

STUDENT WORKSHEET

ELECTRICITY, LIGHTNING AND AIRCRAFT DESIGN


Part 1
Balloons and lightning

- What is static electricity?

Rub a balloon on your clothes and hold it above your head. Your hair sticks to the _____ and stands up. This happens because, when you rub the balloon, negative _____ moves from your clothes to the _____. The balloon gets a _____ charge.

When you put the balloon near your hair, all your hairs become charged with _____ electricity. Since all hairs have the same charge, they _____ each other. The hairs get as far away from each other as possible by standing on end.

- How lightning forms

Work in a group of four students. Follow the steps below.

- Give each person one storm card.
- Read your own card and make sure you understand it.
- Take turns to read out one of the questions below.
- If you know the answer to the question, tell the others in your group.
- When someone tells you an answer, write it in the table below.

Question	Answer
1. What is ionisation, and how do ice crystals with positive charges form in clouds?	
2. How is an electric field created in a storm cloud?	
3. How do negative leaders and positive streamers form?	
4. How is a lightning flash formed from a leader and a streamer?	

Part 2

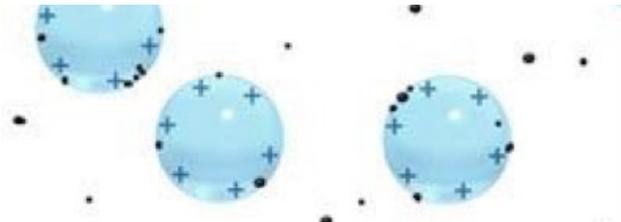
Storm cards

1. Clouds are made of ice crystals and water droplets. Convection currents make the ice and water move up and down in the cloud.

When ice crystals or water droplets bump into each other in the cloud, the frictional force removes negative electrons from some of them. These ice crystals and water particles now have a positive charge.

Some ice crystals and water droplets gain electrons. They now have a negative charge.

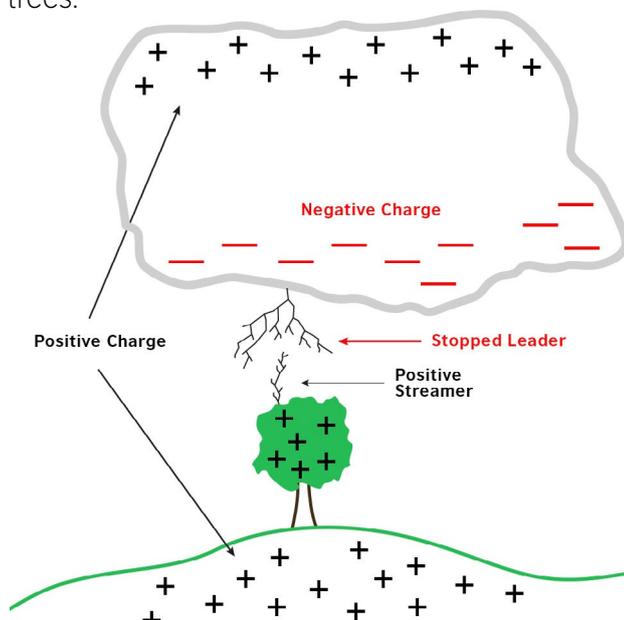
The process of making charged particles is called ionisation.



3. When the negative charge at the base of a cloud is big enough, the cloud lets out energy.

The energy goes through the air to a place with a positive charge, for example from the base of the cloud to the ground. This is a leader. Leaders often split into branches.

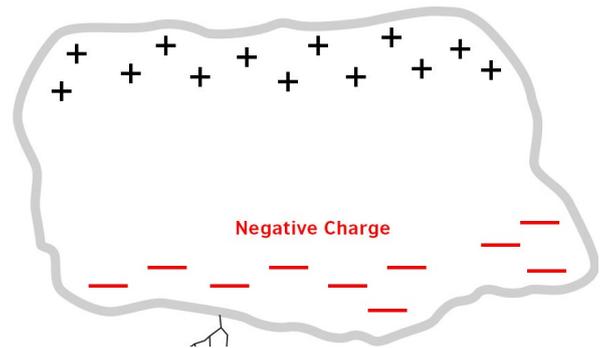
As negatively-charged leaders approach the Earth, positive streamers develop from things that stick up, such as mountain tops and single trees.



