Water Rokit

Activity Day

Introduction

Today is a Rocket and Space Day.

By the end of the day, you will all be a **qualified ‘Junior Rocketeer’!**

Question 1: Why are Space Rockets Important?

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Rockets deliver satellites to Space where they can begin to do their important work.

You have probably used satellites for your daily tasks already today.

Question 2: What is a Satellite?

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A satellite is a **moon, planet, or machine** that **orbits a planet or star.**

Question 3: How Many Satellites Orbit the Earth?

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There are **at least 6,000 satellites that orbit the Earth.**

Here are some of the good things they help with:

- **Crops**
- **Weather patterns**
- **Communications**
- **Navigation**
- **Imagery of the Earth below**
- **Pollution**
- **Research our galaxy and beyond**

Question 4: How Many Miles Per Hour Does a Satellite Travel in Orbit?

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A satellite that is close to the Earth, in what is called a **'Low Earth Orbit',** travels at approximately **17,500 miles per hour.**

Some satellites operate even higher. The **higher** it is, the **slower** it needs to travel to stay in orbit.

Question 5: How Long Does it Take for a Satellite to Orbit the Earth?

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In Low Earth Orbit, it takes about **90 minutes** to go around the Earth once.

Question 6: What is the ISS?

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ISS stands for **International Space Station.**

This is where astronauts and scientists fly to on a rocket and **conduct important experiments in Space.**

Question 7: How Fast Does a Rocket Travel to Get into Space?

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A rocket needs to accelerate to about **17,500 miles per hour** to get into Low Earth Orbit.

If it is **travelling to the Moon,** it needs to go even faster, at around **25,000 miles per hour.**

Question 8: What is a Payload?

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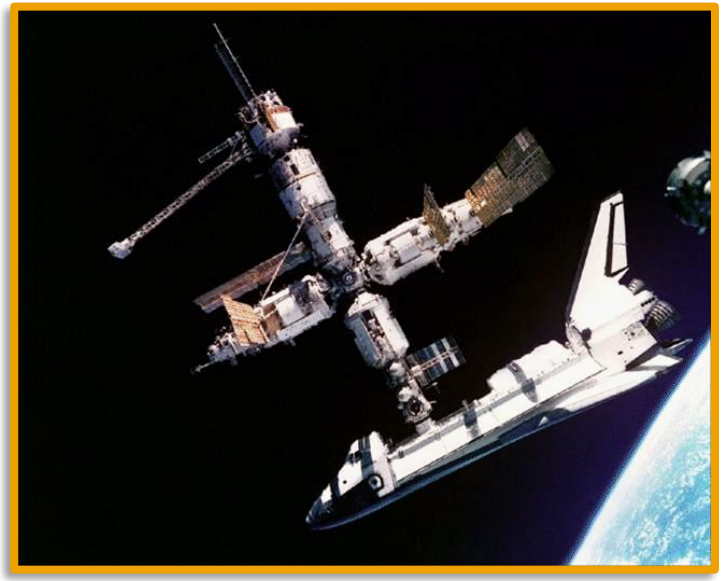
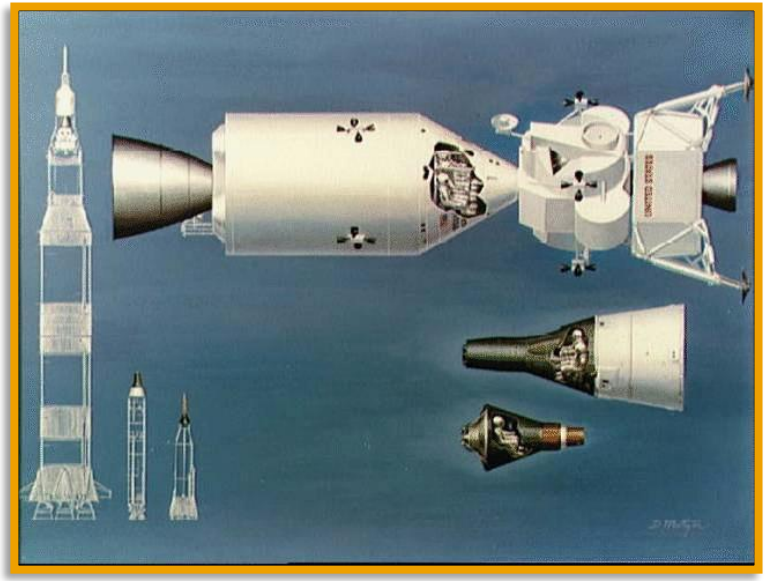
A payload is **the passenger or cargo that sits on top of a Space rocket.**





