

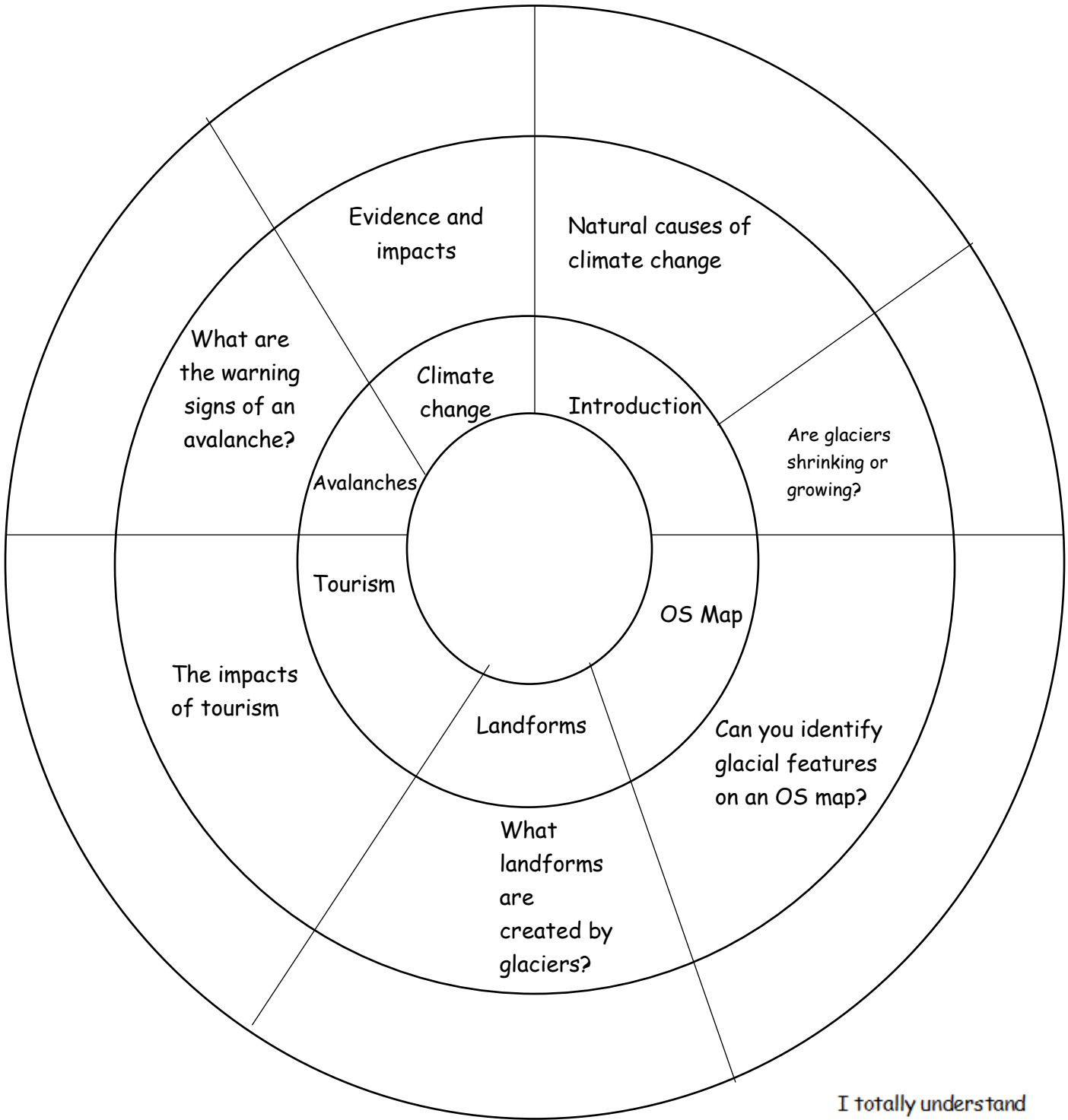
Name: ..... Class: .....

# Year 7, Term 3:



# Glaciation

# What do I already know?



I totally understand

I'm not quite sure

I really don't understand

## Lesson 1: What causes Glaciation?

### Big Picture

		I will...
Learning	Describe some of the natural causes of climate change	
Mastering	Explain the natural causes of climate change and how these could lead to glaciation.	
Extending	Explain the natural causes of climate change and explain in detail how these could lead to glaciation.	

### Do It Now

How much do you already know? Which of the below are True or False?

- At a thickness of four inches ice will support a horse and rider T F
- The thickest ice on earth is 3770m thick T F
- Every year, around a million snow avalanches thunder down Earth's mountains. T F
- The Antarctic ice sheet holds 60% of the world's fresh water. T F
- The coldest recorded place on earth is Canada T F
- Waterfalls can freeze T F
- Glaciers flow T F

Match the key terms to their definitions:

Key Term	Definition
<b>Ice Age</b>	Cooler periods within an ice age.
<b>Glacial Period</b>	Warmer periods within an ice age.
<b>Interglacial Period</b>	The current interglacial period of the current ice age.
<b>Holocene</b>	A period of long-term cooling of the Earth's atmosphere, resulting in the presence and expansion of ice sheets and glaciers.

## New Knowledge

An ice age is a period of long-term reduction in the temperature of Earth's surface and atmosphere, resulting in the presence or expansion of continental and polar ice sheets and alpine glaciers.

Within a long-term ice age, individual pulses of cold climate are termed glacial periods. Intermittent warm periods are called interglacials.

Ice age implies the presence of extensive ice sheets in the northern and southern hemispheres. By this definition, we are in an interglacial period—the Holocene—of the ice age that began 2.6 million years ago because the Greenland, Arctic, and Antarctic ice sheets still exist.

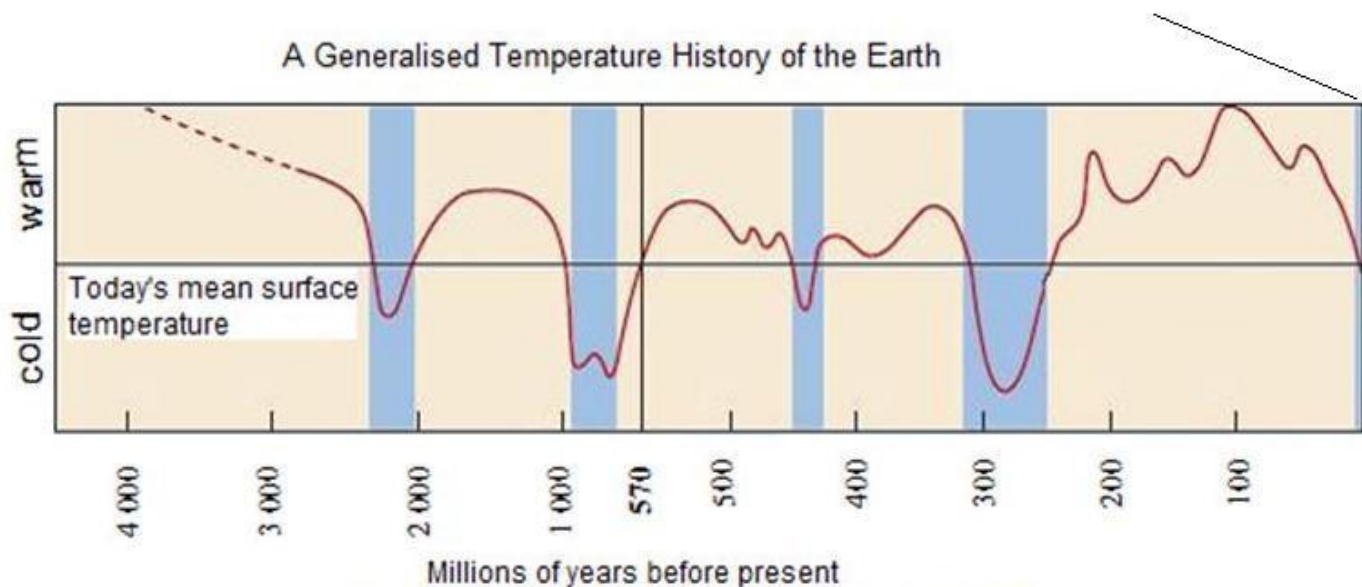


Figure. 1. Adapted from <http://openlearn.open.ac.uk/mod/resource/view.php?id=171497>. Temperature not to scale

What do you think this graph is showing?

