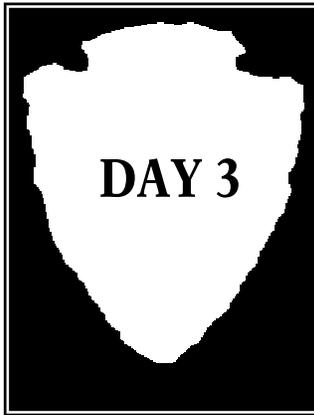


GLACIERS WEBQUEST

OBJECTIVE	Students will learn key glacier concepts in a webquest using the <i>Views of the National Parks</i> multimedia education program.
GRADES	Middle or High School students
DURATION	1 50-minute class period
PROCEDURE	Student will spend an entire class period working independently or in small groups to complete the <i>Glaciers</i> webquest.
MATERIALS	<ul style="list-style-type: none">▪ Copies of the <i>Glaciers</i> webquest for each student▪ Computers for each student or pair of students
KEY CONCEPTS	What makes a glacier a glacier; where glaciers are found and why; types of glaciers; glacial movement; key glacier terms
KEY TERMS	Ablation, ablation zone, abrasion, accumulation, accumulation zone, bed, equilibrium line, firn, firn line, plucking, terminus



GLACIERS WEBQUEST

NATIONAL EDUCATION STANDARDS:

Science:

NS.5-8.4 Earth and Space Science

- Structure of the earth system

NS.5-8.6 Personal and Social Perspectives

- Populations, resources, and environments

NS.9-12.1 Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

NS.9-12.4 Earth and Space Science

- Geochemical cycles

NS.9-12.6 Personal and Social Perspectives

- Natural resources

NS.9-12.7 History and Nature of Science

- Nature of scientific knowledge
-

Technology:

NT.K-12.2 Social, Ethical and Human Issues

- Students practice responsible use of technology systems, information, and software.

NT.K-12.3 Technology Productivity Tools

- Students use technology to enhance learning, increase productivity

GLACIERS

To compliment the NPS Views Glaciers Knowledge Center

Photo By Rose Krueger

Enter the knowledge center by clicking on: **Explore Glaciers**, and then follow the directions to navigate through the **Introduction** section.

What Glaciers Are

Click on : What glaciers are

What are the 3 main criteria for being a glacier?

1. _____
2. _____
3. _____

Click on : Made of Ice

List the 2 features of ice crystals that are significant to glaciers, and then click on each topic to complete the questions below:



1. _____

Complete the following sentence:

Ice crystals are _____ and as a result they
can _____ under their own weight.

2. _____

Describe the density of water:

Click on : Form on Land

Is the following sentence true or false? Circle one: TRUE FALSE

All glaciers must form on land, but can later move out to sea.

Click on : Glaciers move

What are 2 ways that glaciers move?

1. _____



Remember: Ice crystals are weak, allowing glaciers to buckle and deform under their own weight.

2. _____



Tip: Think of a slip-n-slide!

Glossary

Select the glossary link at the bottom right portion of the screen to define the following terms.

Define: ***Plucking***

Define: ***Abrasion***

Where Glaciers Are Found

Click on : Precipitation

Read the text and circle which factor is more important than the other:

Kind of precipitation vs. Total annual precipitation

Amount of snow vs. Conservation of snow

Click on : Temperature

What is the most significant heat source that a glacier receives?

Click on : Relief

Complete the following sentence:

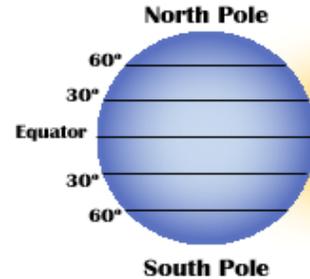
_____ exerts a
powerful influence over glaciation.



Click on : Latitude

Complete the following sentence:

High latitudes receive _____
annual solar radiation and experience
prolonged _____
at sub-zero temperatures.

