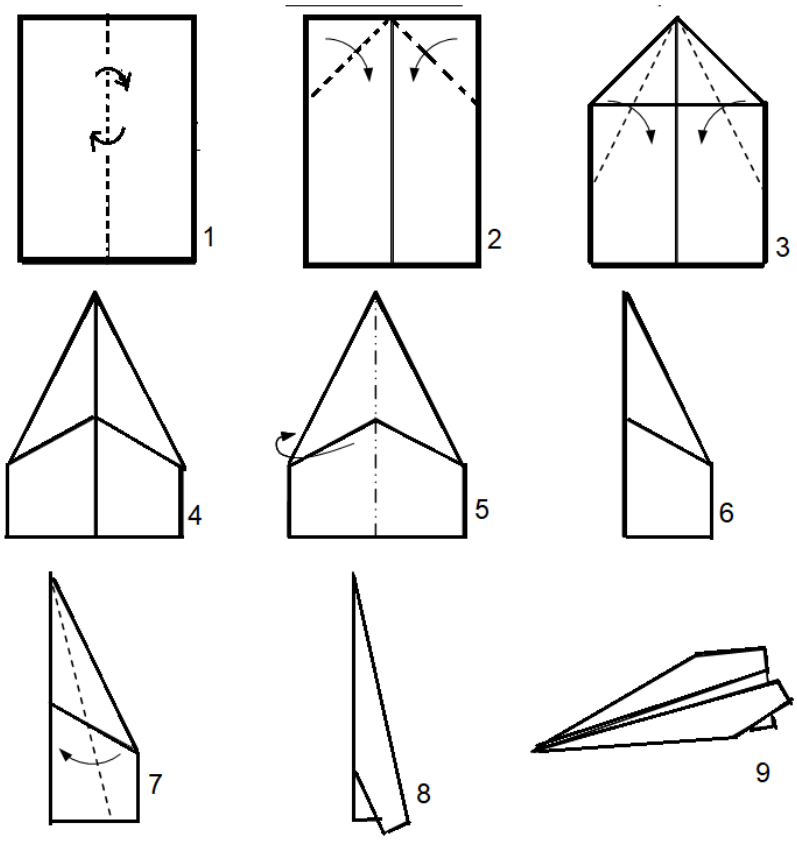
Managing Our Need For Speed (All Ages)

Ages 4 to 7 (Level 1)

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?** ?
Age group:	4 – 7 years
Subjects:	Science, Geography and Art & Design
Total time required:	~ 5 hours over 5 days
Self-guided / Supervised activity:	Medium Supervision
Resources required:	Tub, Water, Paper, Tube and other scrap material, paper, papers of different densities (if available)

Learning outcomes:	- Begin to grasp the concepts of gravity,friction, motion, sinking-floating - Making hypothesis and testing these through experiments - Understanding the importance of transportation safety rules and regulations and related professions
Required previous learning:	Familiarity with conducting science experiments
Inspiration:	None
Topics /Concepts covered and skills developed	● Gravity, friction, floating-sinking, motion ● Transportation on water, land, and air ● Traffic signs and rules ● Professions ● Experimentation ● Observation ● Art and design skills ● Presentation and communication skills

Day	Time	Activity and Description
1	10 minutes	Learners will begin to explore different vehicles and their design challenges. ● Learners will explore how we can get from one place to another – they can illustrate and/or label different ways that they can use to get to different places (e.g. cycling, rickshaw, car, bike, boats, etc.). Once they have brainstormed, ask them if they can think of ways of grouping these forms of getting from one place to another one.

	15 minutes	• Guide their attention to the fact that one possible grouping is related to the element on which they move: air, water, or land. • Learners will look at the original list and add other air vehicles that they know about. • Learners will write or illustrate the different reasons people would use air vehicles (e.g. to travel to another country, to go to the moon / space, for surveillance, to deliver emergency posts, etc.)
	10 minutes	• Learners will try to make their own paper planes. Encourage learners to explore and try out two or three different designs for their planes (they can use heavier or lighter types of papers). Here's one example of a plane that they can build by following the steps below:  • For each design, learners will: a. Try and fly their plane; b. Try different ways to throw the plane and see if it flies higher and / or further c. Think about why some planes can go higher / further than others

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15 minutes</td>
<td>d. Try and add wind with a real fan or paper fan or by blowing air to see if the plane flies further

Learners will reflect on what they learned from the experiment: what did they notice? What are they wondering about real planes based on what they observed with the paper planes? Which was the most successful plane? (e.g. the one that reached the furthest, or the highest, or the one that stayed in the air for longer)? What were the characteristics of the most “successful” plane?
Tell learners that, in the cases where the planes failed to fly, it was because they were not able to overcome the force of gravity. Most objects or even organisms cannot fly or float because of the force 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. Therefore, the greatest challenge for the engineers that build planes is to overcome the force of gravity.
Ask the learners if they can think of other challenges when designing planes.

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15 minutes

20 minutes

10 minutes</td>
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Learners will go back to the first list of vehicles that they created on Day 1. They will add to it additional water vehicles that they know about. To think about different vehicles, they will think about the different types of water bodies like lakes, rivers and seas, their characteristics (e.g. rivers flow in one direction, oceans have waves, water in ponds doesn’t run, etc.), and the different reasons people would be on water vehicles.

Learners will write or illustrate the different reasons why people would use water vehicles e.g. fishing, navy, transportation, pearl diving etc.

To explore the concepts of sinking and floating, learners will fill a tub with water and collect a few “waterproof objects” that do not have batteries. Learners will make a list of these objects and then try and guess whether the objects will sink or float when put in the water – they will then place that object in the tub and write what actually happened.