.....

.....

## Pen to Paper

There are a range of natural and human reasons that cause the climate to change and become either hotter or colder. In terms of glaciation, we must focus on the natural causes:

- Orbital Changes
- Sunspot Activity
- Volcanic Activity

Watch this [video](#) and then fill in the details below.

	What is it? Describe it.	How does it affect temperatures? Explain it.
Orbital Changes		
Sunspot Activity		
Volcanic Activity		

## Reflection

There are several causes of climate change and all of these could lead to glaciation in some way.

The first cause that I would like to explain is .....

This is when .....

.....

This could lead to glaciation because .....

.....

Another cause of glaciation is.....

This is when .....

.....

This could lead to glaciation because .....

.....

One final cause of glaciation is.....

This is when .....

.....

This could lead to glaciation because .....

.....

Remember to use some evidence/examples to be mastering and detailed evidence/examples to be extending. Use the key words on the resources to help you with spellings.

## Lesson 2: Are Glaciers Growing or Shrinking?

### Big Picture

		I will...
Learning	Suggest ways in which we can calculate whether a glacier is expanding or shrinking.	
Mastering	Explain how data allows us to calculate whether a glacier is expanding or shrinking.	
Extending	Explain whether a specific glacier is expanding or shrinking.	

### Do It Now

1. What is the source in a river?

.....

2. What has caused population to change in the UK?

.....

3. What is an example of a human cause of flooding?

.....

4. Name one advantage of a flood management technique.

.....

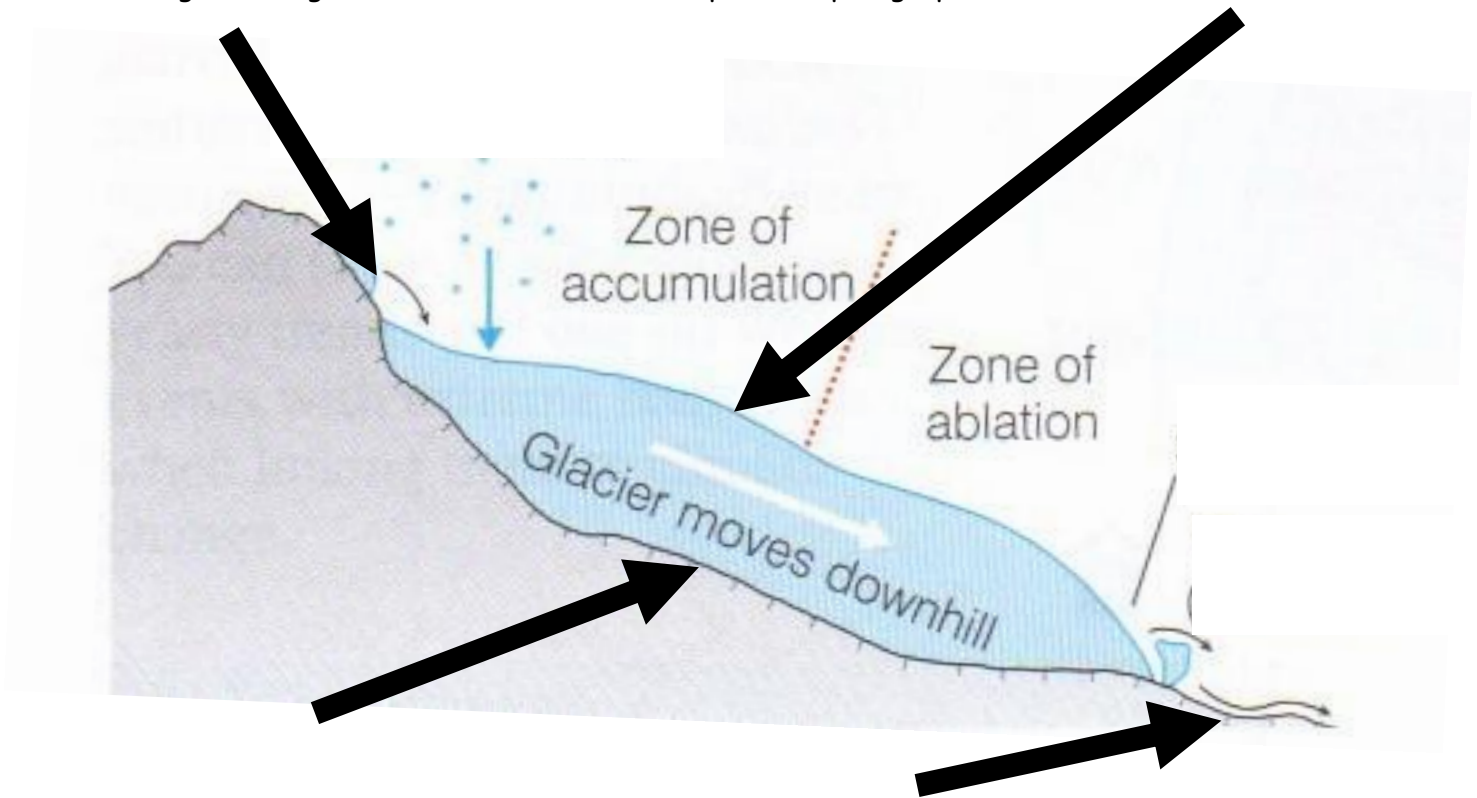
5. Name one factor that affects glaciation.

.....

### New Knowledge & Pen to Paper: [Read this detail from the BBC first.](#)

The glacier system consists of inputs, transfers (flows), stores and outputs in the same way as a river. **Inputs** come from avalanches along the sides of the glacier but mainly from precipitation as snow. Over time **snow accumulates and is compressed** into ice. The water held in storage is the glacier. Under the force of gravity, **the glacier flows downhill**. Melt water is the main **output** from the glacier, along with some evaporation.

Label the diagram using the words in bold from the previous paragraph.



Using the key terms in the box below, enter the words in the gaps.

The balance between inputs and outputs varies. In the winter, inputs usually exceed outputs near to the head of a glacier, this is called: ..... In the summer and at lower altitudes, outputs will exceed inputs, this is called: ..... The balance between the annual rate of accumulation and ablation determines whether the glacier will ..... or ..... Today, most of the world's remaining glaciers are .....

Accumulation	Grow	Shrinking
Ablation	Retreat	



[Watch this about glacier budgets first.](#)

Glaciers accumulate ice in the winter as temperatures are low and snowfall stays frozen. In the summer, temperatures are higher. The ice melts and the glacier shrinks. The loss of water from the glacier is known as ablation.

Complete the budget calculations by subtracting the summer loss of ice from the winter gain in ice.

Year	Winter accumulation (metres of water equivalent)	Summer ablation (metres of water equivalent)	Net Glacial Budget (metres of water equivalent)
1995	2.86	3.55	-0.69
1996	2.94	2.84	
1997	3.71	3.08	
1998	2.76	4.62	
1999	3.59	2.57	
2000	3.32	2.94	
2001	1.9	3.47	
2002	4.02	3.47	
2003	2.66	4.76	
2004	2.08	3.73	
2005	1.97	4.42	
TOTAL NET GLACIAL BUDGET OVER 10 YEARS			

For total net - add up all of the numbers you have just written down!