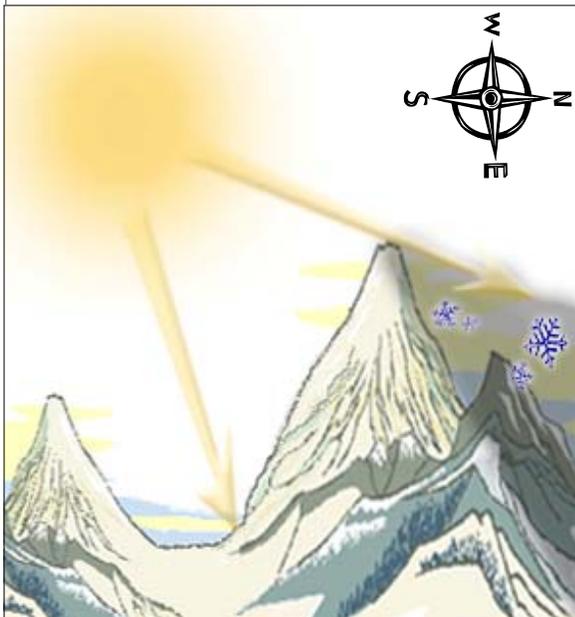


Click on : Altitude

Where are glaciers found at the South Pole? _____

Where are glaciers found at mid to low latitudes? _____

Click on : Aspect



The orientation of the ground surface with respect to incoming solar radiation is important to the existence of glaciers.

In the Northern Hemisphere, which slopes receive the least direct solar radiation?

Types of Glaciers

Click on : Types of Glaciers

How are glaciers most easily differentiated (how best do you tell them apart)?

_____ and _____

Click on : Ice Sheets

Ice sheets and ice caps fall into the same category. Which one is larger?

What are the 2 main components of ice sheets and ice caps?



- 1.
- 2.

Click on : Ice Shelf

Describe an ice shelf:

Is the following sentence true or false? Circle one: TRUE FALSE

*If a glacier is considered to be an ice shelf then
it is no longer attached to land.*

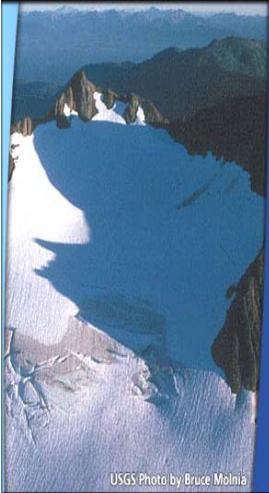
Click on : Icefield

The surface of an icefield is approximately: _____

Click on : Valley Glacier

Where might a valley glacier originate?

_____ or _____



Click on : *Cirque Glacier*

Complete the following sentence describing a cirque glacier:

A small ice mass generally _____ in relation to its _____.

What characteristic shape does a cirque glacier occupy?

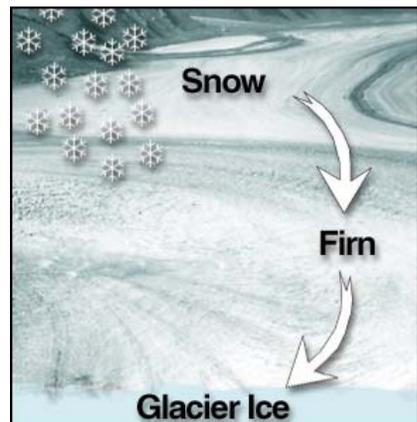
Glossary

Select the glossary link at the bottom right portion of the screen to define the following terms.