For example:
<table>
<tr><th>Object</th><th>Guess / Hypothesis</th><th>Result / Experiment Evidence</th></tr>
<tr><td>1.Spoon</td><td>Sink</td><td>Float</td></tr>
<tr><td>2.Bowl</td><td>Sink</td><td>Sink</td></tr>
<tr><td>3.Block</td><td>Float</td><td>Sink</td></tr>
<tr><td>4.Pen Cover</td><td>Sink</td><td>Float</td></tr>
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Learners will think about the reasons why some objects sink or float.

Example:
- Objects that are heavy sink.
- Objects that are big sink.
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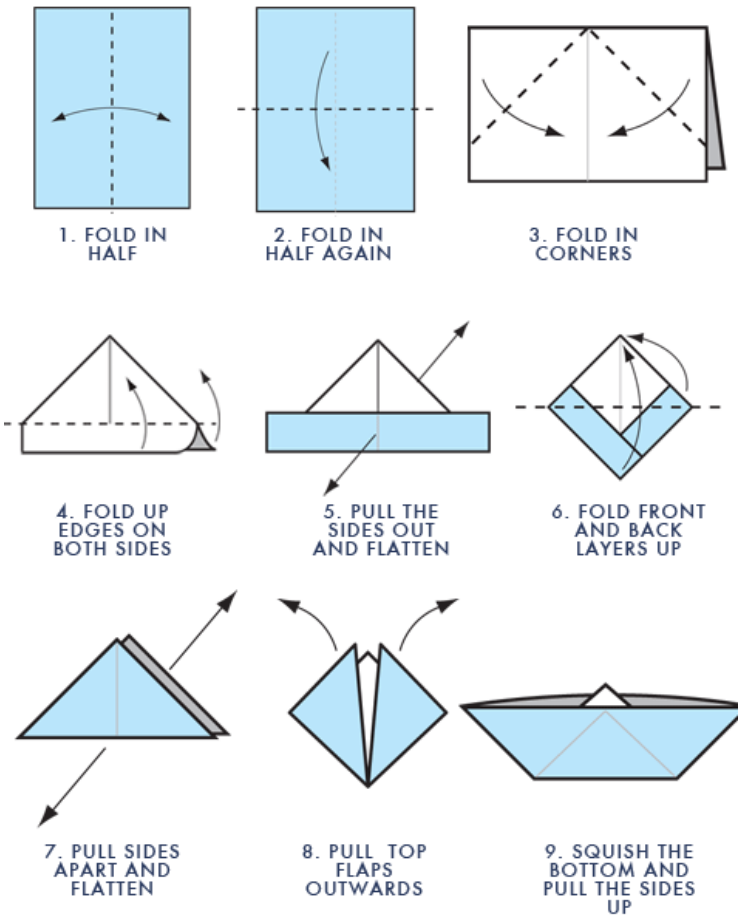
	5 minutes 20 minutes	• Learners will re-try the experiment to test their reasons or hypothesis and make a new guess on how and why boats can float. Based on the experiment, they will write or share aloud the characteristics of objects that float. • Based on their conclusions, learners will make their own paper boats that float on the water. Encourage learners to come up with their own designs. You may show them these examples to guide them in the process.  • Learners will make multiple boats (of different sizes and using different types of paper) and check if ~~it~~ they sink or float • Learners will try and move their boat - Learners can blow on the boats with a straw and see how it pushes the boats forward. This is how sailboats move with the wind.
	10 minutes	Learners will create their own rowing oars to explore how engine propellers help push the water and move boats forward. Learners will make their own oars with little toothpicks, popsicle sticks or straws etc. They should make sure the bottom of the oar has a broad and flat surface

		  Tip: for an extension activity, learners can explore the concept of density. Density is a property of matter (like weight- how much force is pulling the object down, or volume-how much space an object occupies) and is a measure of how much matter an object has in the space it occupies. It is similar to how compact something is. If an object has less density than water, then it will float.
3	15 minutes 15 minutes	Learners will explore land vehicles and what causes them to slow down ● Learners will refer again to the original list and add land vehicles that they can think about. ● They will think and try organize these in terms of speed from the fastest to the slowest land transportation for example: ○ Train ○ Motorbike ○ Car ○ Bus ○ Cycle ○ ● Learners will explore how different vehicles move to go faster and slower on different surfaces. They will also explore the importance of round wheels to help land motion.

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Learners can move a square or rectangular block or a triangular shaped object – these can be constantly pushed with force, but these cannot be rolled. Learners can try the same with a circular tube to see how it rolls forward more easily with less force
Learners will design different roads to reduce resistance (or friction). Is it easier for the vehicle to move faster when the ground is bumpy or uneven?
Learners will make a guess and then test whether they 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 has less resistance (or friction)

For example:
<table>
<tr><th>Surface</th><th>Guess / Hypothesis</th><th>Result / Experiment Evidence</th></tr>
<tr><td>Smooth wooden or tile floor</td><td>Fast – Low Resistance (Friction)</td><td>Fast – Low Resistance (Friction)</td></tr>
<tr><td>Sweater on a surface (bumpy or uneven surface)</td><td>Medium – Med Resistance (Friction)</td><td>Slow – High Resistance (Friction)</td></tr>
<tr><td>Cement floor</td><td>Fast – Low Resistance (Friction)</td><td>Medium – Resistance (Friction)</td></tr>
<tr><td>Carpet</td><td></td><td></td></tr>
<tr><td>Grass</td><td></td><td></td></tr>
</table>
Learners will explore why they think some surfaces increase or decrease the resistance (friction) and share an answer with their parents

Tip: Smooth surfaces have less resistance to motion (friction) than rough surfaces.