Question 9: What Does it Take to Launch a Rocket Upwards?

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We need to generate a lot of energy which creates **thrust** – this pushes the rocket up into the sky.

Have you ever heard of **Sir Isaac Newton**? He established a universal law saying – **"for every action, there is an equal and opposite reaction".**

Watch this quick example of a squid jet propulsion!

Question 10: Let's Test Newton's Third Law of Motion! What Happens When We Jump Up & Down?

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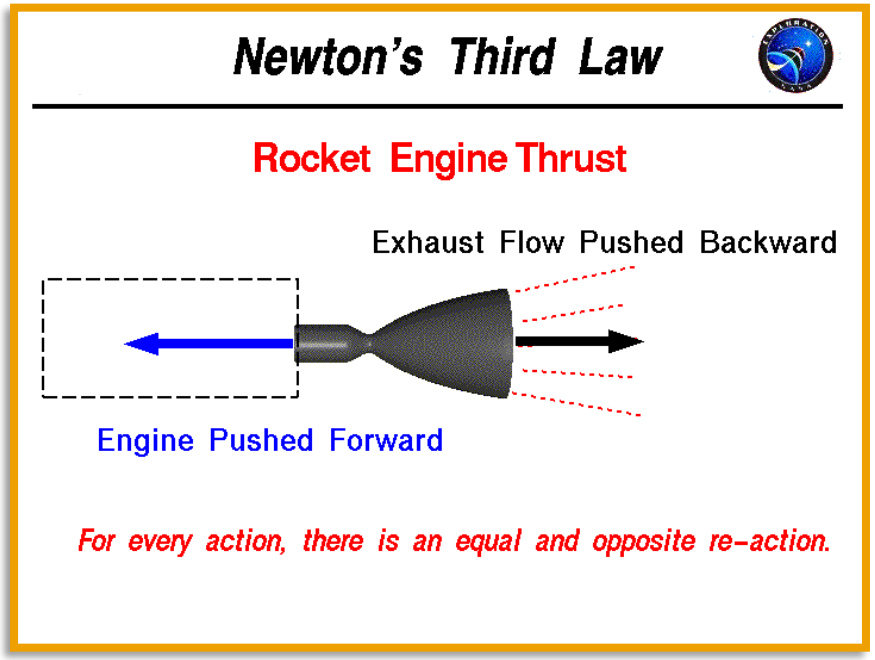
Jump as high as you can!

How are you launching yourself upwards? Your feet are **pushing into the ground** which **pushes your body upwards.**

For every action, there is an equal and opposite re-action.



Question 11: How Do We Generate Thrust?

