Teacher notes – KS2 Clouds and Glider Racing

This unit builds students' ability to work scientifically, investigating convection and how air currents rise. The class will carry out practical demonstrations of this and learn how this is applied by glider pilots to race. National curriculum areas addressed include:

- comparative and fair tests, observations, states of matter and the water cycle.

Essential prior knowledge:

- Basic knowledge of states of matter

Introduction

Before starting the video, elicit experiences from the class. Has anyone been gliding? Seen a glider in the air? Are there any gliding sites local to the school? Does anyone know anything about glider racing and gliding competitions?

The video starts with a snippet of glider racing and introduces a glider pilot – pause video and choose one from our role model videos. The main body of the unit covers changes of state of water and explains how convection causes thermals and clouds form as a result. Pause the video for students to do the practical experiments. Emphasise that we can use water to simulate air currents, as convection happens in liquids and gases.

Student activity

Students will follow the procedure as in student notes below to demonstrate very visually how convective currents move. Build scientific thinking in discussion about why the three experiments. In practice, experiment 1 may happen too quickly to observe easily, hence experiment 2. Experiment 3 shows that a colder liquid does **not** rise through a warmer one.

If it is not practical to let the students do the experiments themselves, they should use the student notes to record their observations as the teacher either works through the experiments or alternatively uses the demonstration video.

INFORMATION

GLIDER RACING:

Glider pilots view the weather forecast to see where the best thermals are likely – enough sunshine and air most suitable for convection, not raining or too overcast. Our race course, known as a 'task', depends on the weather - on an average day we might race 300-500km at speeds of over 100kph and on a good day, flights at speeds of 100mph are possible, with distances over 1000km. We seek rising air – 'thermals' , often marked by clouds - and circle to climb in the rising air, then use the excellent glide performance of our aircraft to glide to the next cloud. A racing task typically has three 'turnpoints' - maybe a motorway junction or a cathedral that we have to visit en route –our progress is recorded with a GPS logging device. The fastest round the task wins!

National and regional gliding competitions last for a week, racing on every day where the weather is suitable. Points gained each day add up over the week to select the winner.

GO GLIDING:

With around 85 sites from the Highlands of Scotland to the south west tip of England, wherever you live you'll never be far from a gliding club. You can find your closest gliding club on the BGA website www.gliding.co.uk

AWESOME FACT: you can fly a glider solo at age 14!

Post experiment activity

Discuss what students saw and why – two key points are that only the warmer liquid rises since it is less dense, and that it does so in a number of 'bubbles'. An obvious equivalent is boiling a kettle where the water around the element heats and rises. The video shows real-life cumulus and timelapse of clouds forming and decaying over Lasham Airfield in Hampshire. **Fun fact:** Lasham Gliding is the biggest gliding club in the world.

Extension task - What else uses these principles?

Elicit from the class other real life examples of convection currents – some examples:

- bubbles in boiling liquids transferring heat to the cooler liquid
- soaring birds also use the thermals to climb to hunt prey and to migrate
- dust devils, willywillies and waterspouts are thermals lifting something as they go and so becoming easily visible
- chimneys and power station cooling towers have smoke or steam rising above them
- sea breezes – where the sun heats the land and air rises, drawing in the colder air from the sea

Students can find out all about gliding at the British Gliding Association website www.gliding.co.uk and the Junior Gliding and Women Gliding communities at the links below. There's information about flying with and without an engine and all types of aviation at https://stem.caa.co.uk/ & www.airleague.co.uk – aviation is not just about being a pilot! The CAA STEM site is particularly good, showcasing the breadth of aviation and associated careers.

We hope you found this useful and a fun way to encourage young people into the world of STEM and aviation. Girls in particular are under-represented in these areas and we are working to change this. Inspire them with videos of our STEM role models along with other exciting gliding-based STEM resources covering various elements of the National Curriculum on gogliding.uk and at www.gliding.co.uk/STEM. You can contact the Go Gliding team at gogliding@gliding.co.uk.

Student notes are shown overleaf.

Clouds and Glider Racing

Do you know about gliding?

Do you know what a glider can do? It's an awesome way to fly, and glider pilots fly hundreds of kilometres at speeds of over 100kph just using renewable energy from the sun and the wind.

Your challenge: to show how convection makes hot air rise and clouds form, and learn how this helps gliders race.

What you need:

- A clear 2l plastic drinks bottle with the top cut off. Use sticky tape to attach a piece of white to the bottle to make a good background to observe what happens
- The smallest jar or bottle you can find and string to make a handle for the small jar long enough to lower it to the bottom of the large bottle
- Hot and cold water and food colouring or ink to colour the 'thermal' so you can observe it

The experiments:

Convection occurs when one part of a gas or liquid heats up. Convection occurs exactly the same way in both **gases** and **liquids** as they are both **fluids**

When a fluid is heated in one area, it expands and becomes less dense. Since it is less dense, it will rise through the other fluid. These experiments show that hot air rises by convection, and look at how that happens. As gases and liquids behave the same way, we can use water to simulate air in our experiment. It's much easier to do the experiment with water!

The small jar will contain be our thermal and the large drinks bottle will be the surrounding air and sky into which our thermal will rise.

We'll do three experiments:

1. Hot water with food colouring or ink in the small jar and cold water in the drinks bottle
2. Warm water in the jar, only slightly warmer than the cold water in the bottle
3. Cold water in the jar and warmer water in the bottle

Q: Why do you think we are doing these three experiments? A:……

Method:

- Make a results table something like this:

Thermal/Small Jar	Surrounding air /Bottle	Observation
Hot	Cold	Write what happens
Warm	Cold	Write what happens
Cold	Warm	Write what happens

- Fill the drinks bottle – our 'sky' - ¾ full with cold water – leave room at the top as we need to leave space for our 'thermal' to fit without spilling any!
- Fill the small jar – our 'thermal' - with hot water and food colour or ink – fill it right to the top
- Note the time and lower the thermal VERY CAREFULLY into the drinks bottle
- Observe what happens over the next minute or two
    - where does the coloured water go?
    - how does the water move – all at once or in separate bubbles? Does it swirl around?
    - does all the water end up the same colour? If so, how long does it take?
- Clean the experimental apparatus
- Repeat with water in the 'thermal' **only very slightly warmer** than the water in the 'sky'
- Repeat with hot water in the 'sky' and cold water in the 'thermal'

Discuss your results with your teacher to be sure you understand how convection caused what you saw happening.

We hope you had fun demonstrating convection and how hot air rises and finding out how we race gliders!
Find out more about GLIDING at the addresses below, and all types of AVIATION at https://stem.caa.co.uk/ & www.airleague.co.uk
We hope to see you on an airfield soon!