Tip: For an extension activity, learners can explore the concept of friction. 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. Any object that rubs against another object causes friction, for example even if you rub your hands together that causes friction.
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<td>4</td>
<td>20 minutes</td>
<td>Now that we have learned how to design the fastest plane, boat and car – it might be quite dangerous to move at very fast speed. Did you know that one person gets hurt every 25 seconds because of a road accident due to high speed? Let’s try and think of all the rules and regulations associated with transportation and also the professions

Land Vehicles: Learners will explore all traffic rules and as a traffic police they will make 5 relevant signs and lights that help slow down land transportation to prevent</td>
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		accidents. Learners can design their own signs that they think will be more effective in preventing accidents. For example: - Red, yellow and green light, - Stop sign - School zone sign - Zebra crossing - Speed limit sign
	20 minutes	Learners will think about traffic in the water and the people that will help in managing this. Learners can make their own lighthouse to help the boats navigate in the darkness. A lighthouse is a tall structure that can help boats find their way in the darkness since it has a light on the top. The lighthouse can also help if boats signal with any issues Learners can make these with empty toilet paper rolls, tubes and paper 
	20 minutes	Learners can now pretend to be the air-traffic controller and help planes with when to "take-off", land or where to fly to make sure that planes do not crash into each other. They will think of the shortest and clearest message that they can convey to pilots on the phone to make sure that there are no plane crashes.
	20 minutes	Literacy extension: Learners can write, or role play the key messages for any one or three of the scenarios below. Learners will need to think about the key messages to share and a clear and short way to communicate it. Options: - Someone booking a railway ticket on the phone (Key points: i) Origin and Destination - From where to where are they travelling; ii) Date and timing; iii) Name of the train; iv) Class of travel; v) Number of passengers) - A captain on a ship letting the ship crew know about a storm (Key points: i) Details on the storm – intensity of the storm; ii) What should the crew be doing; iii) What safety precautions can we take etc.) - An announcement from the pilot in the plane (Key points: i) Destination – where are they travelling; ii) Travel – how long is the flight and what will the weather be; iii) Safety procedures - seatbelt, walking in the plane etc.)
5	20 minutes	Learners will imagine and create their own vehicle that combines all the science principles that they have learnt till now and is:

		- Anti-gravity - Floating - Low friction (resistance) Learners will describe the features of this vehicle through illustrations or writing: - How can we make sure that the vehicle stays in the air and does not fall to the ground with gravity? - What will make the vehicle stay afloat in the water? - How can the vehicle face the least friction to move forward with the most speed with the least amount of effort?
	10 minutes	Learners will think of the purpose of the vehicle e.g. is it to help sick people get to the airport fast like an ambulance, is it a moving school etc.
	20 minutes	Learners will draw their vehicle and label it and share it with their family and also explain the relevant features to make it work best on land, water and air Family feedback will include: ● What do they love about the vehicle's design? ● Any questions they might have about the explanation? ● Any areas of improvement in either the design or the explanations? Learners will use the feedback to revise their design
Assessment Criteria:		Creativity in the final vehicle designed, including the purpose Demonstration of understanding of physics concepts of gravity, friction, floating-sinking Ability to design a plane that flies, the fastest land transportation and a boat that floats Clarity of road signs, lighthouse and ATC ~~A~~bility to make hypothesis and guesses with reasons explaining the project phenomena

Additional enrichment activities:	None
Modifications to simplify the project tasks if need be	- Learners can test the concepts of friction and sinking and floating by designing their own boat and testing the cars and then design their own vehicle

Ages 8 to 10 (Level 1)

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?**
Age group:	8 – 10 years
Subjects:	Science, Geography and Art & Design
Total time required:	~ 5 hours over 5 days
Self-guided / Supervised activity:	Medium Supervision
Resources required:	Tub, Water, Paper, Tube and other Scrap Material, paper, papers of different densities (if available)

Learning outcomes:	- Grasping the concepts of gravity, force, motion, sinking-floating, resistance, wind. - Making hypothesis and test these through experiments -Analyze data to determine if a design solution work as intended - Understanding the importance of transportation safety rules and regulations and related professions
Required previous learning:	Familiarity with conducting science experiments and writing about them
Inspiration:	None
Topics /Concepts covered and skills developed	● Gravity, force, motion, friction, density, floatation-sinking ● Transportation on land, sea and air ● Traffic rules and signs ● Professions ● Experimentation ● observations ● Making hypothesis ● Creativity and design skills ● Presentation and communication skills

Day	Time	Activity and Description
1	 10 minutes 5 minutes	Learners will explore different vehicles and transportation regulations Learners will explore how we can get from one place to another – they can illustrate and label different ways that they can use to get to different places e.g. cycling, rickshaw, car, bike, boats etc. Once they have brainstormed, ask them if they can think of ways of grouping these forms of getting from one place to another one. Guide their attention to the fact that one possible grouping is related to the element on which they move: air, water, or land. Learners will look at the original list and add other air vehicles that they know about.

Learners will write or illustrate the different reasons people would use air vehicles e.g. to travel to another country, to go to the moon / space, for surveillance, to deliver emergency post etc.

Learners will explore the concept of gravity.

15 minutes

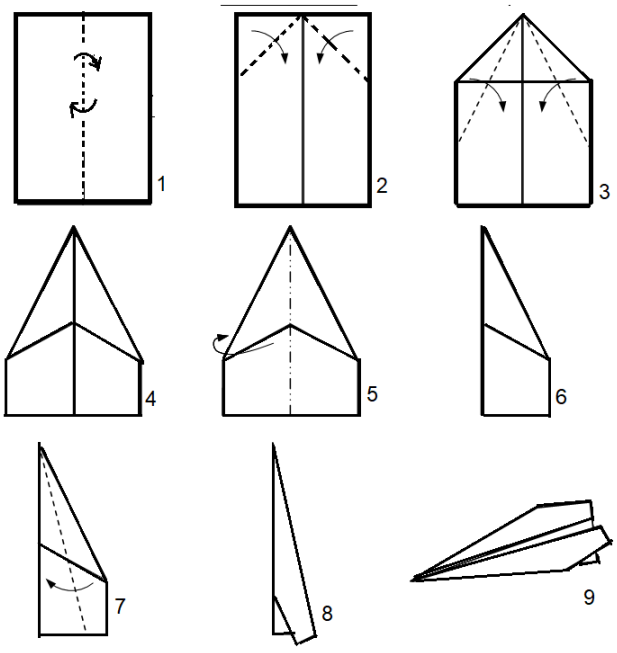
Learners will now explore the speed and force of a gravitational pull by dropping objects of different mass and seeing which ones fall faster and slower. Learners can use any household objects that are unbreakable and time the fall. Learners can start with making a guess of the objects that will fall fastest and then test these out