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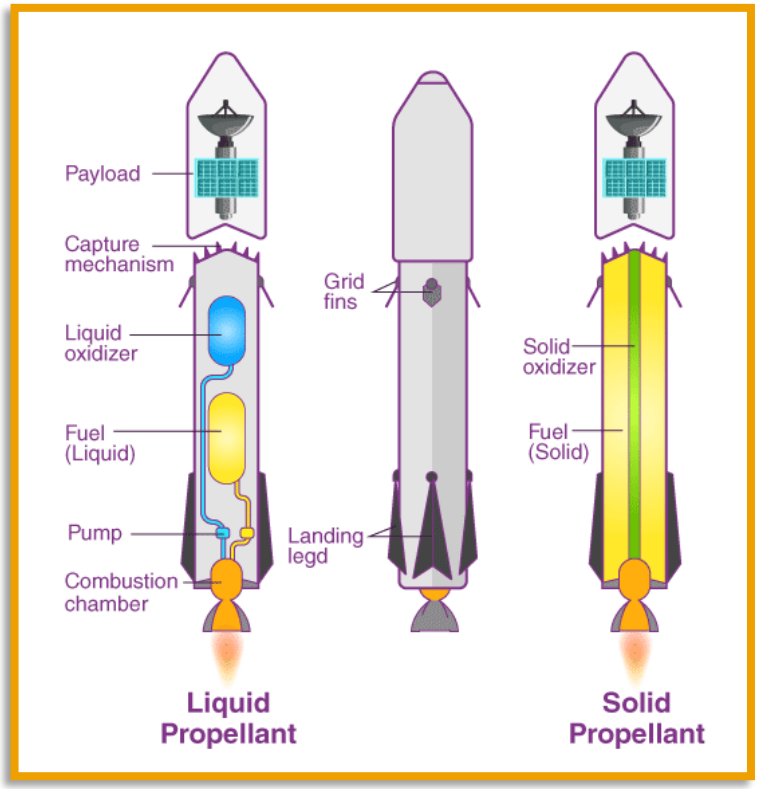
We need fuel.

In the Water Rokit we are going to launch today, our fuel is water, but **a Space rocket needs a special, powerful rocket fuel.** This fuel is either liquid (like the fuel in your car), or solid (like a firework).



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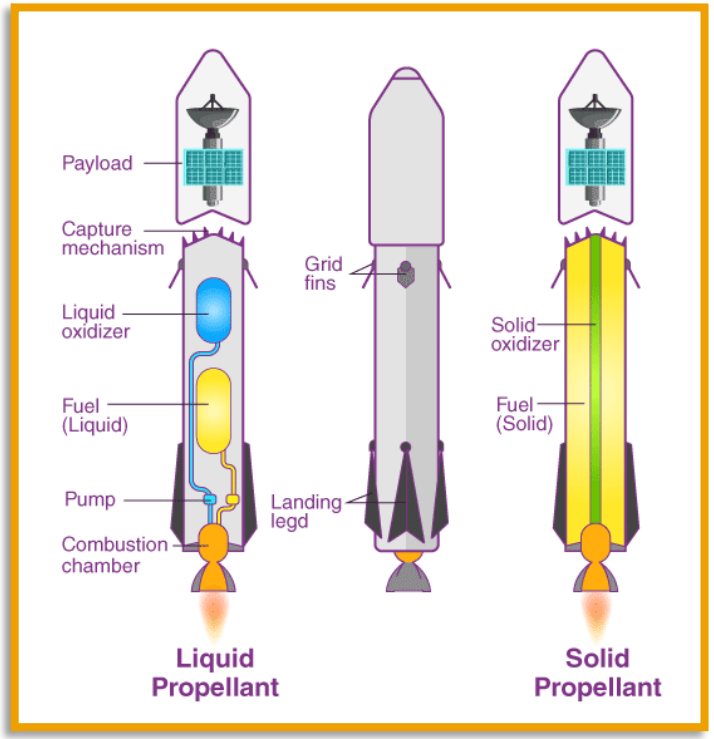

