

GEOG101: The Natural Environment

1. Maps

Geography

1. What do geographers study and what is unique to their study?
2. What are the two main branches of Geography?
3. What is the focus of each of these branches?
4. Give examples of phenomena that could be studied using a geographic focus, and explain what the geography component would be.

"Geography is the science of place and space. Geographers ask where things are located on the surface of the earth, why they are located where they are, how places differ from one another, and how people interact with the environment.

"There are two main branches of geography: human geography and physical geography. Human geography is concerned with the spatial aspects of human existence - how people and their activity are distributed in space, how they use and perceive space, and how they create and sustain the places that make up the earth's surface. Human geographers work in the fields of urban and regional planning, transportation, marketing, real estate, tourism, and international business.

"Physical geographers study patterns of climates, land forms, vegetation, soils, and water. They forecast the weather, manage land and water resources, and analyze and plan for forests, rangelands, and wetlands. Many human and physical geographers have skills in cartography and Geographic Information Systems (GIS).

"Geographers also study the linkages between human activity and natural systems. ... They are active in the study of global warming, desertification, deforestation, loss of biodiversity, groundwater pollution, and flooding."

Association of American Geographers (www.aag.org)

Size

1. What are the approximate diameter, radius, and circumference of Earth?
2. Why is the polar diameter different from the equatorial diameter and which is larger?
3. What is meant by "oblate?"
4. What is geodesy?

Latitude

1. Define latitude and parallel.
2. What are meant by North and South latitude?
3. Where are the Equator, North and South Poles, Tropics of Cancer and Capricorn, and the Arctic and Antarctic Circles?
4. How are each of these parallels defined?

Longitude

1. Define longitude and meridian.
2. What are meant by East and West longitude?
3. Where are the Prime Meridian and International Date Line?
4. How are each of these meridians defined?
5. If you fly from Hawai'i to Japan, do you set your watch ahead one day or back one day?
6. Be able to find the approximate latitude and longitude of a place given a map that includes these coordinates in the margins.

Time

1. What is the relationship between longitude and time?
2. What are time zones and how wide are they?
3. Are times at places East of your location earlier or later? How about to the West?
4. What is the time difference between Hawai'i and the Prime Meridian in England? Hawai'i and Tokyo? Hawai'i and Los Angeles? Hawai'i and New York? Is the time at these places earlier or later than Hawai'i?
5. How can you find your longitude using an accurate clock set to Greenwich time?

Maps

1. What is cartography?
2. Distinguish between thematic and topographic maps.
3. Think of examples of uses for each type of map.
4. What is meant by scale?
5. What is a representative fraction and how is it used?
6. What is a bar scale and how is it used?
7. Distinguish between large and small scale maps.

New Tools

1. What is meant by Remote Sensing?
2. What are some examples of remotely sensed data?
3. What is GPS and why is it useful?
4. What are some examples of how GPS can be used?

5. What is the current accuracy of a stand-alone GPS receiver?
6. What is a datum and which are used in Hawaii?
7. What is a GIS and what is it used for?
8. What is a GIS layer? Think of possible examples.

2. Sky

Origin

1. How and when did the Earth form?
2. How did the modern atmosphere form?
3. Air is composed of what major gases and what is the percentage of each?
4. What is the origin of Oxygen in the atmosphere? Why don't the atmospheres of other planets contain Oxygen?
5. Why are CO₂ and H₂O relatively small percentages of air?
6. How did the oceans form?

Air

1. What is climatology?
2. What is atmospheric pressure and what units is it measured in?
3. What are the approximate pressures at sea level? Top of Mauna Loa? Top of Mt. Everest?
4. At about what altitude is 500 mb ($\frac{1}{2}$ point of atmospheric mass)?

Layers

1. What criteria are used to differentiate layers in the atmosphere?
2. Describe the major layers in the atmosphere, including their characteristics and height.
3. How does the height of the tropopause vary with latitude?
4. What phenomena are associated with each layer and why are they important?

Sunlight

1. What is sunlight?
2. Why is it an important climate element?
3. What is the relationship between temperature and em radiation wavelength?
4. Differentiate between UV, visible light, and IR radiation.
5. What is the wavelength range of visible light?
6. Compare the wavelengths of green, blue, and red light.
7. How does microwave differ from gamma radiation?
8. How fast does em radiation travel in space?