Object	Guess / Hypothesis	Result / Experiment Evidence
Ball		
Paper		
Pen		

Learners will then discover the more massive an object is, the stronger its gravitational pull is

15 minutes

Additionally, learners will try to make their own paper planes. Encourage learners to explore and try out two or three different designs for their planes (they can use heavier or lighter types of papers). Here's one example of a plane that they can build by following the steps below:



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<td>15 minutes</td>
<td>For each design, learners will:

- ry and fly their plane
- try different ways to throw the plane and see if it flies higher and / or further
- think about why some planes ~~and~~ can go going higher / further than others
- Learners will try and add wind with a real fan or paper fan to see if the plane flies further
Learners will reflect on what they learned from the experiment: what did they notice? What are they wondering about real planes based on what they observed with the paper planes? Which was the most successful plane? (e.g. the one that reached the furthest, or the highest, or the one that stayed in the air for longer)? What were the characteristics of the most “successful” plane?

Tip: Any object that is left in mid-air will fall to the ground because of a force of the earth called gravity. Gravity is a force that 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.

Literacy Extension: Learners will write a story titled “A world without gravity!” Let your imagination run free - thinking about a world where nothing stays down. You and everything around you could float and fly!</td>
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<tr>
<td>2</td>
<td>5 minutes

10 minutes

20 minutes</td>
<td>Learners will go back to the first list of vehicles that they created on Day1. They will add to it additional water vehicles that they know. To think about different vehicles, they will think about the different types of water bodies like lakes, rivers and seas, their characteristics (e.g. rivers flow in one direction, oceans have waves, water in ponds doesn’t run, etc.), and the different reasons people would be on water vehicles.

Learners will write or illustrate the different reasons why people would use water vehicles e.g. fishing, navy, transportation, pearl diving etc.

Learners will explore the concept of sinking and floating. Learners will fill a tub with water and collect a few “waterproof objects” that do not have batteries. Learners will make a list of these objects and then try and guess whether an object will sink or float when put in the water – they will then place that object in the tub and write what actually happened

For example:

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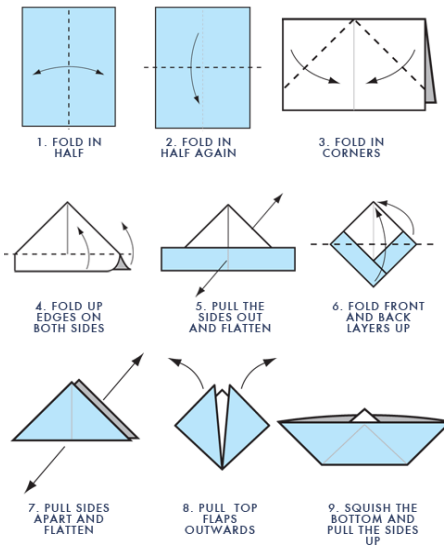
	10 minutes	Learners will think about the reasons why some objects sink and float? For example: - Objects that are heavy sink - Objects that are big sink
	5 minutes	Learners will now explore that neither size nor weight determines whether a body floats or sinks. Learners will explore putting an orange in a glass or tub of water and see that it floats. They will now peel the same orange and put it in the same glass or tub water and see that it sinks. This is even though the orange is the same size and weight, because there is air between the orange peel and the orange reducing its density so it floats! The orange without the peel has more density than water, so it sinks!
	10 minutes	Learners will re-try the experiment to test their reasons or hypothesis and make a new guess on how boats can float. Based on the experiment, they will write or share aloud the characteristics of objects that float. Tip: Sinking or floating has to do with a concept called density. Density is a measure of how compact the mass in a substance or object is or how densely things are packed. Any object with a density higher than the density of water will sink and anything with density less than that of water will float. **Numeracy Extension**: Learners will calculate the percentage of times that their hypothesis was right. Hint: (Total number of right answers divided by the total number of objects) multiplied by 100
	15 minutes	Based on their conclusions, learners will make their own paper boats that float on the water. Encourage learners to come up with their own designs. You may show them these examples to guide them in the process. 

	10 minutes	Learners will make multiple boats (of different sizes and made from different types of paper) and check if they sink or float Learners will try and move their boat - Learners can blow on their boats with a straw and see how it pushes the boat forward. This is how sailboats move with the wind Learners will create their own rowing oars to explore how engine propellers help push the water and move the boat forward. Learners will make their own oars with little toothpicks, popsicle sticks or straws etc. They should make sure the bottom of the oar has a broad and flat surface. The action of the oars pushing the water back helps the boats move forward  
3	15 minutes	Learners will explore land vehicles and how to design the fastest vehicle Learners will refer again to the original list and add land vehicles that they can think about. They will think and try organizing these in terms of speed from the fastest to the slowest land transportation for example: - Train - Motorbike - Car - Bus - Cycle

15 minutes

Learners will 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. Any object that rubs against another object or even against air in the case of air resistance causes friction, for example even if you rub your hands together that causes friction.

Learners will move different objects on the ground to see the effect of friction.

Learners can move a square or rectangular block or a triangular shaped object – these can be constantly pushed with force, but these cannot be rolled. Learners can try the same with a circular tube to see how it rolls forward more easily with less force

Learners will design different roads to reduce friction. Is it easier for the vehicle to move faster when the ground is bumpy, uneven?

