**Running Water II**

(p. 475-490)

**River Drainage**

Rivers rarely reach the ocean without ever encountering other rivers along the way.

What do we call the smaller rivers that flow into a larger river during its course towards the ocean? ___________________

The entire region that is drained by a river and all the rivers that flow into it is called a ___________________.

How big are these drainages? __________________________________________

e.g. the Mississippi drainage basin covers over _____ % of the continental USA!

A drainage basin is separated from the one next to it by a high standing area called a: ____________________

Any water on one side of the divide flows into one basin and water on the other side of the divide flows into the adjacent drainage basin.

Continents usually have high mountain ranges that act as divides between drainage basins that drain into completely different oceans. This type of drainage divide is called a ____________________

Examples: ____________________ and ____________________

**Drainage Patterns**

Not all river networks in drainage basins look the same when looked at from high above. The pattern that a river network makes when viewed from above is controlled greatly by _____________________. These different patterns are called **drainage patterns**. The 5 main types of drainage patterns are:

1) ____________________
2) ____________________
3) ____________________
4) ____________________
5) ____________________
1. What pattern does **dendritic drainage** resemble? _____________________________

This drainage pattern forms on gently sloping surfaces that are equally resistant to erosion everywhere.

What kinds of rocks commonly show dendritic drainage?

_______________________________________________________________________________

2. **Rectangular drainage** is characterized by tributaries joining larger streams at almost right angles (90°). Rivers may also show sudden right-angle bends.

Why does rectangular drainage develop? ________________________________

_______________________________________________________________________________

3. **Trellis drainage** forms where rivers flow along a number of straight valleys that are separated by parallel ridges or mountains. Short streams flow down the mountains into the main rivers in the more easily eroded valleys, forming a pattern resembling a trellis.

4. **Radial drainage** forms when rivers flow in all directions away from a central high area like a volcano.

5. **Deranged drainage** refers to areas that have not yet developed a good drainage pattern. Flow directions are irregular and there may be many swampy areas.

What is typical of the geologic history of areas that show deranged drainage?

_______________________________________________________________________________

U.S. examples: ____________________________________________

---

**Lakes**

A **lake** is a standing body of water exposed to the atmosphere and having little to no gradient (i.e., it sits on a flat surface). The study of lakes is called ________________.

Lakes receive water from rivers flowing into them, rainfall, overland flow, and water from underground. They lose water from rivers flowing out of them, and by evaporation.

Areas having poor drainage, such as marshes and swamps, are called ________________.

Lakes are important to humans by providing fresh water for consumption and agriculture, and by acting as a resource for food.

What type of power is produced from dams built across lakes? _________________
The following geologic processes can result in the formation of lakes:

1) ___________________________________ (e.g., ______________________)
2) ___________________________________
3) ___________________________________ (e.g., ______________________)
4) ___________________________________ (e.g., ______________________)
5) ___________________________________ (e.g., ______________________)
6) ___________________________________ (e.g., ______________________)

Lakes are short-lived features in geologic terms. Lakes eventually disappear because of evaporation, sedimentation (silting up), changes in climate, or human meddling.

What lake in Africa is drying up at an alarming rate? ______________________

What lake in Kazakhstan is drying up at an alarming rate? ______________________

Lakes can also be eradicated by erosion by the river that drains the lake. In order to understand how this happens, we need to look at the concept of **base level**.

**Base Level**

What is base level? _____________________________________________________

What is the lowest elevation that any river can erode down to? ______________

What is the name given to this lowest possible base level? ______________

As a river flows down its channel, it is constantly attempting to erode the land down to base level. As the gradient gets less and less, it gets harder and harder for the river to erode effectively, because the river's energy decreases.

What is the name given to base levels along a river course? ______________

Examples of these types of base levels:

_________________________________  ___________________________________  ___________________________________
A river flowing into a lake cannot erode deeper than the lake because it would then have to flow uphill into the lake. Eventually, the outflow channel from the lake may erode away the local base level and the lake will vanish.

Where do waterfalls form?

The top of the waterfall is a local base level for the part of the river channel above the waterfall. The channel below the waterfall undercuts the resistant rock, causing the waterfall to retreat upstream. Eventually, the waterfall will completely erode away.

Example of a retreating waterfall:

What are possible causes of a change in base level?

1) ................................................
2) ................................................

How far did sea level drop during the Pleistocene ice age?

This caused the ultimate base level to drop, so rivers started eroding into the exposed continental shelf that used to be underwater. At the end of the Pleistocene, sea levels rose again and flooded these river valleys, returning base level to normal.

Example of a river this happened to:

Dams create local base levels that can impact on the natural processes of erosion and deposition along a river channel. Upstream from the dam, the river can no longer erode downwards so it deposits sediment instead, which can result in the dam silting up. This is a huge problem in dams built in mountainous areas.

Stream Profiles

Rivers are constantly adjusting to changes in base level and rates of erosion and deposition. In fact, rivers are always trying to reach some state of balance so that neither significant erosion nor deposition takes place within the channel.

A cross sectional profile of a stream’s elevation along its length is called a:
Irregularities in the stream profile are produced by lakes and waterfalls, which form local base levels. Over time, the stream will attempt to remove these irregularities. Where the gradient is steep, erosion lowers it. Where it is low, deposition may increase it.

The overall result is to produce a smooth, concave longitudinal profile, in which case we call the stream a _____________________.

**Evolution of River Valleys**

Most rivers may not ever become a true graded stream, but they are always adjusting in an attempt to become one, in response to changes in base level, water flow, and interaction with other channels. So the river valley is constantly evolving.

What processes actively change a river valley?

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

**Downcutting** occurs when a river possesses more energy than it needs to just carry the sediment load, so it eroded downwards into its bed. If downcutting is the only process happening, the river forms a deep, steep-sided channel. There are two types:

Wide valley type: ____________________  Example: ____________________
Narrow valley type: ____________________  Example: ____________________

Usually, the sides of the valley also get eroded by **lateral erosion** as the river erodes its banks and gradually widens the valley as the river meanders back and forth across it. **Mass wasting** and **sheet erosion** moves material into the river to be carried away.

As well as becoming deeper and wider, river valleys extend upstream over time, as they erode back into the drainage divide. This process is called _____________________.

Eventually, a river may erode back all the way into another river channel, diverting its water in a process called ____________________ or _____________________. This causes one river to have a sudden increase in discharge, and the other has a decrease. So both rivers must readjust to these changes.

When a river's base level drops, it may cause sudden downcutting that leaves steep sided walls along the river with a flat top representing the old river floodplain. This can happen multiple times, leaving a step-like valley with steep walls called _____________________.


Sudden downcutting by a meandering stream flowing over a floodplain may result in looping gorges called __________________________ bounded by steep valley walls, with a flat top representing the old floodplain.

Example: ____________________________

**Floods**

A flood occurs when a river's discharge exceeds the channel's ability to carry it, so the river overflows its banks. This process is natural and has been occurring throughout geologic history.

What is the average annual dollar cost of flood damage in the U.S.? _______________

e.g. the Mississippi River flooded in ______ and again in ______, inundating agricultural lands and urban areas in Iowa, Illinois, and Missouri.

If we plot a graph of the frequency of a flood with its corresponding discharge, we can see how often floods of a certain size occur. The average time between any 2 floods with the same discharge is called the ____________________________.

Smaller floods have SMALLER or LARGER recurrence intervals?

If the recurrence interval is 100 years, then there is a 1% chance every year that a "100-year flood" will occur. The longer we go without one, the greater the probability that one is going to happen.

**FINAL QUESTION:**

What is the probability of a 100-year flood if 100 years passes without one happening?

____________________