## Reflection

I worked out that the glacier above is .....

This is because .....

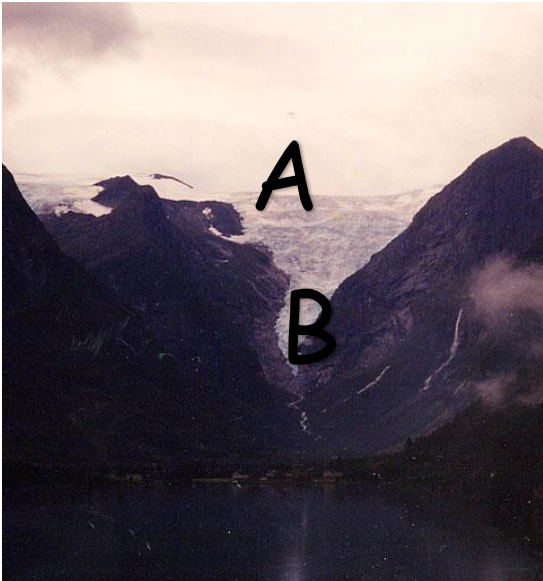
One of the reasons for this could be .....

## Lesson 3: Are Glaciers Growing or Shrinking?

### Big Picture

		I will...
Learning	Suggest ways in which we can calculate whether a glacier is expanding or shrinking.	
Mastering	Explain how data allows us to calculate whether a glacier is expanding or shrinking.	
Extending	Explain whether a specific glacier is expanding or shrinking.	

### Do It Now



Where can you find accumulation and where can you find ablation?

A =

B =

## New Knowledge

Try to answer the following questions:

Which year had the most accumulation?

.....  
 .....

Which year had the most ablation?

.....  
 .....

Which year did the glacier shrink the most?

.....  
 .....

How many years did the glacier actually grow?  
 Name the years.

.....  
 .....

Would you describe this glacier as being in negative or positive budget?

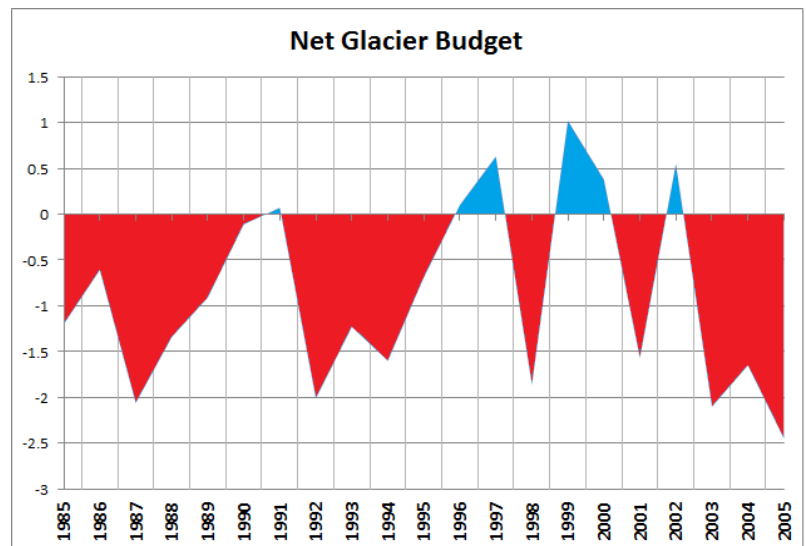
.....  
 .....

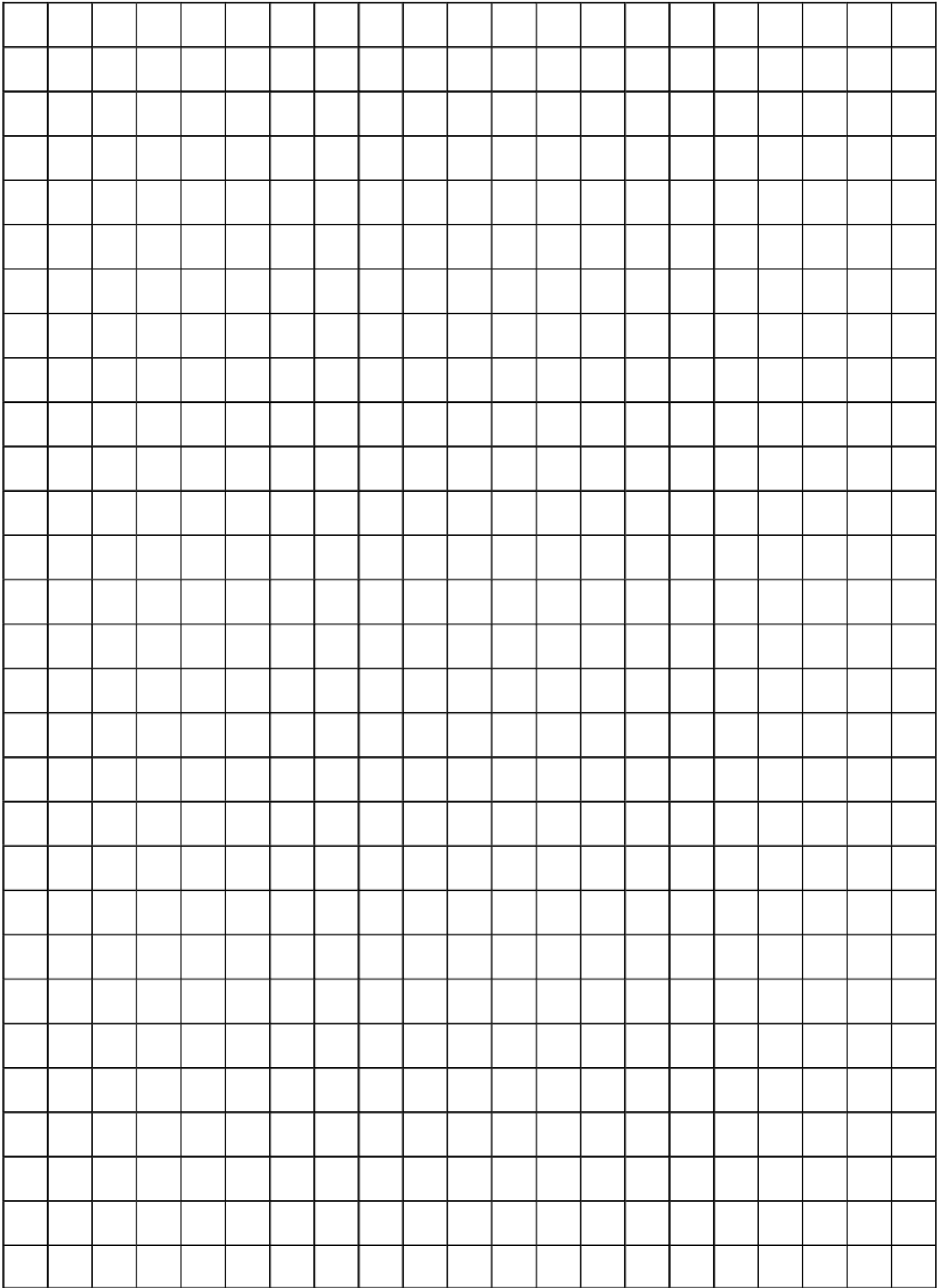
	Winter (Metres of water equivalent)	Summer (Metres of water equivalent)	Net Glacier Budget (Metres of water equivalent)
1985	2.18	-3.38	-1.2
1986	2.45	-3.06	-0.61
1987	2.04	-4.1	-2.06
1988	2.44	-3.78	-1.34
1989	2.43	-3.34	-0.91
1990	2.6	-2.71	-0.11
1991	3.54	-3.47	0.07
1992	1.91	-3.92	-2.01
1993	1.98	-3.21	-1.23
1994	2.39	-3.99	-1.6
1995	2.86	-3.55	-0.69
1996	2.94	-2.84	0.1
1997	3.71	-3.08	0.63
1998	2.76	-4.62	-1.86
1999	3.59	-2.57	1.02
2000	3.32	-2.94	0.38
2001	1.9	-3.47	-1.57
2002	4.02	-3.47	0.55
2003	2.66	-4.76	-2.1
2004	2.08	-3.73	-1.65
2005	1.97	-4.42	-2.45

Using the graph paper on the next page, create a graph which shows the shrinking and growing of the glacier above.