20 minutes

Learners will make a guess and then test whether they 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 has lower friction. It is important that learners need to apply the same level of force or push the vehicles with the same amount of strength

For example:

Surface	Guess / Hypothesis	Result / Experiment Evidence	Reason
Smooth wooden or tile floor	Fast – Low Friction	Fast – Low Friction	
Sweater on a surface (bumpy or uneven surface)	Medium – Med Friction	Slow – High Friction	
Cement floor	Fast – Low Friction	Medium – Medium Friction	
Carpet			
Grass			

Numeracy extension: Learners can make a bar chart depicting the number of times their hypothesis was right and the number of times it was wrong

Learners will explore why they think some surfaces increase or decrease the friction and write their reasons

	15 minutes	Learners will design a ramp which is just a slide that can be made with a book on any flat surface that is at an incline: - How much effort / force needs to be applied to help a tube, or a toy car go down? - How much effort / force needs to be applied to help a tube, or a toy car go up?
4	20 minutes	Now that we have learned how to design vehicles that can go really fast, it might also be dangerous to move them so fast. So, let us understand the rules that help us manage the speed. Did you know that one person gets hurt every 25 seconds because of a road accident resulting from very high speeds? Let's try and think of all the rules and regulations associated with transportation and also the professions Land Vehicles: Learners will explore all traffic rules and as a traffic police they will make 5 relevant signs and lights that help slow down land transportation to prevent accidents. Learners can design their own signs that they think will be more effective in preventing accidents. For example: - Red, yellow and green light, - Stop sign - School zone sign - Zebra crossing - Speed limit sign
	20 minutes	Learners will think about traffic in the water and the people that will help in managing this. Learners can make their own lighthouse to help the boats navigate in the darkness. A lighthouse is a tall structure that can help boats find their way in the darkness since it has a light on the top. The lighthouse can also help if boats signal with any issues Learners can make these with empty toilet paper rolls, tubes and paper 
	20 minutes	Learners can now pretend to be the air-traffic controller and help planes with when to "take-off", land or where to fly to make sure that planes do not crash into each other. They will think of the shortest and clearest message that they can convey to pilots on the phone to make sure that there are no issues

		Literacy extension: Learners will learn how to summarize key messages. In the case of air control and other things like SMS etc. we have to pass on important information, and we cannot use too many words to share this information. How can we best summarize the message to pass the key important points? (2 levels of worksheet are attached) Learners can also write their own short messages to communicate the following scenarios. Learners can communicate 1 or all 3 of the scenarios: - Learner booking a railway ticket on the phone (Key points: i) Origin and Destination - From where to where are they travelling; ii) Date and timing; iii) Name of the train; iv) Class of travel; v) Number of passengers) - A captain on a ship letting the ship crew know about a storm (Key points: i) Details on the storm – intensity of the storm; ii) What should the crew be doing; iii) What safety precautions can we take etc.) - An announcement from the pilot in the plane (Key points: i) Destination – where are they travelling; ii) Travel – how long is the flight and what will the weather be; iii) Safety procedures - seatbelt, walking in the plane etc.)
5	20 minutes 10 minutes 20 minutes	Learners will imagine and create their own vehicle that combines all the science principles that they have learnt till now and is: - Anti-gravity - Floating - Low friction Learners will describe the features of this vehicle through illustrations or writing: - How can we make sure that the vehicle stays in the air and does not fall to the ground with gravity? - What will make the vehicle stay afloat in the water? - How can the vehicle face the least friction to move forward with the most speed with the least amount of effort? - For example: Can it be a boat, which has folded in wings to be a plane that can be placed on wheels? Learners will think of the purpose of the vehicle e.g. is it to help sick people get to the airport fast like an ambulance, is it a moving school etc. Learners will draw their vehicle and label it and share it with their family and also explain the relevant features to make it work best on land, water and air Family feedback will include: ● What do they love about the vehicle's design? ● Any questions they might have about the explanation? ● Any areas of improvement in either the design or the explanations? Learners will use the feedback to revise their design

Assessment Criteria:	Creativity in the final vehicle designed, including the purpose Demonstration of understanding of physics concepts of gravity, density, force, motion, friction, floatation and sinking Ability to design a plane that flies, the fastest land transportation and a boat that floats Clarity of road signs, lighthouse and ATC Learners hypothesis and guesses with reasons explaining the project phenomena

Additional enrichment activities:	Learners can explore creating their own moving car with rubber-bands as in Level 3 of the same project
Modifications to simplify the project tasks if need be	Learners can test the concepts of friction and sinking and floating by designing their own boat and testing the cars and then design their own vehicle

WORKSHEET 1

Can you summarize the following instructions between a pilot and air traffic controller

Example: ***Long Form:*** *Hello, I am testing the sound system. Pilot Sam, can you hear me?* ***Short Form / Summary:*** *Mic, check testing.*
Question 1: **Long Form:** Hello, how are you? I am trying to test this mic, this is Pilot Sam. I can hear you, can you hear me also? **Key Messages:** **Short Form / Summary:**
Question 2: **Long Form:** Hello Pilot, Can you hear me. Please do not come to land right now because there is another flight using the runway to take off. Please circle around the airport in the air for sometime **Key Messages:** **Short Form / Summary:**
Question 3: **Long Form:** Air Controller, This is Pilot Sam from the Plane that was coming from London. We have flown a long time and our fuel is finishing, if this happens we will not be able to continue flying and might even crash. Please can we land soon **Key Messages:** **Short Form / Summary:**

Question 4: **Long Form:** Ok Pilot I understood. I have some important questions: how much more petrol do you have in your plane? How much more time can you fly before you have to land? I have 2 more flights, I can stop them and ask you to land first. **Key Messages:** **Short Form / Summary:**
<u>Can you summarize the following communication between the pilot and the air control tower</u> Question 5: **Long Form:** Thank you, Air Controller – Since we flew for 10 hours, we only have 5 litres of fuel left and maybe we can circle one more time for another 3 minutes and then we will have to land. I suggest you ask the other planes to wait **Key Messages:** **Short Form / Summary:**

<u>WORKSHEET 2</u>

Directions: Read each passage

1. Create a title for the passage related to the main idea.
2. Accurately summarize the text.
3. Your summary must describe all key ideas from the text.
4. Do **not** include opinions or personal info in your summary.
5. Highlight or underline key ideas in the passage

Example:

Long Form: There was a grumble in the air and dark clouds forming, the captain on the ship looked up at the sky. The captain had his hands folded and was wearing a rather worried expression while he muttered to himself. The mild breeze that was blowing against the sail through the afternoon, was now a strong gusty wind and the entire shop was rocking from side to side. The sea waves were beginning to rise and crash into the ship, sometimes coming over the deck

Main Idea: There was a storm and the captain was worried

Short Form: There was a storm forming and the captain of the ship was worried. The wind was stronger than in the afternoon and rocking the boat and the sea waves were coming over the deck.

Paragraph 1: Imagine a herd of elephants almost flying past you at sixty miles per hour, followed by a streak of tigers, a pride of lions, and a bunch of clowns. What do you see? It must be a circus train! As early as 1871, people started using trains to have a moving circus from city to city. Before circus trains, it would be difficult for people to move the animals, performers, and equipment with a team of more than 600 horses. Since there were no highways, these journeys were tough and took a long time. Circuses

would stop at many small towns between the large venues. Performing at many of these small towns did not make a lot of sense or make money for the circus. It was difficult for the circus to become too big because of these issues until they started using trains and reaching many of the big cities for big audiences. These performances were much more profitable and the profits went toward creating an even bigger and better circus. Multiple rings were added and the show went on. Today, Ringling Bros.and Barnum and Bailey Circus still rely on the circus train to transport their astounding show.

Main Idea of the Passage:

Summary:

Paragraph 2: I am trying to test the sound system and checking that you are able to hear and understand me clearly. I am speaking from the main air controller tower in the Dhaka airport and my name is Ron. My job is to make sure that only one plane at a time is taking off from the runway at a time to make sure that planes do not crash. Since you cannot see the other planes that might be ready to take off or land, I will coordinate between all of us. There are many planes waiting to take off and since there is only one runway to be used, we think it is better for you to not land right now. I understand that you have come from far away, so I want to make sure that you have enough fuel in the tanker to be able to stay in the air for some time. We want to make sure that another three flights take off before so that the passengers on the flight do not get very late to their destination.

Main Idea of the Passage:

Summary:

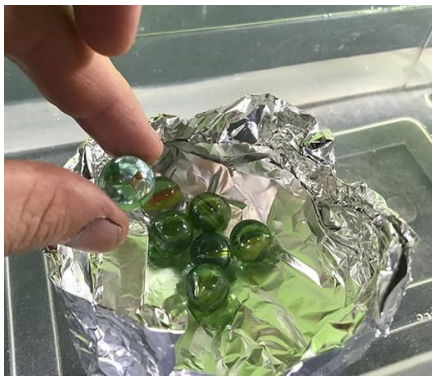
Ages 11 to 14 (Level 3)

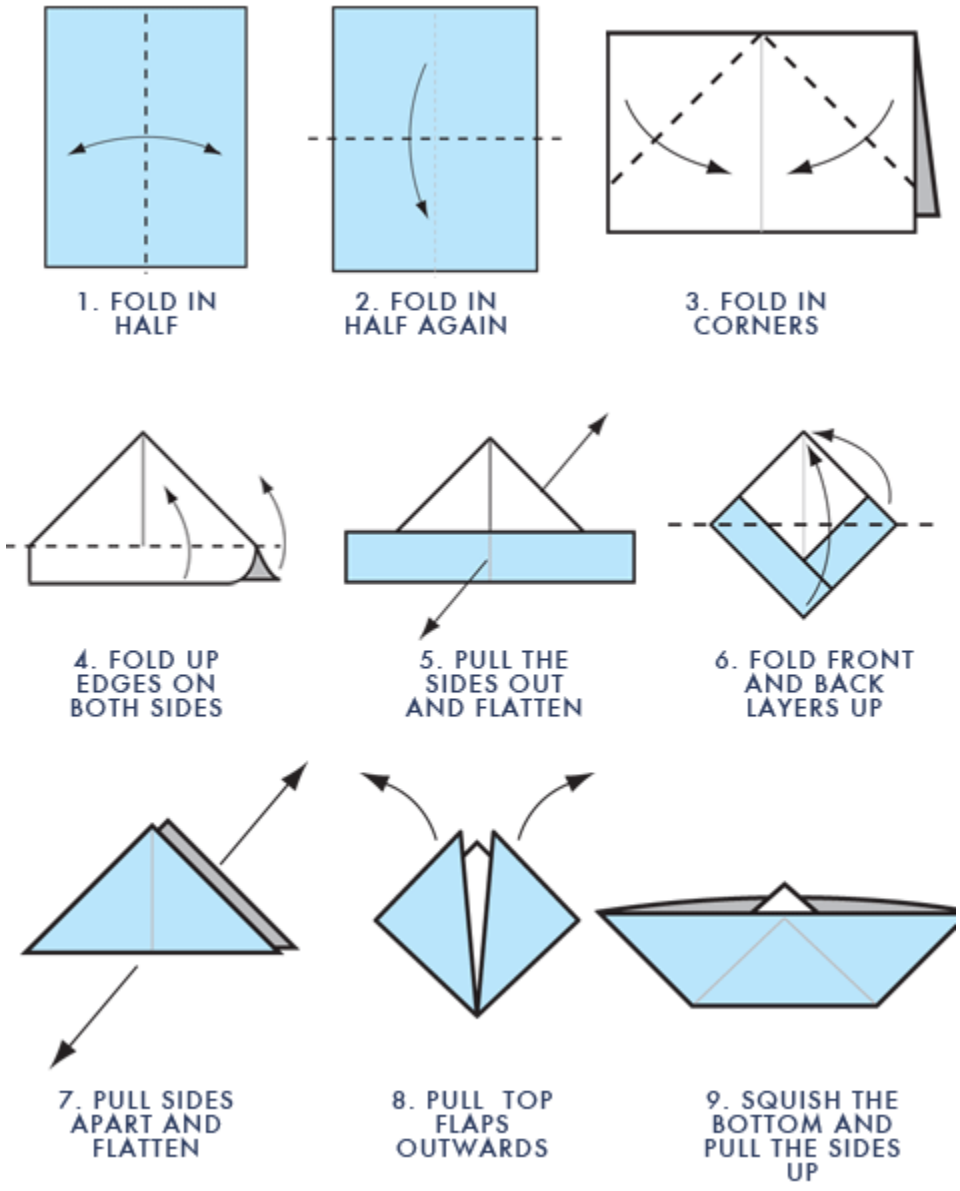
Description:	Learners will explore designing the fastest vehicles on the land, water and air through physics concepts. Learners will explore how vehicles move and related regulations, before making their own dream vehicle
Leading question:	**What's the fastest vehicle that you can make?**
Age group:	11 – 14 years
Subjects:	Science, Geography and Art & Design
Total time required:	~ 5 hours over 5 days
Self-guided / Supervised activity:	Medium Supervision
Resources required:	Tub, Water, Paper, Tube and other scrap material

