



Southern AER

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Did You Know?

The thickest ice in Antarctica is in Wilkes Land, where it reaches a depth of 15,669 feet. That is about as deep as the highest of the Alps is high!

Ice covers 11% of Earth's Land, Scientists say life will go on

Earth's climate, or average weather over time, is regulated by many factors. (Major climate controls are described in the Spring 2003 issue of *Southern AER*.) One of these climate controls is the amount and distribution of ice over Earth's surface. This may surprise you since chances are, nothing stays icy year-round where you live, but in fact this is no breaking news. Throughout human history, ice has made Earth just right for us.

Sea ice forming near the North and South pole is a great temperature regulator for the atmosphere. Without sea ice, the ocean delivers large amounts of heat to the atmosphere in the area keeping both air and water near freezing. Once ice covers an area, the heat release stops, and atmospheric temperature can drop to -30 degrees Celsius or lower.

The seasons of the Southern Ocean see new ice form each year and it usually reaches a thickness of about 1 meter (3.3 feet). In the Arctic however, land around the sea allows the ice to remain for 4-5 years at a time and the oldest ice can get as thick as 4 meters (over 13 feet).

Ice on land is called a *glacier* or *ice sheet*. Mountain glaciers form in valleys throughout the world. Because the yearly average temperature must remain



Continued on page 2...

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below freezing in order to maintain a glacier, mountains near the equator can only have glaciers above a 5 kilometer (3 mile) elevation, while at higher latitudes glaciers can reach down to sea level. Continental ice sheets are a larger form of land ice covering entire land masses like Antarctica and Greenland. Together, glaciers and ice sheets store 75% of the world's fresh water.

Glaciers and ice sheets grow and shrink with the seasons and there are special terms to describe this change in size. Where ice thickens or grows in an area, *accumulation* occurs. *Ablation* describes the mass of ice shrinking. Beside simple melting, ice sheets and glaciers can shrink by *calving* which occurs as huge chunks of ice are broken off from the main mass becoming *icebergs*.

Read on to learn more about albedo and the positive feedback mechanism. These are crucial to studying icy climate controls.

READ THE FINE PRINT: Average Albedo Ranges of Common Environments...



Fresh snow/ice	60-90%	Tundra	15-35%
Old, melting snow	40-70%	Grasslands	18-25%
Clouds	40-90%	Forest	5-20%
Desert Sand	30-50%	Water	5-10%
Soil	5-30%		

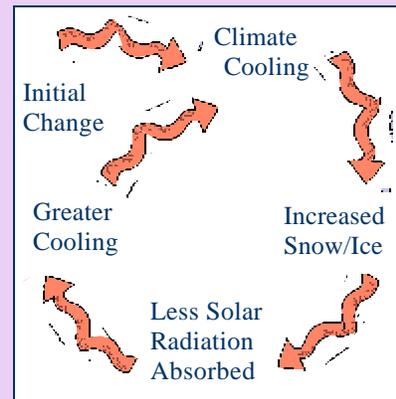
When sunlight enters the atmosphere, we see objects because of the light they reflect to our eyes from the sun and the rest of the light is absorbed. So a green leaf absorbs all colors but green which it reflects away from itself. The amount of solar radiation reflected from an object is called its *albedo* and varies for different objects. Snow and ice have albedos ranging from 60-90%! In contrast, water reflects only 5% of radiation when the sun is overhead. The more light a surface absorbs, the more heat it gains from the sun. This is why black asphalt feels hotter than white sidewalk cement on your bare feet! Albedo contributes greatly to what is called a positive feedback mechanism. Read the article on page 3 for more on *feedback*.

It may be
winter but the sun
is still a-shinin'!
Find your
sunglasses!

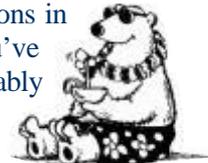
Climate Connection: The Positive Feedback Mechanism

You've learned about ice sheets and albedo and so much more - here's the connection. The positive feedback mechanism: If an initial change takes place (say a long period of intense cold) ice and snow increase over that time, solar *absorption* decreases and the area's albedo increases. Because reflection of solar radiation is higher the system continues to cool down. This increased cooling keeps the cycle going - it provides positive feedback. The opposite would happen if the system started warming up. A little bit of melting would lower the albedo of the system since water has a lower albedo than ice, allowing greater absorption of solar radiation and further raising the temperature.

The albedo/temperature feedback mechanism isn't the only one though. There are positive feedback mechanisms for the weathering of rocks, for the growth of vegetation in cold climates, and for water vapor and plant growth. See if you can draw some of these other feedback cycles like the one above.



READ THE FINE PRINT on page 2, then decide what you think the average albedo range is for the area you live in. Choose two other locations in the world - maybe a grandparent's hometown or someplace you've gone on vacation - and do the same. Which National Park probably has the highest albedo? The lowest? Visit the National Park Service website at <http://www.nps.gov> to find the parks!



Fun Facts

The largest iceberg ever sighted was 208 miles long and 60 miles wide - **about the size of Belgium!**

Penguins never have to worry about becoming a Polar bear snack? That's because Polar bears live in the Northern hemisphere and penguins live in the Southern hemisphere!



