _____
Hypothesis: _____
Evidence from the Experiment: _____
Conclusion: _____

Object 8: _____
Mass: High / Low
Volume: Large / Small
Shape: _____
Material: _____
Hypothesis: _____
Evidence from the Experiment: _____
Conclusion: _____

WORKSHEET 2: DISPLACEMENT

Worksheet 2: Displacement Experiment

Definition: Things float in water because of the up-thrust force or buoyancy. When we place an object in water, it displaces some water out of the way and the water pushes back on the object. If

the weight of the object is less than the weight of the water displaced, it will float otherwise it will sink.

- Ask a question:

- Form a hypothesis:

- Plan the procedure and conduct an experiment:

- Record data:

- State a conclusion: