**Surface Processes**

According to the CSET test guide, there will be a total of 50 mutliple choice questions and three constructed response questions for CSET 122.

**a. Assess mechanisms by which tectonics, geologic structures (i.e., folds and faults), and rock properties influence surface properties (e.g., flow of water, differential erosion, uplift, subsidence)**

**b. Discuss the factors controlling the influence of water in modifying the landscape**

I went into some detail in part C.

**c. Interpret the factors controlling erosion, deposition, and transport in surficial processes**

**Water:**Observing the Grand Canyon is visible evidence of the strong and power forces that water has on shaping the Earth's landscape. With each rainfall, each tiny drop of rain droplet acts like a bomb, spewing soil fragments in all direction. When a ground becomes saturated, then the flow of water lifts and transports loose rock fragments (sediments) downslope. These sediments can also act abrasively on rocks, wearing them down (weathering) as it is transported. When water moves sediments by thin sheets of water, then the process is called sheet erosion. On slopes with no vegetation, sheet flows often forms small rills, which eventually evolve into larger gullies. Once the volume has increased, then it becomes a stream

Rivers and streams have important roles in the formation of our landscape. These systems erode channels in which they flow, transport sediments and materials, and shape the landform. Within each river system there are three parts: a zone of erosion, a zone of sediment transport, and a zone of sediment deposition. In a river system, erosion is the dominant process in upstream areas, where streams erode the channel through which they flow and carry sediments and other materials that was broken down by weathering or mass wasting. All streams, regardless of size, are able to transport some sediments. Streams sort sediments as they are transported. The finer, lighter sediments are carried further than the larger, heavier sediments. Sediments are carried by streams in three different ways:

**- dissolved load:**Sediments dissolved in the stream. The amount of dissolved sediments that a stream will carry varies and depends on geological factors and climate. The sediment was brought to the stream through groundwater. This dissolved load will continue to flow with the stream, regardless of the stream's velocity or streamflow. The dissolved load will only precipitate out when the chemistry of the stream changes.

**- suspended load:**when sediments are suspended in the stream. The most common portion of the stream's load consists of particle sizes of fine sand, silt, and clay. The type and amount of sediments and materials that can be suspended in a stream depends on its velocity of the stream and the settling velocity of sediment grains. Settling velocity means that larger sediments will settle to the floor more rapidly than smaller ones. In addition, the shape, size, and density of the sediment also affects its settling velocity. Flat grains settle out more slowly than spherical grains. Dense grains settle out more rapidly than less dense ones. The longer sediments that stay suspended, the further it will travel.

**- bed load:**Sediments that are too large to be carried in suspension moves along the floor of the stream, called a bed load. Because the bed load is rolling and sliding along the bed floor, it is grinding the floor down. Sediments that aren't too heavy may experience saltation, where it is moved upward by the current and pulled back down by gravity.

Where the zone of deposition takes place is generally where a river enters a large body of water (a place where a change in velocity takes place). Accumulation of sediments may form a delta, or other coastal features.

**Wind:**Not as strong erosional force as water or glacier is. Wind erosion is much more effect in arid regions. In humid regions, particles are held together and the vegetation helps hold soil together. Thus, for wind to be an effective erosional force, the region needs to be dry and have little vegetation. Deflation (the act of lifting and removing loose material) is one way that wind erodes sediments. Some areas begin to develop a shallow depression as a result of deflation called a blowout. Wind can also erode through abrasion when windblown sand polishes rock surfaces. Wind, in general, doesn't not produce erosional landforms as sand don't travel more than a meter above the Earth's surface, so sandblasting effect is limited to an extent above the surface.

Wind is able to create great depositional landforms. These features are especially evident in dry regions and along sandy coasts. There are different types of wind deposits:

**- Dunes:**dunes are mounds and ridges made up of sand that is deposited from the wind's bed
                   load
      **- Loess:**these are blankets of silt that were carried in suspension

Just like streams and rivers, wind also carries sediments in suspension and will drop sediments when wind's velocity drops. So, sand is able to accumulate in a region that causes wind to drop its velocity. As sand drops in this region, the sand begins to build up. This accumulation of sand becomes an even better barrier to wind and is able to trap more and more sand. Eventually, if wind continues to drop sand in this region, then it grows large enough to become a dune. There are many different kinds of dunes, but many are asymmetrical, leeward steep slope, and windward gentle slope. Through the process of saltation, sand particles are moved up the windward slope, and when the velocity of the wind drops, it collects at this region, steepening the crest of of the dune. Once enough sand is piled on, some of it slides down as a result of gravity. The leeward slope of the dune, called slipface, maintains an angle of 34 degrees. This cycle continues and results in a slow movement of dunes being created in the direction of wind movement. The windward side of dunes are called cross beds. The name cross beds comes from the fact that as sand is deposited, layers are formed at an incline in the direction that the wind is moving in. These layers become buried and become part of the sedimentary rock layer.