2. The ice crystals and water particles with positive charges move to the top of the cloud. At the same time, ice crystals and water particles with negative charges move to the base of the cloud.

The separation of positive and negative charge creates an electric field. The electric field is positive at the top and negative at the base of the cloud.

The negative charge at the base of the electric field repels negative charges below the surface of the Earth. This gives the Earth's surface — especially things that stick up — a positive charge.



4. When a downwards moving leader meets an upward moving streamer, a conductive path forms.

An electric current flows along the conductive path. We see a bright spark, which is a lightning bolt.

A lightning bolt lasts for less than a second. Its temperature is up to 30 000 °C.



Part 3

Aircraft materials

• Activity 1

Draw lines to match each material to its description.

metals	a silvery-white metal with a low density.
copper	hard, shiny, opaque substances that are good conductors of heat and electricity.
aluminium	a strong material with a very low density.
carbon fibre reinforced plastic (CFRP)	a pink-orange metal that is a good conductor of heat and electricity.

• Activity 2

Complete the table by writing **true** next to the statements that are true, and **false** next to the statements that are false.

	True or false?
Metal aircraft are not damaged by lightning because metals conduct electricity.	
Some modern aircraft are made from carbon fibre reinforced plastic (CFRP).	
CFRP is not affected if it is struck by lightning.	
Including a thin layer of copper metal into aircraft parts made from CFRP does not protect the aircraft from lightning damage.	
The lighter an aircraft, the less fuel it needs to fly a certain distance.	

Part 4A

News report

• The story

A modern aircraft, an Airbus A380, was struck by lightning as it came in to land at Moscow Sheremetyevo airport. The plane was carrying more than 400 people. There was no damage to the aircraft, and no injuries were reported to passengers or crew.

• Your task

In your group, make a television news report about the story. Choose your roles from the list below, and use the facts in the box. Your finished report should be 2 minutes long.

Later, you will present your report to the rest of the class. You will give each other feedback using the peer assessment table on worksheet 4B.

Roles

- News reporter
- A passenger who was on the plane
- A witness on the ground
- A representative from the airline
- A scientific expert

Facts

- An Airbus A380 aircraft has metal wings. Its fuselage is made from carbon fibre reinforced plastic, CFRP.
- Metal aircraft are not damaged by lightning strikes because metal conducts electricity.
- Aircraft made from CFRP are not damaged by lightning strikes because they include a thin layer of copper metal.
- A lightning bolt has a temperature of up to 30 000 °C.
- New aircraft designs are tested in lightning laboratories.
- Aircraft that include CFRP are lighter than metal aircraft of the same size. They require less fuel, so their flights cause less damage to the environment than heavier aircraft.
- Engineers are working hard to design new ways of protecting aircraft from lightning strikes so that they are lighter but still safe.

Part 4C

Role cards**Role: scientific expert**

You work in a aircraft lightning lab. You do tests and research on materials and the impact of lightning. Explain to the reporter how the plane is protected from lightning.

Start by saying:

Most aircraft as struck by lightning at least once every year. The metal structure of an aeroplane...

Words to use:

Conducts electricity, lightning bolt, protection

Role: witness on the ground

You were walking down the road when you noticed the plan in the sky being struck by lightning. Describe to the reporter what you saw and how you felt.

Start by saying:

I was walking down the road when suddenly...

Words to use:

Sky, thunder, lightning, runway

Role: news reporter

You will interview everyone in your live news report for the evening news. Prepare two questions for each person: passenger, witness, airline representative, scientific expert.

Start by saying:

Hello, my name is... and I am reporting from the airport. This morning an Airbus A380 was struck by lightning. We are speaking live to...

Words to use:

Cause, consequence, impact

Role: representative from the airline

You are responsible for the safety inspection of planes before they fly. Explain to the reporter what your job is.

Start by saying:

We inspect all our aircraft...

Words to use:

Inspect, test, safety

Role:

A passenger who was on the plane
You were on the plan when the lightning struck. Describe to the reporter what you saw and how you felt.

Start by saying:

I was ... when suddenly I ...

Words to use:

Felt, saw, heard

Role

Invent a new role if you have six people in your group.