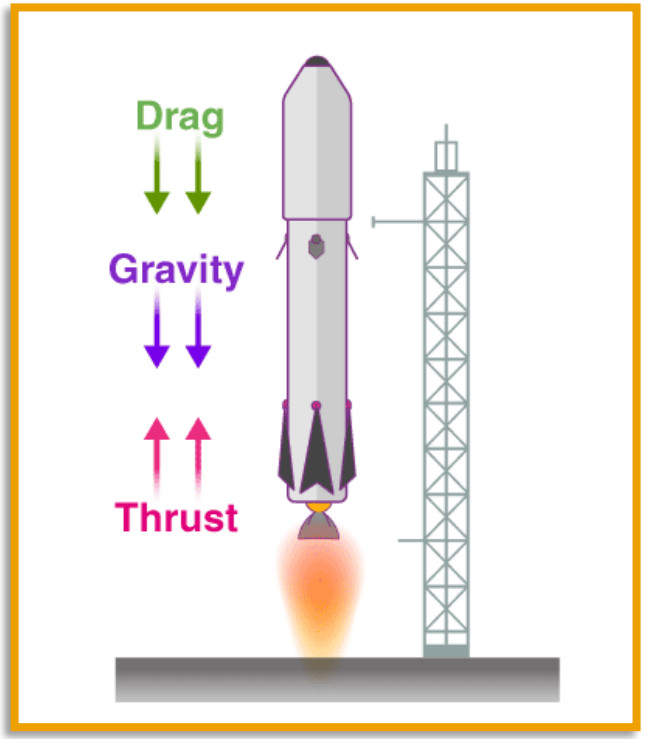

Question 12: How Do We Make Sure the Rocket Goes Straight Up and Doesn't Shoot Off to the Left or Right? How Do We Keep it Stable?

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Our Water Rokit has fins on it. These fins make the rocket stable as it climbs through the air.

On big rockets, the engines adjust a little bit to the left, and a little bit to the right. This is called **gimbaling.** This helps stabilise the rocket.

Question 12: How Do We Make Sure the Rocket Goes Straight Up and Doesn't Shoot Off to the Left or Right? How Do We Keep it Stable?

There is **one** more important thing the rocket needs to help it travel. It needs to be aerodynamically **streamlined.**

We need to make the rocket as sleek and streamlined as possible.

The faster the rocket travels, the more wind resistance (drag) it will face.

Question 13: Why Reuse a Rocket?

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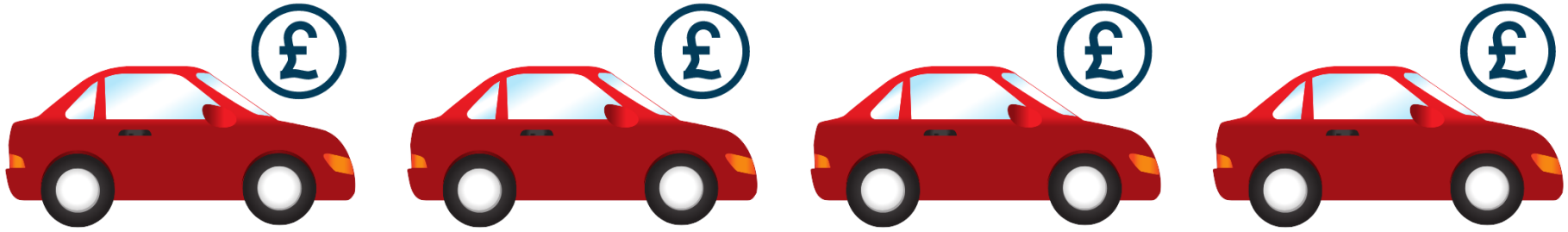
Imagine every time you boarded an aeroplane or jumped into a car it was **only good for a single journey.**

How much would it cost? It's just **too wasteful,** isn't it?



Question 13: Why Reuse a Rocket?

SpaceX have been working on **reusable rockets** since 2011.

On their **Falcon 9 Rocket,** which is used to take satellites, cargo and people into Space, the **booster** section of the rocket **returns to Earth and lands,** often on an unmanned ship called a ‘Drone Ship’. This dramatically reduces the cost of a Spaceship reaching orbit.

Question 13: Why Reuse a Rocket?

The gigantic new spaceship – **Starship** – from SpaceX is currently in testing, and perhaps one day will take people to Mars and back! It will be like an aeroplane - **fully reusable for more journeys.**

Just like with our Water Rokit, we reuse and recycle our bottles. Less waste, reduces the need for future manufacturing, and of course, it's better for the environment as less resources are used.

What else could you reuse every day instead of throwing it away?
What things do you recycle each week at home?

Kit Required

- NASA stickers
- Card
- Sticky tape
- Eggs (optional)
- Pens
- Water
- 1 litre or 1.5 litre empty recycled carbonated fizzy pop bottles / and extras for (egg experiments)
- Cotton wool (stuffing)
- Decoration materials of choice
- Stirrup pumps
- **1 Water Rokit per group** (and a spare)
- Water containers (if no water on tap)

Activities & Experiments

Experiments:

Watch this simple, practical balloon experiment illustrating Newton's Third Law of Motion.

Balloon on a string

Watch this video for an illustration of the effects on the body in the vacuum of Space, where there is no atmosphere.

Marshmallow experiment

Activities & Experiments

Activities:

Now, we are going to **decorate our rockets.** Get some stickers and other craft materials and customise your rockets.

Lower age groups: Simply add stickers.

Activities & Experiments

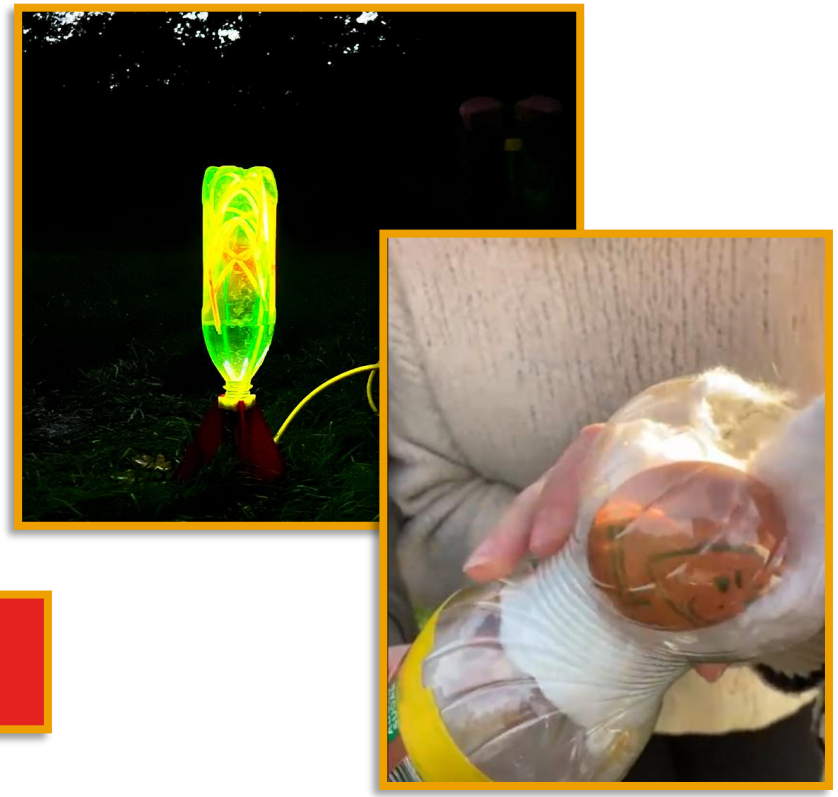
Older age groups: Vary the rocket design by considering…

- **Cones to add to streamlining**
- **Making things to increase drag**

Tip: ‘Drag’ is the force that acts on the surface of an object moving through a gas or liquid that slows it down. It acts in the same line of motion as the object, but in the opposite direction.

Activities & Experiments

- Adding a “payload” by attaching another half bottle containing an egg protected with cotton wool.
- How about glow sticks or LED lights?