*Hint: Turn the page landscape as this will give you a better graph.*

*Example:*





## Pen to Paper

The glacial system describes the way in which water (as ice) is added to and lost from a glacier.

Precipitation, normally in the form of snow is classed as an i..... to the system. If

it is cold enough then this will stay frozen and lead to the glacier getting bigger. This process is known

as a.....

In the summer the ice in the glacier melts and is lost from the system. This is an

o..... . This process is known as a.....

The overall difference between the accumulation and ablation within in a year is known as the

g..... b.....

If the accumulation in a year is higher than the ablation, the glacier will e..... .

This is known as a year in which the glacial budget is p.....

If the ablation in a year is higher than the accumulation, the glacier will s.....

This is known as a year in which the glacial budget is n.....

## Reflection

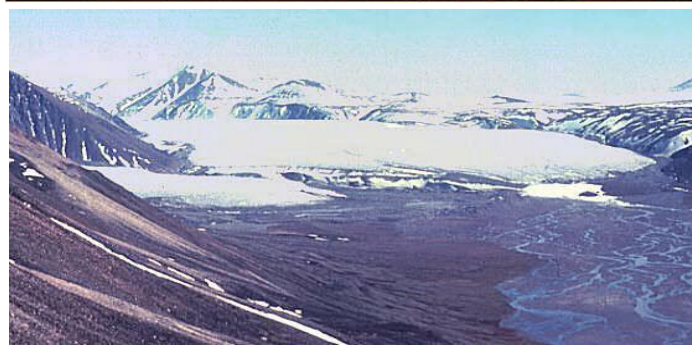


## Lesson 4: How do Glaciers Shape Our Landscape?

### Big Picture

		I will...
Learning	Identify the different landforms created by erosion.	
Mastering	Describe the different landforms created by erosion.	
Extending	Explain using key words the different landforms created by erosion.	

### Do It Now



Name 3 similarities and 3 differences between the pictures above.

Similarities	Differences

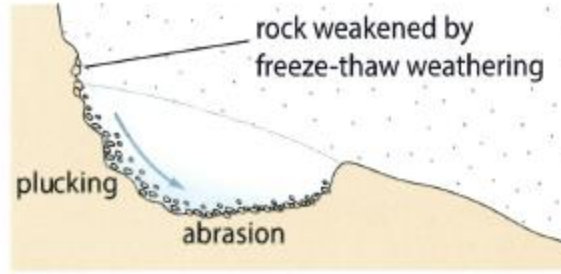
New Knowledge & Pen to Paper: [Watch this video first](#) and then read below.

## Corrie

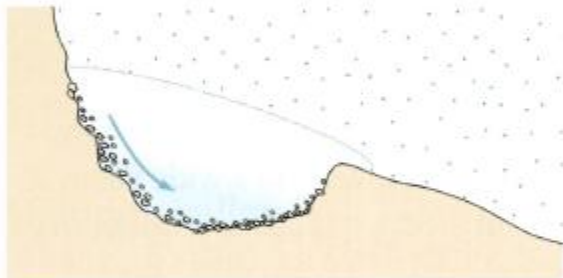
A **corrie** begins as a sheltered hollow, where snow builds up year after year.



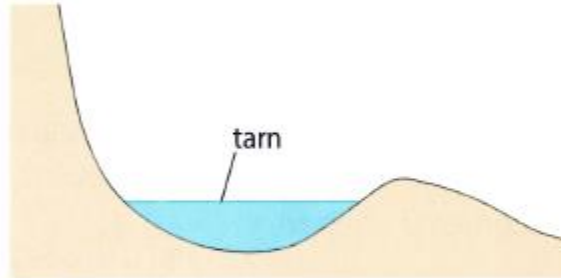
**1** The snow compacts to ice. When the ice is thick enough, it starts to flow. Now it's a glacier! First it flows within the hollow.



**2** Through plucking and abrasion, the hollow grows deeper, and the walls steeper. Freeze-thaw weathering helps.

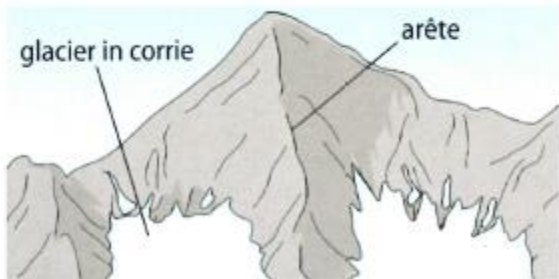


**3** Eventually the glacier is big enough to flow over the edge of the corrie. It's off on its journey down the mountain.



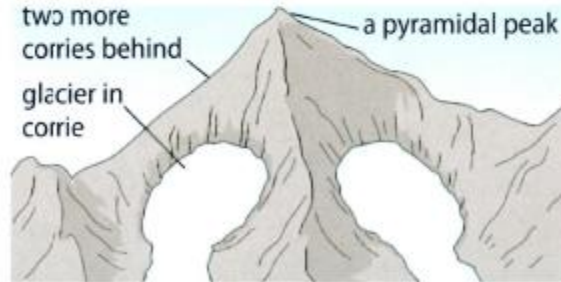
**4** Later, when the glacier melts, the corrie is revealed. It may have a lake in it. These corrie lakes are often called **tarns**.

## Arête



Sometimes two corries form side by side. The glaciers erode the rock between them, leaving a sharp ridge of rock. It is called an **arête**.

## Pyramidal peak



Imagine three or four corries around a mountain top. The glaciers erode their back walls, cutting into the mountain top. It becomes a **pyramidal peak**.

Using the storyboard on the next page, explain how corries are formed using your own diagrams and words. Then, choose either an Arête or a Pyramidal Peak to finish off your story.

Blank writing area with a vertical line on the left and a small square box at the top left.

Blank writing area with a vertical line on the left and a small square box at the top left.

Blank writing area with a vertical line on the left and a small square box at the top left.

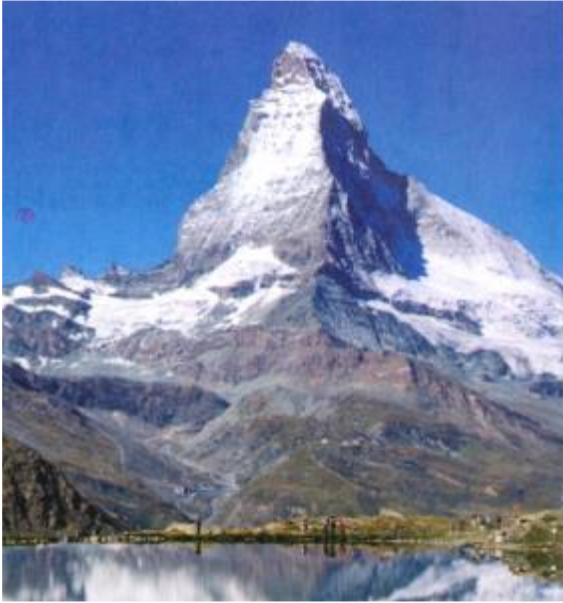
Blank writing area with a vertical line on the left and a small square box at the top left.

Blank writing area with a vertical line on the left and a small square box at the top left.

Blank writing area with a vertical line on the left and a small square box at the top left.



## Reflection



Imagine you are stood at the bottom of this Pyramidal Peak in the Alps. Look around, what do you see? How do you feel? Describe the scene around you!

.....

.....

.....

.....

.....

.....

## Lesson 5: How do Glaciers Shape Our Landscape?

### Big Picture

		I will...
Learning	Describe the how glaciers deposit material	
Mastering	Explain how landforms are created by deposition	
Extending	Evaluate how the different types of landforms are created	

### Do It Now

#### Knowledge Quiz

1. What does OS stand for?

.....

2. What is the difference between latitude and longitude?

.....

3. In which county is Sittingbourne?

.....

4. Which place is more urbanised, Kent or London?

.....

5. What is a 4 figure grid reference?

.....

6. Name one factor that affects glaciation.

.....

7. What does accumulation mean?

.....

8. What does ablation mean?

.....

9. How can you tell whether a glacier is growing or shrinking?

.....

10. Which force moves a glacier downhill?

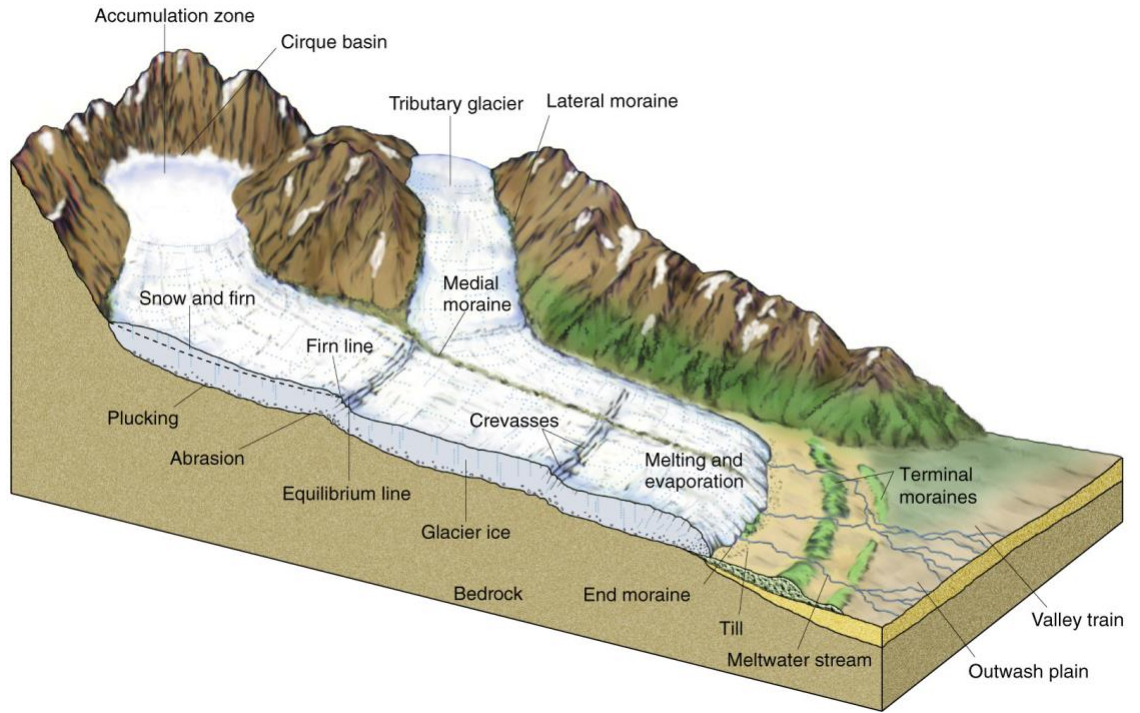
.....

**New Knowledge & Pen to Paper: [Watch this clip](#) before attempting the tasks**

Moraine is a type of landform that is created when a glacier deposits the material (till) that it has been transporting. It is made up of unsorted angular rocks. There are three main types of moraine:

1. Lateral
2. Medial
3. Terminal

Highlight the three moraine labels on the diagram.



Use the key terms in

the boxes below to

help describe the different types of moraines.

L..... moraines form at the side edges of the glacier.

M..... moraines form when two glaciers meet and lateral moraines combine. They are a..... the valley.

T..... moraines mark the maximum extent (end) of the glacier. R..... moraines mark stages of retreat.

Recessional	Along	Medial	Lateral	Terminal
-------------	-------	--------	---------	----------

Close up: Lateral, Medial or Terminal Moraine? Write next to each one what it is, with an explanation why.



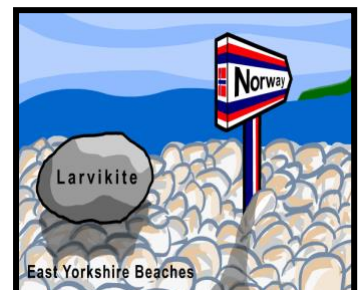
Arial view: Lateral, Medial or Terminal Moraine? Write next to each one what it is, with an explanation why.



- 1. ....
- 2. ....
- 3. ....

Erratics

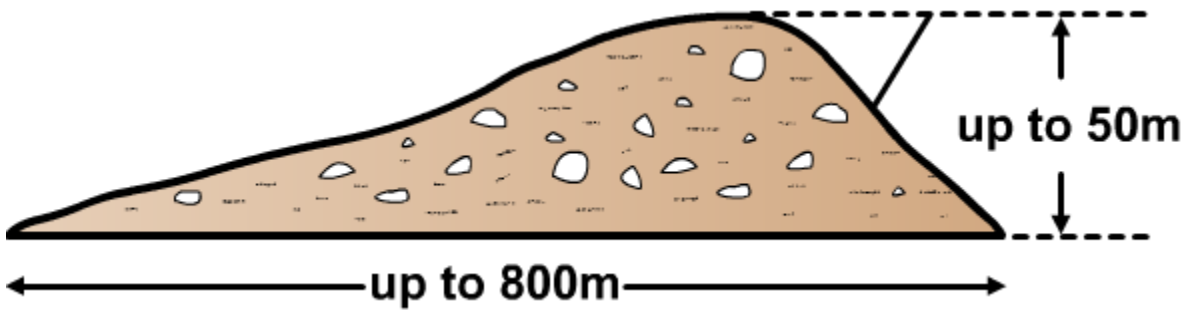
An erratic is a b..... that is d..... to the bedrock upon which it is sitting. They have been t..... and deposited by a glacier. Therefore e..... are useful indicators of patterns of former ice flow.



Drumlins

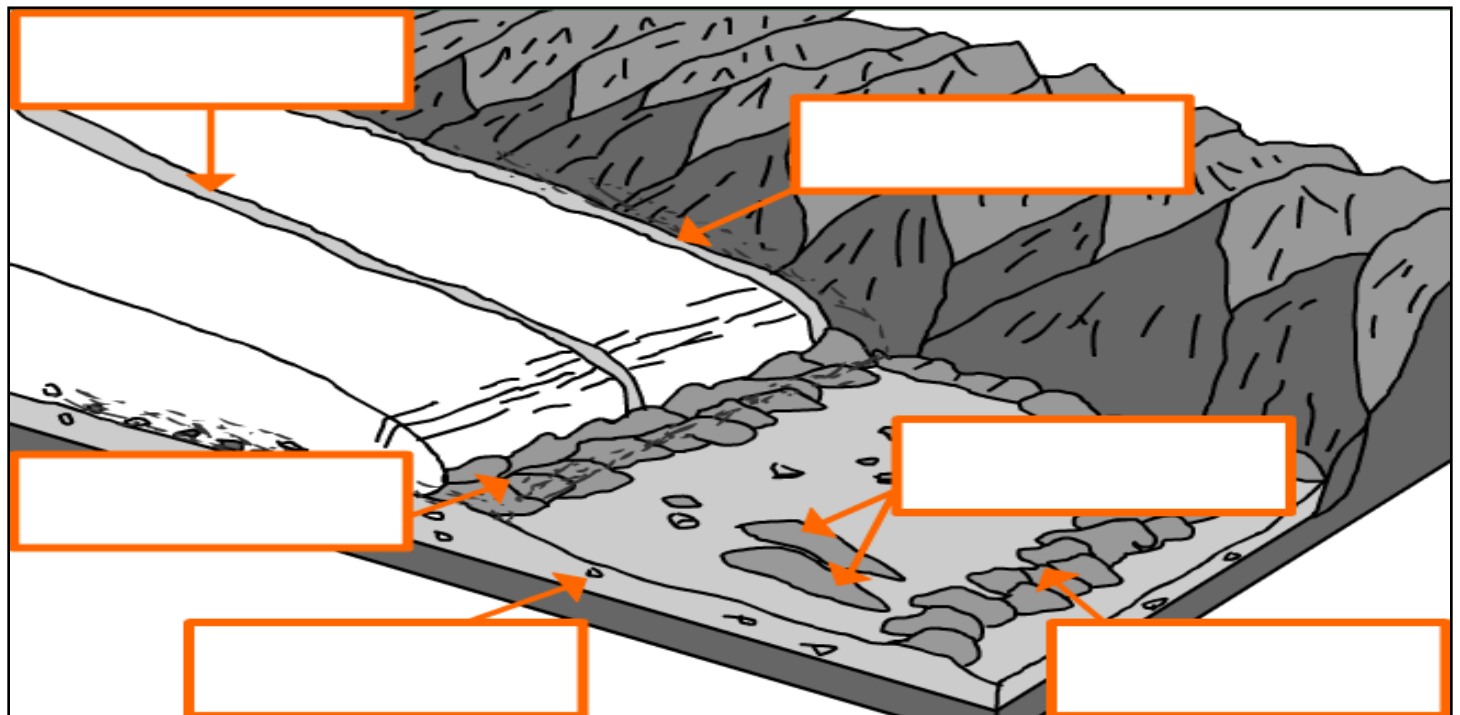
D..... are formed of till. They are elongated features that can reach a k..... or more in length, 500m or so in width and over 50m in height. It is common to find several drumlins grouped together. A collection of drumlins is called a s.....

Boulder	Erratics	Drumlins	Kilometer
Different	Taken	Swarm	



**Reflection**

Label the diagram with: Drumlin, Lateral moraine, Medial moraine, Terminal moraine, Recessional moraine, Erratics

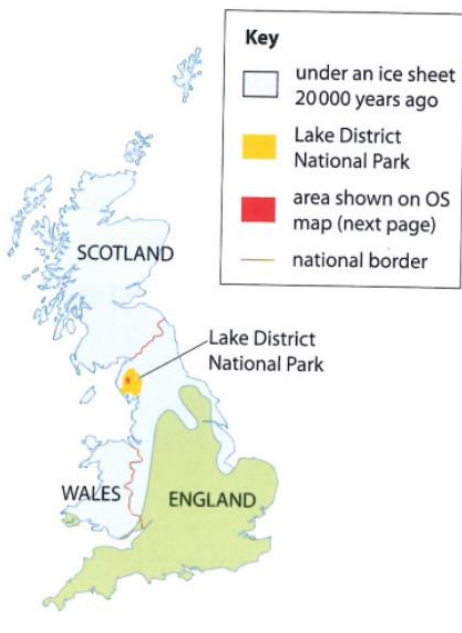


# Lesson 6: How do We Know Where Glaciers Once Were?

## Big Picture

		I will...
Learning	Identify glacial features on a map	
Mastering	Explain how maps can show glacial activity	
Extending	Analyse a map to interpret glacial features	

## Do It Now



How would you describe this map to someone who couldn't see it?

.....

.....

.....

.....

.....

.....

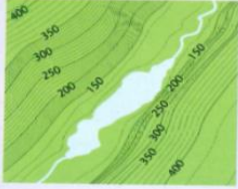
## New Knowledge

20,000 years ago, during the last ice age, all of Wales, Scotland and some of England was under an ice sheet. As temperatures fell...

- Glaciers formed on the highest land first, since it was coldest, with most snow.
- They flowed down the valleys to the low land, where they all fused together. The ice spread.
- Eventually, it became part of the ice sheet that covered much of northern Europe.
- Then Earth began to warm up again and the glaciers melted away.

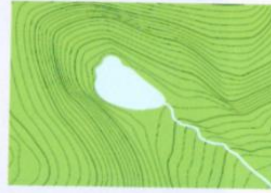
This is how we can tell a glacial feature from looking at an OS map.

### U-shaped valley



- 1 The sides of the valley are steep, so the contour lines are close together.
- 2 But the bottom of the valley is quite flat, so the contour lines are far apart.
- 3 There may be a ribbon lake in the valley – as here – or a misfit river.

### Corrie



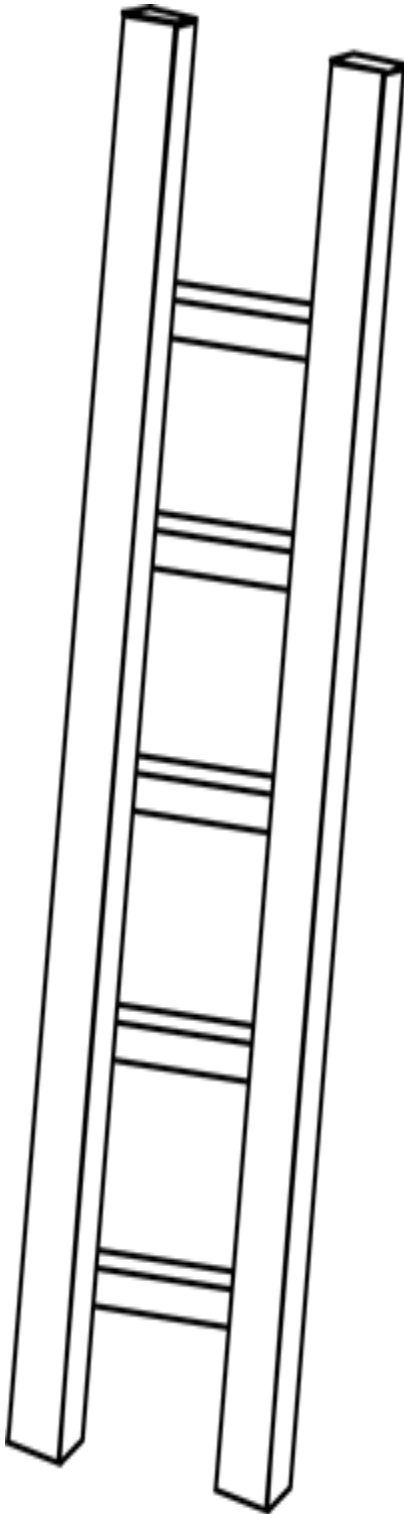
- 1 A corrie is rounded, so the contour lines are curved, a bit like a horseshoe.
- 2 Its sides are steep, so the contour lines are close together.
- 3 It may have a lake in it – which may be labelled 'tarn' on the map.





## Pen to Paper

Using the OS map on the previous page, answer the following questions. Work your way from the bottom of the ladder to the top.



There is a tarn in square 1615. What is its name and what kind of landform is it sitting in?

.....  
.....

Find Kaskadale Beck on the OS map. What do you think a beck is?

.....  
.....

Which lake is deeper, Crummock Water or Buttermere? How can you tell?

.....

How long is Crummock Water in km? The scale is 1cm: 5km. Show your working.

.....  
.....  
.....

The map shows three lakes and part of a fourth. What are their names?

.....

U-shaped valleys are a sign that an area was once glaciated. Find one on the map and give the four-figure grid reference.

.....

## Lesson 7: How Different Are Antarctica and the Arctic?

### Big Picture

		I will...
Learning	Describe some similarities and differences between Antarctica and the Arctic	
Mastering	Explain why Antarctica and the Arctic are cold	
Extending	Explain why Antarctica is colder than the Arctic	

### Do It Now

Watch the YouTube video: [www.youtube.com/watch?v=Z5VRoGTF60s](http://www.youtube.com/watch?v=Z5VRoGTF60s)

Write down 3 things you learn from the first three minutes of the video.

1. ....
2. ....
3. ....

## New Knowledge

Read this [link](#) and then fill in the chart below with the facts that you find and the difference between them.

	Antarctica	The Arctic	The Difference
People			
Temperatures			
Animals			
Ice			

## Pen to Paper

Some similarities between the Arctic and Antarctica are.....

.....

.....

Some differences between the Arctic and Antarctica are.....

.....

.....

Overall, I think they are more similar / different because.....

.....

.....

### Challenge:

Use the key terms in the box below to explain why Antarctica is colder than The Arctic.

Light from the ..... brings heat to the surface of the earth. At the equator the ..... hits a small area of land. This means the heat is ..... over a small area and therefore there is ..... heat reaching each bit of land. This makes it.....

At the ..... the heat hits a ..... area of land. This means the heat is shared over a much larger area and therefore there is ..... heat reaching each bit of land. This makes the poles ..... than the equator.

Sun	Shared	Warmer	Larger	Colder
Heat	More	Poles	Less	

## Reflection

The most surprising thing I have learnt is.....

The most important thing I have learnt is.....

What I would like to find out is.....

## Lesson 8: How can Glaciers Promote Tourism?

### Big Picture

		I will...
Learning	Describe the effects of tourism and a viewpoint on a potential development	
Mastering	Explain positive and negative effects of tourism and opposing viewpoints on a potential development	
Extending	Explain in detail positive and negative effects of tourism and persuade people using opposing viewpoints on a potential development	

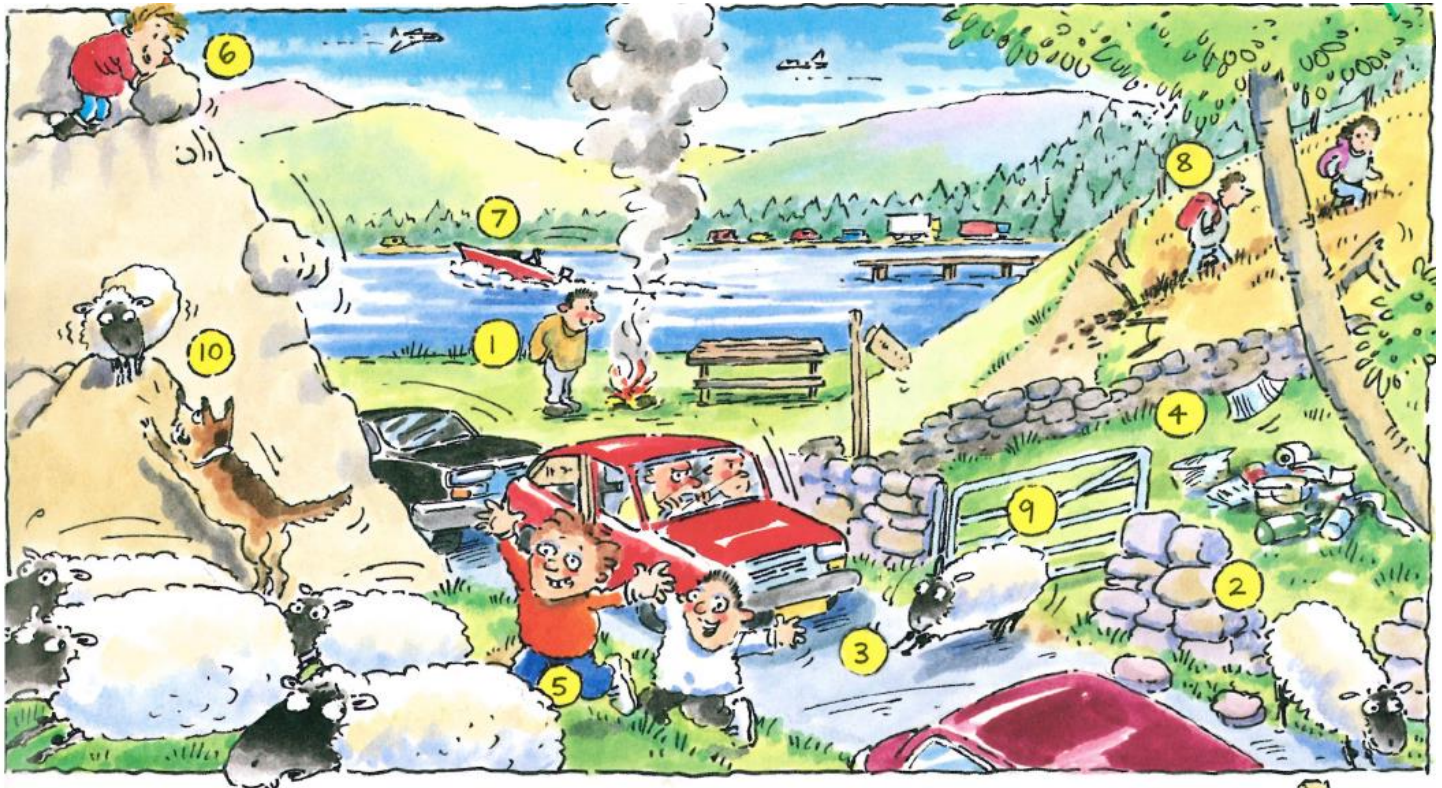


### Do It Now

Name the different glacial features you can see in these pictures of the Lake District.

1. ....
2. ....
3. ....
4. ....
5. ....

**New Knowledge:** The amazing glacial features in the Lake District make it a perfect honey pot site for tourists. Lake District National Park is in Cumbria, North West England. It gets 12 million tourists each year but only 42,239 residents live there.



Study the picture and look at the impacts tourism is having on the environment.

Number	What is it showing?	Why is this a negative impact?
1		
2		
3		
4		
5		

6		
7		
8		
9		
10		

## Pen to Paper

A planning application has been sent to the Cumbrian council applying to build a big super modern hotel right in the middle of the Lake District!

You are going to be attending the council meeting to discuss the building of this new hotel. Your job is to write a balanced report, to present to the council that takes into account a range of stakeholder's views. You should reach an overall decision at the end.

<b>Learning</b>	<b>Mastering</b>	<b>Extending</b>
Describe your characters views on the proposed new hotel.	Explain your characters views on the proposed new hotel and explain why someone might disagree with your character.	Explain your characters views on the proposed new hotel and explain why someone might disagree with your character. Use persuasive language to try and convince them that your point of view is the correct one.

.....  
.....  
.....

Date: .....

Town Council  
Lake District  
North West England  
United Kingdom

Dear Town Councilor,

I am writing to you because .....

I am a ..... and I think that .....

I think there will be benefits to the new hotel. For example, .....

This means that .....

However, I think there will be problems to the new hotel. For example, .....

This means that .....



Overall, I think that .....

Thank you for reading my letter.

Yours sincerely,

## Reflection

Ask the person next to you to look at your letter and fill in the grid below:

Well done, you have...	To do even better, you could...	To meet all the success criteria, use something like...

## Lesson 9: Avalanches!

### Big Picture

		I will...
Learning	Define what an avalanche is	
Mastering	Describe the different types of avalanche	
Extending	Explain how avalanches occur and what the triggers are	

### Do It Now

1. What does OS stand for?

.....

2. What is the difference between latitude and longitude?

.....