**Glacial:**Glaciers have the ability to carry huge blocks of debris that no other erosional force could handle. The debris that is carried by the glacial ice eventually drops out when the glacier melts and retreats. The deposition of sediments can help to shape the landscape. Glacial drift is the term used to describe sediments that were deposited due to glaciers, no matter how, where or in what shape the sediments that were deposited were in. There are different types of landforms created by glacial drift.

**Till:** Unlike moving water or wind, glacial ice sheets are not able to sort sediments. When the glacier deposits its sediments, there is a mixture of many different particle sizes. This is a pretty good indicator that if you stumble into a mound that consists of unsorted debris, that it was a result of glacier activity. In addition, if you were to examine the sediments closely, you would see that many of them have scratches and are polished. Large boulders that differ in composition and size from the surrounding rocks are called glacial erratics. Sometimes the source of these boulders can be figured out by looking at the mineral composition and texture and direction the boulder and other nearby glacial erratics came from. Doing this also helps track the path of the glacial ice.

**Moraine:**Another landform made from glacial ice are moraines. There are two types of moraines. Lateral moraines are formed when glacial ice is moving down a valley. As it moves down, it erodes the sides of the valley, quite efficiently. The sediments produced are added to the sides of the glacier. When the ice melts and begins to retreat, the debris that accumulated drops next to the valley walls. This forms lateral moraines that runs alongside the valley. The other type of moraine is called medial moraine. These types of moraines forms when two alpine glaciers combine to form a single ice stream. The lateral moraines that have been carried along the sides of the alpine glacier now combines together. As the ice moves down, you can see single dark stripes. Some glacier ice sheets may have several strips throughout.

**Terminal Moraine:**These types of moraines drop off sediments at the end of the glacier. Glaciers act like a conveyor belt in which the sediments are moving through the glacier to the end as the ice melts. The end moraine continues to grow as long as the ice front remains stable. Meaning, the rate of melting that is taking place equals the forward movement of the glacier. So, as long as this equilibrium stays the same, then sediments will constantly be dropped off. The longer this equilibrium stays stable, the larger the moraine will be. Eventually, the evaporation of ice (ablation) becomes greater than the forward movement of the glacier. The glacier begins to retreat, still dropping off sediments. These form ground moraine land features.

**Ground Moraine:**These are produced when a glacial ice sheets are retreating. As it melts away, it drops layers of till. These deposits create gently rolling layer of tills. Ground moraines changes the landscape, such as clogging streams and changing drainage systems.

**Recessional Moraine:**Sometimes, as glaciers retreat, a balance of evaporation and forward movement is archived again. Thus, new terminal moraines may form again. This cycle of creating terminal moraines and ground moraines may take place several times. Terminal moraines that were created when ice retreated and then stabilized are called recessional moraines. Terminal and recessional moraines are alike. The difference is that terminal moraines were created when glacial ice sheets retreated and then achieved equilibrium again.

**Drumlins:**These are large hills composted of till. Drumlins are found in clusters called drumlin fields. Their actual formation is still being studied, however it is thought that they form over previously deposited drift.

Glaciers scrape and scour rocks from the floor and walls of valley as it moves downward. Glacial erosion is not as widespread as it was during the last ice age. Glaciers erode by plucking or abrasion.

**Plucking:**As a glacier moves over rocks, the water moves in through the cracks and freezes. The ice expands and acts as a leverage, pushing the rock loose. The glacier lifts these blocks of rock (plucking) and the rock mass becomes a part of the glacier load**.**

**Abrasion:**The rocks that have become incorporated in the glacier load moves along, with the glacier. As it does so, the rocks scrape (glacial striations) , grind, or polish as it moves over the bedrock. Rock fragments produced by this action are called rock flour. So much rock flour may be produced that when meltwater moves through the glacier, it has a grayish color. Glacial striations gives us clues as to the glacier's direction. The rate of glacier erosion is based on several different factors: rate of glacier movement; thickness of the ice sheet; shape, hardness of the rock fragments found in the glacier load; and the material below the glacier sheet and it's erodibility.

**d. Appraise desert environments in terms of water resource needs for habitation**