A typical  has $\frac{4}{5}$ of its mass underwater.

Quick Quiz!

Glaciers and Icebergs and calving. Oh my!

Answer the questions below using your newfound knowledge from the articles on pages 1-3.

1. What happens before and after a layer of ice forms on the oceans? _____

2. What is the difference in ice thickness between the North and South poles? Which is greater? _____

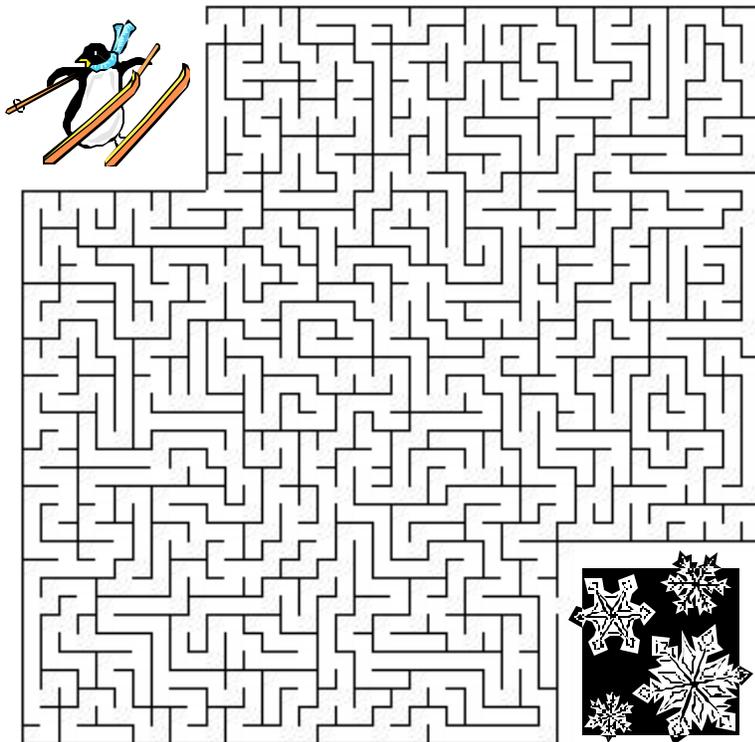
3. What is the difference between a glacier and an ice sheet? _____

4. How much fresh water is stored in ice sheets? _____

5. Why do light-colored objects feel cooler in the sun than dark-colored objects? _____

6. Does the absorption of solar radiation make something warmer or cooler? _____

7. How does a positive feedback mechanism work? _____



Snow Flurries
Frustration!

Help this frantic
Sphenisciform
find her
way home!

UnScRaMbLe the words below to **seal** your fate in the lettered boxes at the bottom.

Hint: all these words are found in italics in the text of the articles.

LOEDAB

Word box for LOEDAB with 6 empty slots and a '2' below the second slot.

BDEFCEAK

Word box for BDEFCEAK with 9 empty slots and a '7' below the seventh slot.

HESCEISET

Word box for HESCEISET with 10 empty slots, a '9' below the ninth slot, and a '6' below the sixth slot.

LIGCEAR

Word box for LIGCEAR with 7 empty slots and a '3' below the third slot.

NICLAVG

Word box for NICLAVG with 7 empty slots and an '8' below the eighth slot.

AANITBOL

Word box for AANITBOL with 9 empty slots and a '5' below the fifth slot.

ATLUNCUIMOAC

Word box for ATLUNCUIMOAC with 12 empty slots and a '4' below the fourth slot.

SORPTBIONA

Word box for SORPTBIONA with 11 empty slots, a '10' below the tenth slot, and a '11' below the eleventh slot.

REBGEIC

Word box for REBGEIC with 7 empty slots and a '1' below the first slot.



Okay Glacier Guru!

Rest your weary brain by coloring in this friendly seal. You can even make up a story about your seal to share with your class!

Word box with 7 numbered slots (1-7).

Word box with 11 numbered slots (1-11) and an exclamation mark at the end.

Write your story here:

Handwriting lines for writing a story.

By:

Learn More About It!

These resources can help you discover more about Sea Ice Controls and their affect on Earth's climate.

- USGS Water Science for Schools: <http://ga.water.usgs.gov/edu/earthglacier.html>
- How Stuff Works <http://science.howstuffworks.com/>
- National Snow and Ice Data Center: <http://nsidc.org/cryosphere/>

Thanks to all of the following:

References:

- Ruddiman, William F. Earth's Climate: Past and Future. W.H. Freeman and Co. New York, NY. 2001. Pg. 23-25, 44-46

- Encarta Encyclopedia Online:
<http://encarta.msn.com>
- Center for Astrophysical Research in Antarctica:
<http://astro.uchicago.edu/cara/outreach>
- Icebergs of Newfoundland and Labrador:
<http://www.wordplay.com/tourism/icebergs/index.html>
- National Snow and Ice Data Center
<http://nsidc.org>

Remember to check out our website too for more climate resources and fun learning tools!

www.sercc.net

This publication is brought to you by:



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