3. What is a 4 figure grid reference?

.....

4. What is the capital city of the UK?

.....

5. Name one factor that affects glaciation.

.....

6. What does ablation mean?

.....

7. How can you tell whether a glacier is growing or shrinking?

.....

8. Which force moves a glacier downhill?

.....

9. Name a type of moraine.

.....

10. Describe the type of moraine you have named above.

.....

11. What does 'erosion' mean?

.....

12. Explain one difference between Antarctica and the Arctic

.....

# New Knowledge & Pen to Paper



## Definition

An avalanche is a sudden and often rapid mass movement of snow and ice down a mountainside.

## Types of Avalanche

### Slab Avalanches:

These avalanches involve large blocks of snow fracturing away from the main plain of the mountainside. They often come about due to high winds, which can force their way between the upper and lower levels of the slab. Of the annual fatalities caused by avalanches, ninety percent of them occur as a result of this type.



### Powder Snow Avalanches:

When snow is very dry, these types of avalanche occur. The top layers of the snowpack mix with moving air and a cloud of snow can make its way very quickly (sometimes more than 300 km/hr) down a hillside. The speed of this type of avalanche is such that it can even cross valley floors and start travelling uphill on the opposite side. Though these are rare, up to ten million tonnes of snow can move in any one of these avalanche events.



### Wet Snow Avalanches:

This type of avalanche occurs when the base of the snowpack become wet and a slip plain is made over which some snow slides as a mass while drier, more powdery snow on top forms a cloud which is similar to powder snow avalanches. These travel at slower speeds (around 60 km/hr) but are still highly destructive as they tend to move over a wider area.



## Avalanche Processes

### Snowpacks

A snowpack is a series of parallel layers of snow that build up over time. These layers become hardened and compacted by ongoing cycles of thawing and freezing. If there is any disruption to this cycle however then the snowpack is vulnerable to avalanche movement.

Each snow fall will have a different set of characteristics such as the size of the snow crystals, and their moisture content. Therefore if snow with a large and weak crystal structure falls onto of a layer that is more cohesive, the slope becomes more vulnerable to avalanches.

### Slopes

The gradient of the mountainside is a critical factor in the ability of avalanches to form. The critical slope angle at which most snow will start to move is 38° but many also occur between 25° and 60°. This gradient is shallow enough for snowpacks to build but also steep enough for gravity to act on the snowpack too.

More avalanches tend to occur on the lee ward (facing away from the prevailing wind) side of mountains as there is likely to be a greater accumulation of snow there.

### Pathways

Avalanches will commonly taken the already established paths of streams or rivers, taking rocks, trees and ice blocks with them. This creates what is known as a 'trim line': a visible break in the vegetation cover signifying the path of avalanches in the area.

### Weather

Prevailing weather can create favourable or unfavourable avalanche conditions. Intense bursts of wind and rain can dislodge snowpacks as well as move extra snow weight to more unstable areas. Sunlight radiation can warm areas of snow and turn them into slip plains.

## What triggers an avalanche?

At its most basic level an avalanche occurs when the load that the mountain is holding exceeds its ability to hold it up. However, while the conditions may be right for an avalanche to occur, a single event or trigger is usually needed to kick start the process. For example:

- A sudden increase in snowfall
- Skiers stepping onto fragile snowpacks
- Animals digging through the snowpacks
- Snow vehicles causing vibrations
- Earthquakes or tremors

Create a leaflet for tourists to a Ski Resort on Avalanches. Use the success criteria below to help you:

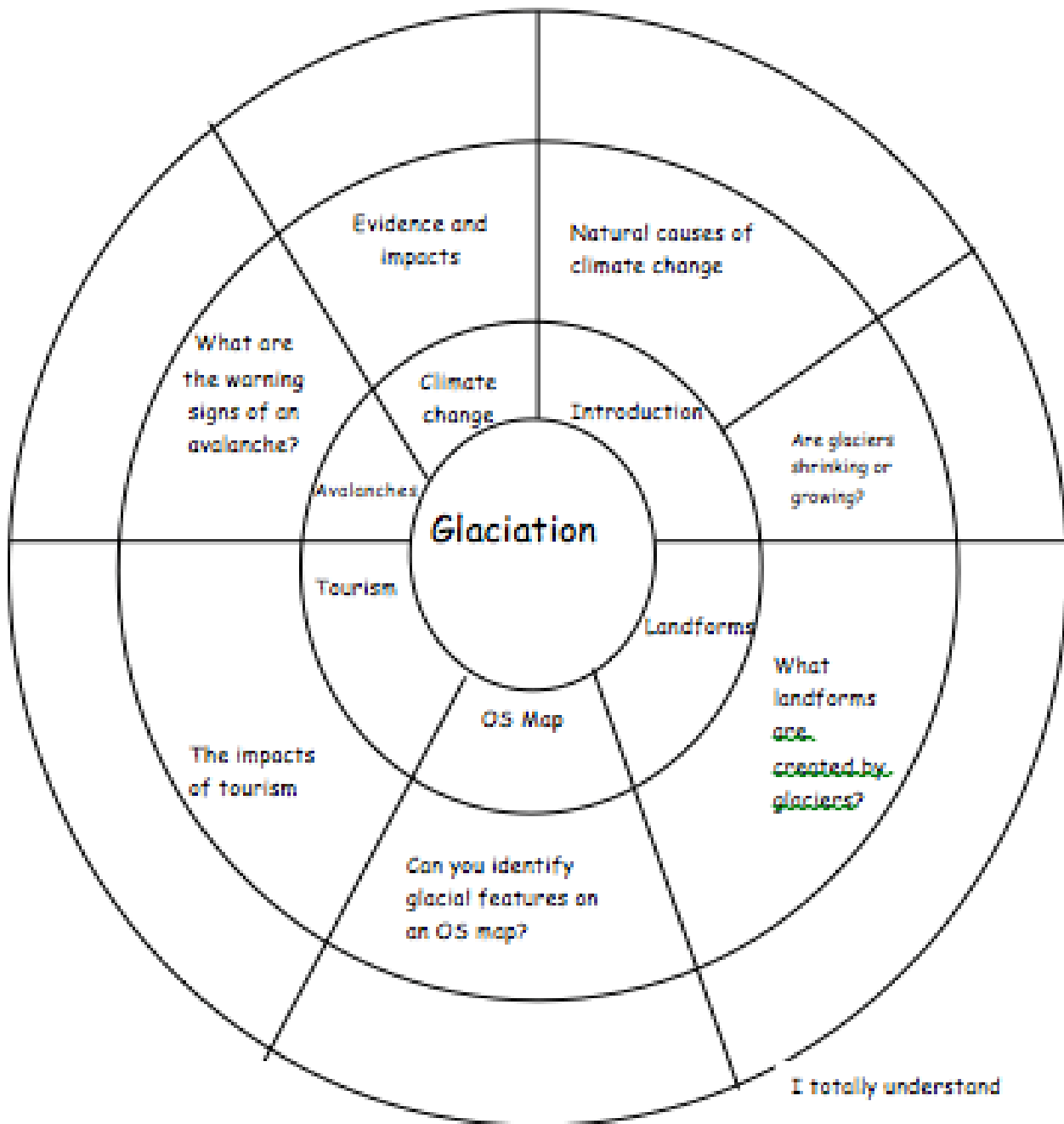
<b>Learning</b>	<b>Mastering</b>	<b>Extending</b>
Defines and describes an avalanche, with a diagram.	Describes the different types of avalanche and how they are formed, with diagrams.	Explains how avalanches occur and what their triggers are, using diagrams,

## Reflection

Ask the person next to you to look at your leaflet and fill in the grid below:

Well done, you have...	To do even better, you could...	To meet all the success criteria, use something like...
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## What do I already know?



I really don't understand

4