Name: ________________________

Vocabulary Related to Glaciers:

cryoconite – dust from the air (made of rock, microbes, and carbon soot) that builds up on ice sheets and glaciers, resulting in dark areas in and on the ice. These dark areas absorb sunlight, melting the ice below causing holes to form in the glacier (called cryoconite holes)

ice cores – a cylindrical length of ice, obtained by drilling deep into ice sheets and glaciers. Similar to a tree ring, ice cores show yearly snow accumulation, and hold tiny air bubbles frozen in the ice that scientists use to understand the history of our climate.

ice caps – a type of glacier – miniature ice sheets (covering less than 50,000 square kilometers)

ice sheet – a type of glacier – a permanent layer of ice covering an extensive tract of land (more than 50,000 square kilometers). Only Antarctica and Greenland have ice sheets.

ice field – a type of glacier – similar to ice caps, except that their flow is influenced by the underlying topography and they are typically smaller than ice caps

ice shelves – a type of glacier – occurs when ice sheets extend over the sea and float on the water. Ice shelves surround most of the Antarctic continent.

glacier – a large mass of slow moving ice, formed as successive snowfalls are compacted over time.

How Do Glaciers Move? (https://youtu.be/RnlPrdMoQ1Y)

Mendenhall Glacier is one of about ________ glaciers in the famed Juneau Icefield in Alaska. This glacier was born in the ocean. Warm, moist air from the _______________ rises up coastal mountains, where it cools, condenses and falls as snow and rain. _____ meters of snow (sometimes more) falls on this ice field every year. To create a glacier, you also need the right ________________. Even in summer, temperatures at the Mendenhall Glacier dip near freezing. What this means is the accumulation of snow in ___________ exceeds snowmelt in _______________. So snow builds over time, with each layer landing on top of the one before it.

A cubic meter of fresh snow typically weighs 70-150 kilograms, which is equivalent to about __________ adult humans. Most of that volume is ________ (90-95%). But as it continues to pile up, collective forces on the fluffy stuff begin a transformation. First, the snowflake shapes are shattered into _____________ crystals and as they are squished, the air pockets between them start to _______________. The snow becomes denser. After about 2 years, ground snow takes a new form, called "___________" – an intermediate state between snow and glacial ice. Firn is about 2/3 the density of ________________, and it can take decades to complete the transition into its final form. That final form is a big mass of dense, bubble-free ice.

The ice in Mendenhall is flowing forward more than a __________ meter every day. Glaciers are often compared to "rivers of ___________," and that's not wrong. These giant solid structures behave with liquid-like tendencies. Glaciers can move WITHOUT ________________. In glacial ice, water molecules are arranged in an orderly pattern, but under certain conditions they can still ____________. Much of this has to do with the pressure ______________ point. As pressure increases, the melting point of ice decreases. When glacier ice stays close to – but just below –

that point, it becomes malleable, much like how you can bend and deform solid metal when it's heated near its melting point.

The deepest layers of a glacier are exposed to the most _______________. This is known as the "zone of _______________ flow," because the bonds between the ice crystals can be stretched rather than broken.

Up in the top of the glacier – the upper 150 feet or so – that's the "zone of __________ flow" and the ice isn't under as much pressure. That makes it prone to ________________ under stress, which is why you'll find deep crevasses near the surface.

But glaciers are a product of climate and they change with the climate. The terminal edge of a glacier is one of the easiest places to see its movement in action, but its also where we can see how much things are _________________. Glaciers never move backwards, and they are always melting. But when mass melts away at the bottom faster than new mass is added up top, they can ___________. At the Mendenhall glacier, it takes about _________ years for new ice to move from the ice field to the lake (a journey of only 13 miles). It's a slow process, but warmer summers combined with less snow in winter are speeding things up. The glacier is melting faster than it's growing – and it's already retreated miles.

Why is This Ice Blue? (https://youtu.be/P7LKm9jtm8I)

What color is ice? Snow is made of ice, and it's ________________. The ice most of us get out of our freezer is clear or cloudy. But glacier ice is different. It's ___________.

The sky is blue because light hitting the atmosphere is ________________ and blue light is scattered predominantly down into our eyes. But glacier ice is blue for a completely different reason. A single snowflake viewed up close is ____________, but when snow piles up, it's mostly air. When light hits those air pockets, the faces of ice crystals act like a bazillion tiny little ____________ that scatter the full spectrum (white light) in every direction. Glacier ice begins its life as snow, but year after year, it's squeezed by so much ______________ that the air bubbles between the crystals disappear. And without those air bubbles, white light isn't scattered. But still, even a block of ultra-pure ice doesn't show any color. Inside a glacier, the water molecules in ice are actually __________________ all light that isn't glacier blue.

And to understand how this works, we need to explore three ideas: wavelengths, frequencies, and overtones. Because light always travels at the same ___________, the wavelength of light also tells us its frequency – the number of waves that cross a point in a certain time. Violet light – _________ frequency. Red light – _________ frequency. It's similar to how we think of sound waves – higher frequencies and lower frequencies. Now you might not know this, but water molecules (even in ice) can ___________ – sort of like the atoms are connected by little springs. These little springs only vibrate at a special frequency. If light at this same special frequency comes along, the water molecule _______________ that energy and keeps vibrating. That frequency (or color) of light is subtracted from the rest. Light that isn't the right frequency passes right through (and isn't absorbed). A water molecule's typical vibration frequency is _______________ of the visible range.

So how can it have any effect on the colors we see? Let's explain with _______________ – a series of higher frequencies that accompany the initial frequency. The vibrations in water molecules can also be excited by "___________ wave overtones" that are at higher frequencies. For solid water, one of those absorbed overtones sits right in the _________ /___________ part of the spectrum. When white light from the sun passes through the glacier, the red and orange frequencies are just right to be absorbed by the water molecules. And what's left when all the other light frequencies have passed through is a beautiful glacial __________. The red and orange light isn't absorbed very strongly. So it takes many, many ___________ of ice to achieve this effect.

Extension Video: https://youtu.be/Bm3_sX_obmQ

If the globe is warming, how can Antarctica be gaining ice?!

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Glacier Mini-Research Project:

You need to include the following in your project:

- Name of glacier/ice sheet
- A picture of your glacier/icesheet.
- Location – be very specific.
- Name 3 species that are found in your area that are reliant upon this glacial habitat.
- Is your glacier growing or receding?
- Has anyone researched (or is anyone currently researching) your glacier? Who and, if with a specific project, what was the name of the project?
- 2 more interesting facts related to your glacier/ice sheet.

Your project can be a poster, collage, paragraph, PowerPoint slide, or other form that is able to present all of the information above in one place.

Your project is due on: Monday, November 12th at the beginning of class.