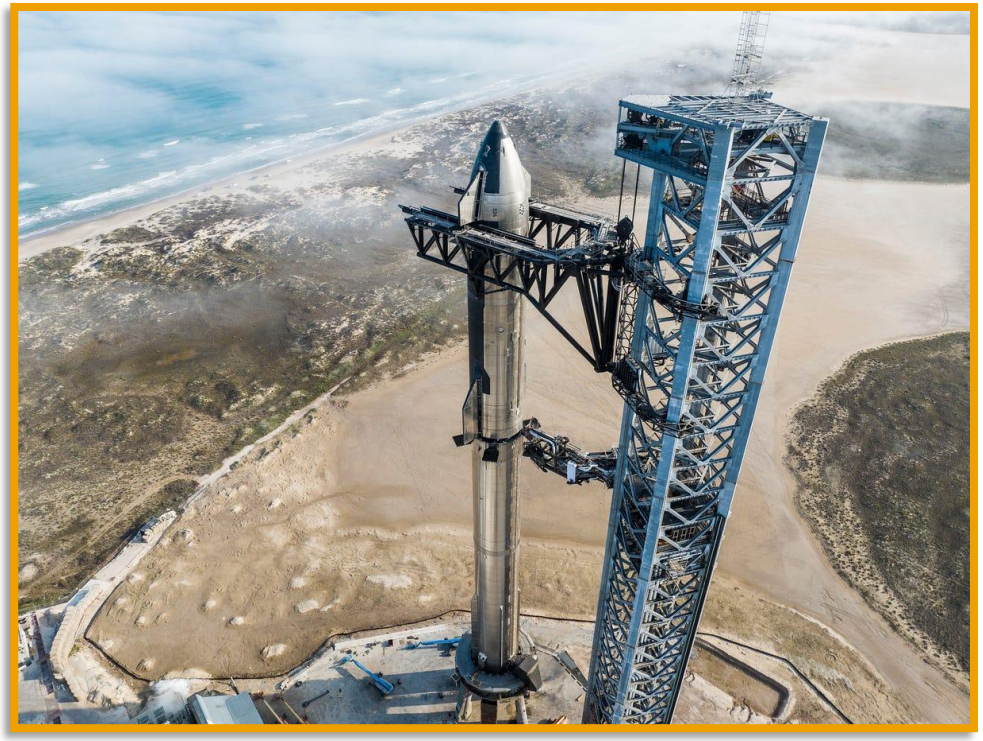


Tip: Whilst making your rockets, why not complete a Space quiz?

Let's Go Outside and Test Our Rockets!

Questions About Rockets

- Why are they shaped like this?
- What do you notice about your rocket?
- How do you think you can make it go higher?



Rocket Launch Practical

- Launch a rocket with **more or less water** in the bottle.
- Add some **cardboard fins** on the side of the rocket to increase drag.
- Make some **different nose cones for the rocket.**
- Launch the rocket at **an angle.**
- The **egg experiment** (attach a payload to your rocket).
- Show photos / videos.

The Astronaut Egg Experiment

Your mission is to launch an ‘Astronaut Egg’ into Space, landing it safely in one piece.

The Astronaut Egg Experiment

How NASA prepares for a mission

Before a mission commences at NASA, the team will agree on their mission objective.

At the end of the mission, they assess what parts of the mission were successful, and what could be improved for next time.

Adopt this method when experimenting:

Test/Measure/Improve/Optimise

Mission Objective – To launch and return your Astronaut Egg to Earth in one piece

Step 1 – Decorate your Astronaut Egg.

Step 2 – Create your additional payload by cutting another plastic bottle (the same size as your booster bottle) in half.

Step 3 – Protect your egg with different types of soft materials and packaging. Bubble wrap / cotton wool – anything you can bring from home that will soften the impact on re-entry.

Step 4 – Place your astronaut into the bottle with its protective covering.

Step 5 – Attach your payload on top of your booster bottle with sticky tape, ensuring that your astronaut is secured inside.

Step 6 – Execute your mission by launching your rocket.

Step 7 – Record your findings and observations.

- Was your mission successful and why? What could you further improve for next time?
- Was your mission unsuccessful and why? What could you improve for next time?

The science behind the experiment

Impact Force

Impact force is a force that delivers a high impact in a relatively short period of time.

How else could you reduce the energy of impact?

How about slowing your Water Rokit down by either fitting a parachute, by using a bigger bottle, or by adding less water to start with?

Why understanding ‘Impact Forces’ is a great example of illustrating the effects of Newton’s Third Law of Motion

When the Water Rokit and Astronaut Egg hit the ground, there will be an **‘impact force’** to the ground, and the ground will have **‘an equal and opposite reaction’.**

The dropped egg will **absorb the forces** from the collision upon landing and react.

Packing the egg in soft protective materials means that the energy will be absorbed by the material.