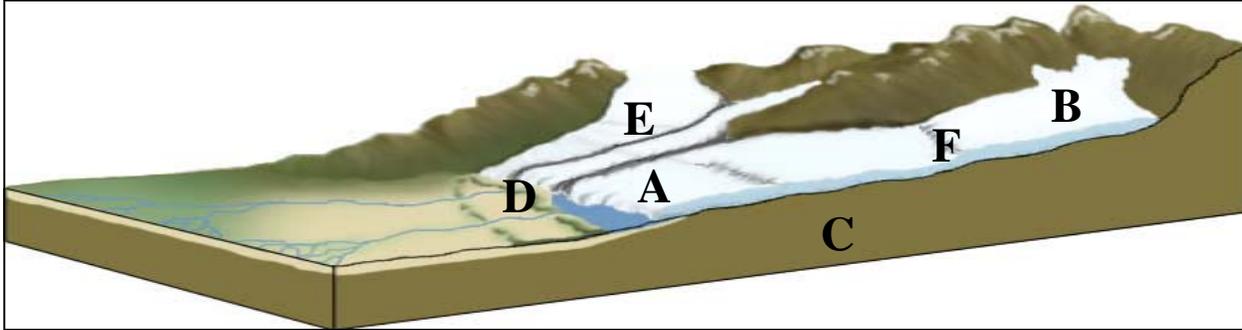
Define: *Accumulation*

Define: *Ablation*

Define: *Firn*



Parts of a Glacier



Click on : Parts of a Glacier

Match the following terms with their definitions below:

- | | |
|----------------------|---------------------|
| A. Ablation Zone | D. Terminus |
| B. Accumulation Zone | E. Firn Line |
| C. Bed | F. Equilibrium Line |

- This is not part of a glacier, but directly interacts with the glacier.
- This is the highest level to which winter snow cover retreats on a glacier.
- This is the part of the glacier's surface over which ablation (wastage) exceeds accumulation each year.
- The part of a glacier's surface over which more snow is deposited than ablated each year.
- The boundary between areas of gain and loss on a glacier's surface during one year. This is where accumulation meets ablation, and the net balance of snow is zero.
- The end or lowest part of a glacier.



GLACIERS WEBQUEST

ANSWER KEY

GLACIERS—Answer Key

To compliment the NPS Views Glaciers Knowledge Center

Photo By Ross Strandberg

Enter the knowledge center by clicking on: **Explore Glaciers**, and then follow the directions to navigate through the **Introduction** section.

What Glaciers Are

Click on : What glaciers are

What are the 3 main criteria for being a glacier?

1. **MADE OF ICE**
2. **FORM ON LAND**
3. **GLACIERS MOVE**

Click on : Made of Ice

List the 2 features of ice crystals that are significant to glaciers, and then click on each topic to complete the questions below:



1. **STRUCTURE**

Complete the following sentence:

Ice crystals are WEAK and as a result they can DEFORM under their own weight.

2. **DENSITY**

Describe the density of water:

WATER IS A SUBSTANCE THAT IS LESS DENSE IN ITS SOLID FORM THAN IN ITS LIQUID

Click on : Form on Land

Is the following sentence true or false? Circle one: TRUE FALSE

All glaciers must form on land, but can later move out to sea.

Click on : *Glaciers move*

What are 2 ways that glaciers move?

1. **INTERNAL DEFORMATION**



Remember: Ice crystals are weak, allowing glaciers to buckle and deform under their own weight.

2. **BASAL SLIDING**



Tip: Think of a slip-n-slide!

Glossary

Select the glossary link at the bottom right portion of the screen to define the following terms.

Define: **Plucking**

THE MECHANICAL REMOVAL OF PIECES OF ROCK FROM A BEDROCK FACE THAT IS IN CONTACT WITH GLACIER ICE. BLOCKS ARE QUARRIED AND PREPARED FOR REMOVAL BY THE FREEZING AND THAWING OF WATER IN CRACKS, JOINTS, AND FRACTURES. THE RESULTING PIECES ARE FROZEN INTO THE GLACIER ICE AND TRANSPORTED AWAY.

Define: **Abrasion**

ABRASION IS THE MECHANICAL WEARING, GRINDING, SCRAPING, OR RUBBING AWAY (OR DOWN) OF A ROCK SURFACE BY FRICTION AND IMPACT, IN THIS CASE BY ROCKS AND ROCK FRAGMENTS FROZEN IN A GLACIER.