Learning outcomes:	- Understanding Physics principles of gravity, thrust, lift, drag, density, force, inertia and displacement scientific processes of hypothesis, evidence and conclusions -Being creative in designing and creating their own vehicles
Required previous learning:	None
Topics/concepts covered and skills developed	● gravity, force, motion, friction, floating-sinking, inertia, thrust, lift, drag, density, displacement ● Archimedes' principle ● Making hypothesis ● Experimentation ● Transportation in water, air, and land ● Safety policies ● Observation ● Creativity, presentation, and communication skills

Day	Time	Activity and Description
1	15 minutes	Learners will explore vehicles that travel through water, air and land and what helps them move Learners will make an illustrated and labelled list of vehicles that travel in water, air and on land and also organize these based on when they think they were invented. Learners will write and illustrate the different reasons people would use water vehicles e.g. fishing, navy, transportation, pearl diving etc.

	30 minutes	Learners will explore the concept of sinking and floating on water bodies. Learners will fill a tub with water and experiment with a few different objects based on their mass, volume, shape, and material. Learners will first make a hypothesis (guess) on what will happen with the object, then record the result and state a conclusion Definitions: 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, learners 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 Learners will 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 the ratio of Mass to Volume and 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 for your size. If you can add surface area to an object without adding much weight, the object will be lighter relative to its size. This means that the density of the overall object will decrease and be more likely to float. This is why wearing a light life jacket adds size but not weight and helps people float. Even our body: if we form the shape of a ball, our body would sink in water. In order to float, we must stretch our arms and legs. 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) Learners will fill out Worksheet 2: Displacement (appendix) There is still something unexplained, why does a large and heavy ship float? Learners will explore the Archimedes principle of displacement Learners will take a piece of foil (20 cms by 20 cms) and fold in the edges to form a square to ensure that the boat is stronger, pull up the sides of the square to form a

	10 minutes	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? Input from Parent/Educator: 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. Learners will write down the weight of the various objects placed in the foil boat and the consequences of floating and sinking. Learners will fill the related science experiment sheet. For those that do not have a weighing scale, learners can estimate the weights by lifting the object. - Ask a question - Form a hypothesis - Plan the procedure and conduct an experiment - Record data - State a conclusion Encourage learners to explore and try out two or three different designs for their planes (they can use heavier or lighter types of papers). Here's one example of a boat that they can build by following the steps below:

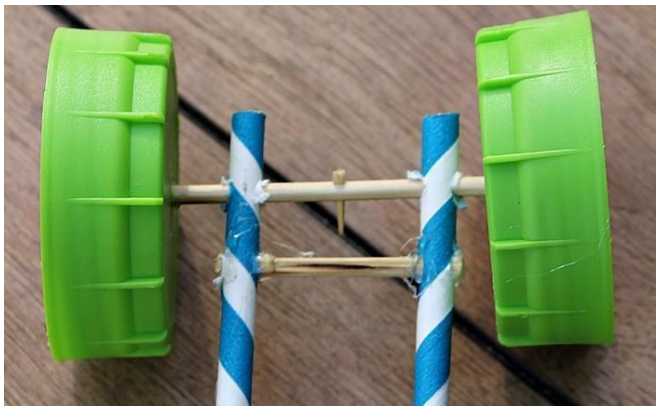
		
2	20 minutes	Learners will explore how to make a fast-moving land vehicle by exploring the concept of friction, force, motion and inertia Learners will explore the concept of friction and the importance of wheels to help most land motion. Friction is the resistance of motion when one object rubs against 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. Any object that rubs against another object causes friction, for example even if you rub your hands together that causes friction.