9. If you could see UV, what color do you think it would be (just a thought question)?

Scattering

1. What is scattering?
2. Explain the two types of scattering.
3. Why is the sky blue on clear days and why are sunsets red?
4. Why are clouds white and the sky white on hazy days?
5. Explain crepuscular rays.
6. Differentiate between diffuse and direct beam radiation.

Refraction

1. What is refraction and what are some examples in the atmosphere?
2. Why do rainbows form?
3. Where are red, green, and blue located in rainbows? Why?
4. Why does the green flash occur?

Hawai'i Solar Radiation

1. Why did Hawai'i have an extensive solar radiation monitoring network?
2. How does sunlight vary from place to place in Hawai'i and why?

3. Heat

Albedo

1. What is the relationship between reflection, absorption, and albedo?
2. How does albedo affect temperature?
3. If the albedo of a surface is 40%, what percentage of sunlight is absorbed? If a surface absorbs 70% of the sunlight falling on it, what is its albedo?
4. Rank the following by albedo: forest, cloud, asphalt, snow, grass, water, soil and give their approximate values.
5. What is an urban heat island and what causes it?
6. Which is brightest (reflects the most sunlight per unit area) if seen from space, Earth, Moon, or Venus? Which is least bright?
7. How and why would changes in Earth's cloud cover affect the planetary temperature?

Greenhouse Warming

1. What is longwave radiation and what wavelength bands does it include?
2. Give an example of terrestrial radiation that you can see.
3. What is meant by greenhouse warming?
4. Explain how atmospheric gases cause greenhouse warming.
5. Which gases cause the most greenhouse warming?
6. Compare the greenhouse effects of Venus, Earth, and Mars and the gases responsible.
7. What is the Gaia Hypothesis?
8. What is meant by enhanced greenhouse effect and which gas is mostly responsible?

Energy Balance

1. What is an energy balance?
2. Compare the planetary energy balance between tropical and polar areas.
3. What the relationship between the global energy balance and the global winds and surface currents?
4. Explain the surface energy balance and how it affects temperature.
5. Why are deserts hot and forests cool?
6. Why do humans sweat?

Global Temperature

1. How is air temperature measured and at what height?
2. What determines differences in temperature from place to place and seasonally?
3. What is the most obvious pattern in a map of global temperatures and what causes this pattern?
4. What is the approximate average annual temperature near the Hawaiian Islands? The average difference from Equator to Pole?
5. How does the presence of large water bodies affect temperature?
6. What are meant by continental and marine climates?
7. Where are the greatest annual temperature ranges? The least?

Local Temperature

1. How does elevation affect the local temperature pattern?
2. What is a temperature inversion, and where is it commonly present in Hawai'i?
3. How does the inversion affect weather in Hawai'i?
4. How do daytime high and low temperatures differ between windward and leeward areas in Hawai'i? Why?
5. What is the approximate annual temperature range in Hawai'i?
6. What is meant by the expression, "night is the winter of the tropics?"
7. In general, what are the hottest and coolest hours of the day?

4. Wind

Wind Forces

1. What are isobars and what does an isobaric map show?
2. What is the relationship between wind and air pressure?
3. What is the pressure gradient force and how is it related to wind speed?
4. How could you determine the PGF by looking at an isobaric map?
5. What is Coriolis Force and how does it affect wind direction?
6. How does friction affect wind and where is its effect felt most?
7. What is a weather vane?

Air Motion

1. What is the direction of the wind in relation to High and Low pressure centers and isobars?
2. What is the direction of circular wind flow around High and Low pressure systems in the Northern and Southern Hemisphere (clockwise or counterclockwise for each)?
3. Does wind blow slightly away from or toward High pressure centers? How about Low pressure centers?
4. How can Buys-Ballot's Law help locate pressure systems?
5. What are pressure troughs and ridges?
6. Describe the winds at the center of Highs and Lows.

Global Winds

1. If Earth did not rotate, what would the global atmospheric circulation be like?
2. What is the Hadley Cell?
3. Low pressure systems are the ITCZ, polar fronts, and subpolar Lows. At what latitude are they located and what are their characteristics?
4. High pressure systems are the subtropical Highs (horse latitudes), and polar Highs. At what latitude are they located and what are their characteristics?
5. Based on your knowledge of sky conditions for High and Low pressure, at what latitude do you think the subtropical deserts are located? The tropical rainforests?

Local Winds

1. What are land and sea breezes and what causes them?
2. What areas of the Islands most often experience sea breezes?
3. Describe some of the topographic effects on wind.
4. What are some examples of topographically induced winds and clouds in Hawai'i?

5. Cloud

Evaporation

1. Describe the atmospheric water cycle.
2. Where is water vapor concentrated in the atmosphere?
3. How is heat transferred to the atmosphere by water vapor?
4. What is precipitation?
5. Compare evaporation from land and ocean.
6. Describe the pattern of evaporation from oceans.
7. How do sun, wind, and humidity affect the evaporation rate?
8. How can evaporation be measured?

Humidity

1. What is humidity and how does it vary in the atmosphere?
2. What are meant by vapor pressure and saturation vapor pressure?
3. What is the relationship between SVP and air temperature?
4. Define relative humidity and calculate the missing RH values in the table of examples.

Stability

1. Why don't clouds fall from the sky?
2. What is meant by atmospheric stability?
3. Why does air cool when rising?
4. Distinguish between stable and unstable conditions and describe sky conditions associated with each.
5. What are the DALR and the ELR?
6. What conditions cause high and low ELRs?
7. What is meant by conditionally unstable air? How does it become unstable?
8. What causes the flat cloud deck over the Hawaiian Islands?

Condensation

1. What are some common examples of condensation?
2. What are CCNs?
3. Compare the sizes of CCNs, cloud droplets, and raindrops.
4. Explain how the eruption of Kilauea volcano may cause reduced rainfall in Kona.
5. How do raindrops form?
6. How is cloud drop size related to raindrop formation?
7. How do snowflakes form?
8. How does artificial cloud seeding work?
9. How does hail form?

Clouds

1. What are the five basic cloud classification words and what do they mean?
2. Describe ten basic cloud types shown in the diagram.
3. Describe how the four types of fog form and give examples.

6. Weather

Lifting

1. Why is lifting important in forming clouds and rain?
2. Explain orographic lifting. What is meant by windward, leeward, and rainshadow?
3. How does orographic lifting affect Hawai'i?
4. Explain convergence.
5. Why is the ITCZ so rainy?
6. Explain convection and describe conditions that favor it.

Air Masses

1. What are the four basic air mass types and their characteristics?
2. Over what surfaces do each of these form?
3. Describe how the basic air masses affect North America.
4. How might air mass movements help predict weather?

Fronts & Midlatitude Cyclones

1. Describe cold fronts and the weather changes they cause.
2. Describe warm fronts and the weather changes they cause.
3. Be familiar with the use of the weather symbols shown.
4. Distinguish between cyclones and anticyclones.
5. What are the characteristics of midlatitude cyclones?
6. Explain the relationship between midlatitude cyclones and fronts.
7. Which direction do midlatitude cyclones move?

Tropical Cyclones

1. Distinguish between tropical cyclones, depressions, storms, and hurricanes.
2. What are the requirements for hurricane formation and growth?
3. Why do hurricanes seldom affect Hawai'i?
4. How is eye pressure related to hurricane strength?

5. Why do the clouds swirl in opposite directions at the surface and upper atmosphere in hurricanes?
6. How do hurricanes cause damage?
7. Which part of the hurricane has the highest wind speeds?
8. Describe the global distribution of hurricanes.
9. What is a typhoon?

Hawai'i Weather Patterns

7. Water & Soil

Earth's Water

1. What is the origin of water at Earth's surface?
2. Why are the oceans salty?
3. What is the distribution of water on Earth? Distinguish between fresh and saltwater reservoirs.
4. Describe the hydrologic cycle.
5. Distinguish between surface runoff and groundwater and describe their characteristics.

Soil Water Balance

1. Describe the possible paths that water can take once it falls upon the ground.
2. What most affects the partitioning of water between infiltration and runoff and why?
3. Why is the root zone important? What would happen to recharge if the root zone were twice as deep?
4. Explain each term in the soil water balance.
5. Why is irrigation included? Can you think of another possible source of Water In to the surface?
6. If you cover a surface with concrete and asphalt, how would that affect each term in the soil water balance?
7. How does land use affect the soil water balance?

Soil Water In

1. What are the primary Water In sources to the soil water balance?
2. Why do the Hawaiian Islands have such many rain monitoring stations?
3. Describe the rainfall distribution over O'ahu.
4. Why and where were water diversion tunnels and ditches built in Hawaii?
5. What is fog drip and under what circumstances is it important?

Soil Water Out

1. What determines surface runoff?
2. How do forests affect runoff and infiltration?
3. What are some potentially negative effects of deforestation?
4. How can deforestation cause rivers to dry up?
5. How can converting forest to grassland reduce the overall transpiration losses from a watershed?

Soil

1. What is soil?
2. Why would crushed rock not be considered soil?
3. What is soil made of?
4. Define parent material, illuviation, eluviation, humus, horizon, soil texture, soil fertility, colloid, field capacity, and wilting point.
5. How do termites help soil fertility in the tropics?
6. How does bauxite form?
7. What are sand, clay, silt, and loam? What is a sandy loam?
8. What can affect soil color?
9. How can acidity affect soil fertility?
10. When and why do plants wilt?

Soil Classification

1. What is a hierarchical classification system?
2. Where are Oxisols, Ultisols, Inceptisols, and Vertisols, found on O'ahu?
3. What are the characteristics of each of these soils?

8. Life

Animals

1. What are biogeography and zoogeography?
2. Distinguish between placental, marsupial, and monotreme mammals.
3. Why did marsupials and monotremes survive in Australia?
4. What is the name of each Realm and what distinguishes it?
5. What are some characteristic animals of each Realm?

Terrestrial Biomes

1. What is a biome?
2. What are the climate factors that influence biome location?
3. Approximately where on the Earth are each of terrestrial biomes located?

Tropical Biomes

1. What controls the climate of each tropical biome?
2. Where is each of the tropical biome types located?
3. What are some characteristics of each tropical biome?
4. What is an environmental issue in each tropical biome?
5. What are some survival strategies for plants and animals in deserts?

Temperate Biomes

1. What controls the climate of temperate biomes?
2. Where is each of the temperate biome types located?
3. What are some characteristics of each temperate biome?

Cold Climate Biomes

1. Where are tundra and taiga located and what are their climates like?
2. What are some characteristics of taiga and tundra?
3. What are some plant and animal adaptations in taiga and tundra?
4. Why do climates and their biomes vary greatly in mountains?
5. What is the relationship between tree line, latitude, and elevation?
6. What are the differences between tundra and alpine environments?

Hawaiian Vegetation

1. What islands have alpine and subalpine ecosystems?
2. Where were the wet forests located?
3. What islands have only lowland dry ecosystems?
4. Where are the largest remaining areas of native vegetation that have not been transformed by human activity?
5. On O'ahu, Maui, Kaua'i, Lana'i, and Moloka'i what is the major native ecosystem that remains?
6. Why does Hawai'i have a high extinction rate for native species?

9. Earth

Geomorphology

1. What is geomorphology?
2. What is the difference between structure and process?
3. Compare endogenic and exogenic processes. Where does each get its energy?
4. Think of some examples of landforms created by each of these forces.
5. What are uniformitarianism and catastrophism?
6. Think of an example of a violation of the principle of uniformitarianism.

Interior of the Earth

1. Describe the interior layers of Earth.
2. Why do different layers have different densities?
3. Compare oceanic and continental crust.
4. What is the Moho?
5. What are the lithosphere and asthenosphere and where are they located?
6. Distinguish between igneous, sedimentary, and metamorphic rocks and give examples of each.
7. What are felsic and mafic rocks?

Plate Tectonics

1. What spurred the development of the theory of plate tectonics and how was it confirmed?
2. Describe plate tectonics.
3. What are the names of the largest plates?
4. What are mid-oceanic ridges, subduction zones, lithospheric plates, transform faults, deep ocean trenches, and sea-floor spreading?
5. Distinguish between convergent, divergent, and transform plate boundaries.
6. What causes tectonic plates to move?

History of Plate Movement

1. Describe plate movements and locations over the past 225 million years.
2. How did plate movement affect the distribution of mammals?
3. What directions are the largest plates moving today?
4. What are island arcs and where are they found?

Hot Spots

1. What is a hot spot?
2. What formed the Hawaiian Islands and Emperor Seamount chains?
3. Explain the differing ages of rocks on the different Hawaiian Islands.

4. What are two different theories to explain the bend in the Hawaiian Island-Emperor Seamount chain?

10. Mountains

The Crust

1. What is a hypsometric curve?
2. What are the average depths of the oceans and average elevation of exposed land? The highest elevation? The lowest depth?
3. What are continental shields and where are they located?
4. How does new continental crust form and what are terranes?

Folding & Faulting

1. What causes the tension and compression that creates landforms?
2. Describe the compressional sequence of folding and the landforms produced.
3. How did the Himalayas form? The Appalachian Mountains? The Alps?
4. What are some landforms created by tension and how do they form?
5. What is the Hilina Pali Fault System and why did it form?

Earthquakes

1. What causes earthquakes?
2. Why are most earthquakes located at plate boundaries?
3. What motions do earthquakes produce at the surface?
4. How is earthquake intensity measured? How much larger is a magnitude 4 earthquake than a magnitude 3? Than a magnitude 2?
5. What causes earthquakes in Hawai'i and where do most of them occur?

Volcanoes

1. How do felsic and mafic magmas differ?
2. Compare effusive and explosive eruptions and the volcanic cones they produce.
3. Where do effusive and explosive eruptions occur and what is the source of their magma?
4. What kind of volcanism created the Philippines? The Hawaiian Islands? The Andes? Japan? The Cascade Range?
5. Why is volcanism active at lithospheric plate boundaries?

Hawaiian Volcanoes

1. Which volcanoes are active in Hawai'i?
2. What are rift zones?
3. What is a lava hazard map and what areas are the most hazardous?
4. Which volcanoes are dormant in Hawai'i? Which are extinct?
5. What is the rejuvenated stage of volcanism and what are some examples of it?

11. Valleys

Weathering & Landslides

1. What is weathering?
2. What are some of the ways rock is physically broken apart and what are some resulting landforms?
3. What are some of the ways rock breaks down chemically and what are some resulting landforms?
4. What types of landslides occur in Hawai'i and what are their characteristics?
5. How have landslides shaped features of the Islands?

Stream Patterns

1. Distinguish between erosion, transportation, and deposition.
2. What are drainage basins and divides and how are they related to stream flow?
3. What are the most common drainage patterns and what causes them to form?
4. What is a water gap?

Fluvial Landforms by Erosion

1. How do streams erode their beds?
2. How is sediment transported?
3. What is a stream profile?
4. Describe some of the landforms of floodplains.
5. What is a nickpoint and how does it move?

Fluvial Landforms by Deposition

1. What are some characteristics of floodplains?
2. Why are floodplains especially hazardous?
3. What causes alluvial terraces to form?
4. Describe 3 types of delta and give examples of each.
5. Why is the Ganges delta particularly hazardous?

Fluvial Landforms in Hawai'i

1. Describe the sequence of fluvial landform development in Hawai'i.
2. What are planezes, amphitheater-headed valleys and palis, and how do they form?
3. What causes the steep walls of amphitheater-headed valleys?

12. Erosion

Erosion by Wind

1. Compare wind to other exogenic processes.
2. In what ways does wind erode the surface and what landforms are created?
3. How is material transported by wind and what is the relation to grain size?
4. What are some depositional landforms of wind?
5. What landforms in Hawai'i have been shaped by wind?

Waves

1. How do waves get energy from sunlight?
2. Describe the process of wave and swell formation.
3. What determines wave height?
4. What is meant by wave height, wave period, wave length, crest, and trough?
5. What is the relationship between wave period and speed?
6. How are Hawai'i surf heights reported?
7. How are tsunamis generated and how fast do they travel?
8. About how long would it take a tsunami to reach Hawai'i from Alaska? From California? From South America?

Coastal Landforms

1. How do waves erode solid land?
2. What are some erosional landforms of coasts?
3. How can coastline features exist both above and below present day sea level in Hawai'i?
4. What are some coastal depositional landforms?
5. Explain how atolls and guyots form.

Erosion by Ice

1. What is the relationship between the amount of ice, global temperatures, and sea level and how have they changed over the past two million years?

2. Distinguish between ice sheets, highland ice fields, and alpine glaciers.
3. What are glacial plucking and abrasion?
4. What are some erosional landforms of glaciers?
5. What are some depositional landforms of glaciers?
6. What evidence exists of glaciation in Hawai'i?
7. How was the Hawaiian environment affected during periods of glaciation?