Where Glaciers Are Found

Click on : *Precipitation*

Read the text and circle which factor is more important than the other:

Kind of precipitation vs. Total annual precipitation
Amount of snow vs. Conservation of snow

Click on : *Temperature*

What is the most significant heat source that a glacier receives?

SOLAR RADIATION

Click on : *Relief*

Complete the following sentence:

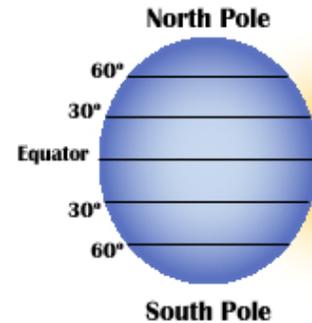
TOPOGRAPHY exerts a powerful influence over glaciation.



Click on : *Latitude*

Complete the following sentence:

High latitudes receive LESS annual solar radiation and experience prolonged WINTERS at sub-zero temperatures.



Click on : *Altitude*

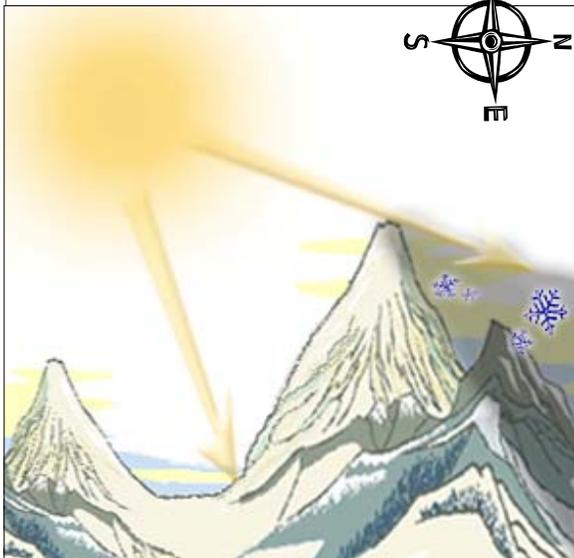
Where are glaciers found at the South Pole?

SEA LEVEL

Where are glaciers found at mid to low latitudes?

HIGHLANDS

Click on : *Aspect*



The orientation of the ground surface with respect to incoming solar radiation is important to the existence of glaciers.

In the Northern Hemisphere, which slopes receive the least direct solar radiation?

STEEP, NORTH-FACING SLOPES

Types of Glaciers

Click on : Types of Glaciers

How are glaciers most easily differentiated (how best do you tell them apart)?

TOPOGRAPHY and **TEMPERATURE**

Click on : Ice Sheets

Ice sheets and ice caps fall into the same category. Which one is larger?

ICE SHEETS

What are the 2 main components of ice sheets and ice caps?



1. **ICE DOMES**

2. **OUTLET GLACIERS**

Click on : Ice Shelf

Describe an ice shelf:

A VERY THICK SHEET OF ICE THAT HAS BEEN PUSHED OUT OVER THE SEA FLOOR FROM A LAND-BASED GLACIER.

Is the following sentence true or false? Circle one: TRUE **FALSE**

If a glacier is considered to be an ice shelf than it is no longer attached to land.

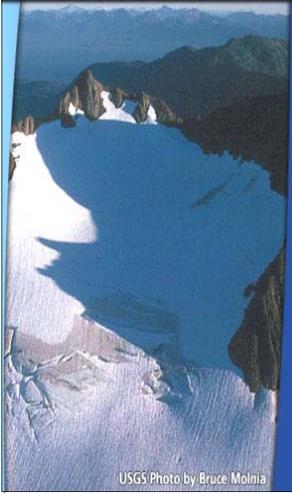
Click on : Icefield

The surface of an icefield is approximately: **LEVEL**

Click on : Valley Glacier

Where might a valley glacier originate?

ICEFIELD or **CIRQUE**



Click on : *Cirque Glacier*

Complete the following sentence describing a cirque glacier:

A small ice mass generally WIDE in relation to its LENGTH.

What characteristic shape does a cirque glacier occupy?

ARMCHAIR-SHAPED BEDROCK HOLLOW

Glossary

Select the glossary link at the bottom right portion of the screen to define the following terms.

Define: **Accumulation**

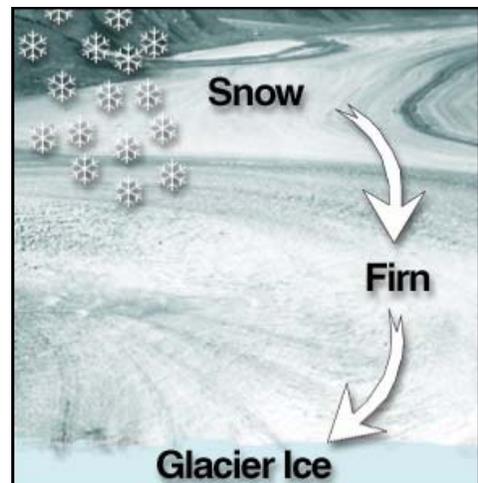
ACCUMULATION IS THE ADDITION OF ICE AND SNOW TO A GLACIER. THIS OCCURS THROUGH A VARIETY OF PROCESSES INCLUDING PRECIPITATION AND WIND DEPOSITION.

Define: **Ablation**

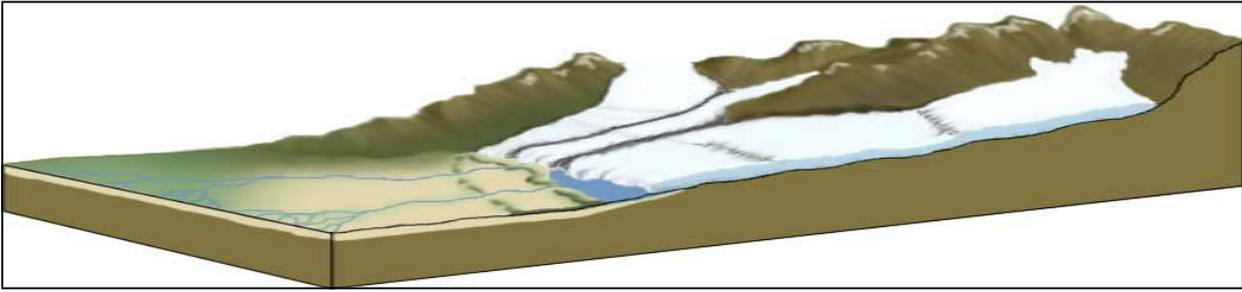
THE LOSSES IN GLACIAL BALANCE ARE PRODUCTS OF ABLATION. IN MOST GLACIERS, MELTING CONSTITUTES THE MAJORITY OF ABLATION, BUT EVAPORATION, SUBLIMATION , WIND EROSION, AND CALVING ALSO CONTRIBUTE TO NET LOSS.

Define: **Firn**

FIRN IS AN INTERMEDIATE STAGE IN THE TRANSFORMATION OF SNOW TO GLACIER ICE. SNOW BECOMES FIRN WHEN IT HAS BEEN COMPRESSED SO THAT NO SPACES REMAIN BETWEEN FLAKES OR CRYSTALS, A PROCESS THAT TAKES LESS THAN A YEAR.



Parts of a Glacier



Click on : *Parts of a Glacier*

Match the following terms with their definitions below:

- | | |
|----------------------|---------------------|
| A. Ablation Zone | D. Terminus |
| B. Accumulation Zone | E. Firn Line |
| C. Bed | F. Equilibrium Line |

- C** This is not part of a glacier, per se, but the direct interaction between a glacier and this part warrants mention.
- E** This is the highest level to which winter snow cover retreats on a glacier.
- A** This is the part of the glacier's surface over which ablation (wastage) exceeds accumulation each year.
- B** The part of a glacier's surface over which more snow is deposited than ablated each year.
- F** The boundary between areas of gain and loss on a glacier's surface during one year. This is where accumulation meets ablation, and the net balance of snow is zero.
- D** The end or lowest part of a glacier.