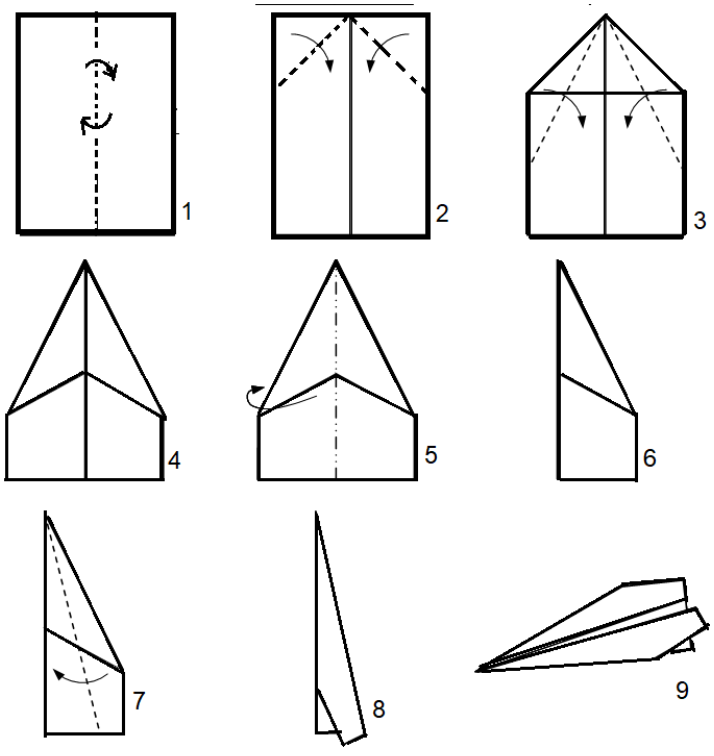
	10 minutes	Learners will do an experiment to understand friction better. They will insert a pencil into a glass or jar full of uncooked rice or sand. Push the pencil in and pull it out of the rice and find how much effort is needed to pull the pencil out of uncooked rice or sand. Learners will -slowly compact- the rice pushing the air out of the jar and find the new effort needed to pull out the pencil. The more contact there is the more the friction – eventually you can hold up the jar with the pencil. The force of this friction is more than the force of gravity  Learners will make a guess and then test whether they 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 has lower friction. Learners will make a hypothesis, test and capture the evidence from the experiment and then write their conclusion

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

	30 minutes	Learners will explore the concept of inertia 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. Learners can 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 Learners will design their own rubber-band car  Step 1: Bore 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 Input: By pulling and stretching the rubber-band you can store energy known as potential energy – when you release the rubber-band the energy is released to kinetic force which makes the car move forward
3	15 minutes	Learners will explore the concept of air travel and what makes planes fly by exploring the concept of gravity, thrust, lift and drag Learners will 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.

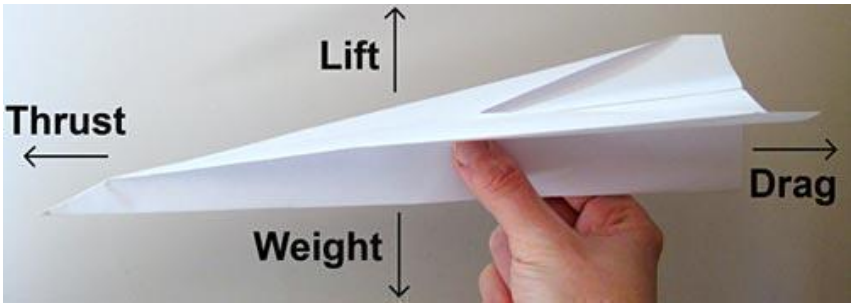
	45 minutes	Learners will explore the speed and force of a gravitational pull trying objects of different mass and seeing what falls faster and slower to the ground. Learners can use any 5 household objects that are unbreakable and time the fall. Learners will make a hypothesis on what objects faster and slower and make a conclusion. Learners will then discover the more massive an object is, the stronger its gravitational pull is Learners will make their own paper plane. Encourage learners to try out two or three different designs for their planes (they can use heavier or lighter types of papers). Here's one example of a plane that they can build by following the steps below:  Learners will 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

Object	Hypothesis	Speed after the Experiment

- 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

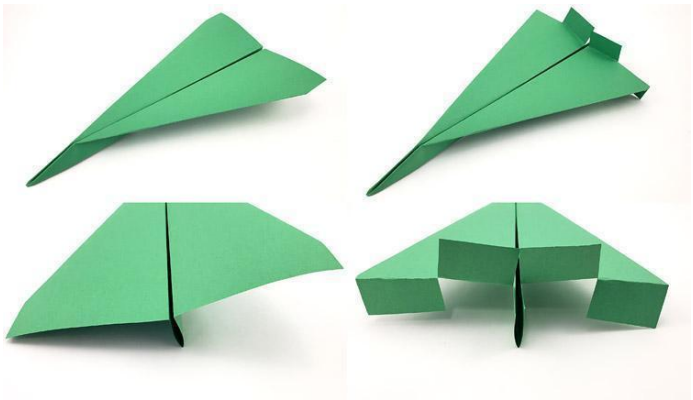
Learners will create an observation sheet for the three experiments:

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



To test thrust: Learners will now throw this 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. Learners will measure the distance of flight 1

Learners will now create drag, in order to do this the more surface area exposed to rushing air, the greater the drag.
Learners can 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. Learners will now measure the distance of flight 2



		Learners will now change the paper of the paper 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. Learners will now 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 the learner does not have tools to measure distance, they can measure with the number of footsteps etc.) Learners can also calculate the speed with the following formula: Speed = Distance / Time. To calculate this the learners will measure the distance the plane flies in each event and divide it by the time it took
4	40 minutes 20 minutes	While we are trying to design the fastest vehicle, we do need to think about safety. Around the world, 2 people die every minute because of road crashes Imagine that you are the road safety department or traffic police. - 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: - Grab the attention of the government official reading it - Identify the major reasons for car accidents (if learners do not have access to information on this, they can think of reasons by discussing these with family members) - Suggest clear policies or laws - Give an implementation plan 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: - Be “catchy” so people look at it and remember it - Have a clear and actionable message - Be simple and easy to do Learners will present their report on car accidents (including reasons for car accidents , suggested policies or laws and implementation plan to family members Learners will also present the advertisement banner to the family members. Family members feedback will include: -Questions of clarification -What they appreciate about the report -Some concerns or puzzles

		-Suggestions for improvement Learners will use the feedback to revise their car accidents report and advertisement banner
5	1 hour	Learners will use all the principles that they have learnt to design and create their own super vehicle Learners will need to: - 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 – learners can explain these for example: How will the vehicle work with relation to gravity, thrust, displacement, density, friction and inertia to move efficiently and fast? - 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
Modifications to simplify the project tasks if need be	

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 I: 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: