Energy and Radiation
Sun, Earth's Surface and atmospheric Processes

Fill in the blanks with a term from the list below. Cross them off as you go.

Almost all of the energy that drives processes on the earth comes from the sun and is called in-coming solar radiation or _____. This energy drives the physical processes (winds, ocean currents, hydrologic cycle) and the life processes (photosynthesis) at the earth's surface and atmosphere. Understanding the energy budget is essential to understanding these processes. Ultimately there is a _____between the sun's energy that is intercepted by the earth (and its atmosphere) and the amount that is returned to space. The amount coming in equals the amount going out, so the earth as a whole (planet) has an _____ _____ where these amounts balance.

All of the energy that the sun produces is some part of the _____ _____. This energy is divided in regions or _____ based on its _____ which are inversely related to frequency. _____ frequency energy has a _____ wavelength and carries a lot of energy. The very shortest wavelengths of energy, _____ and _____ _____ are hazardous because of the large amounts of energy transferred in these parts of the spectrum. They are lethal to most life forms. The longest wavelengths are _____ _____ and _____ and are much less dangerous. In between the extremely short wavelengths and the very long wavelengths is the middle part of the spectrum where most energy exchange takes place. In this middle part of the spectrum, the sun's energy cascades through the atmosphere as _____ _____. The energy then returns to space as _____ _____. About 9% of the energy is _____ and is absorbed in the stratosphere by the _____ _____. This absorption causes the stratosphere to be relatively warm. About 50% is _____ _____ consisting of the colors of the spectrum known as _____. The remaining 41% is _____ _____. Human eyes are not sensitive to this energy, but it behaves just like light, i.e., it can be _____, _____ or _____. The amount reflected is determined by the material's _____. This is important because reflected energy does no _____, and is lost to the system. Since the gases that make up the atmosphere (including water vapor) are _____, radiant energy (sunlight) is transmitted through easily through the atmosphere.

balance	reflected	transparent
isolation	electromagnetic spectrums	albedo
X-rays	equilibrium temperature	work
short wave	transmitted	visible light
microwaves	high	near infrared
ultraviolet	short	radio waves
gamma rays	long wave	Roy G. Biv
absorbed	ozone (layer)	bands
wave length		

Once the energy is absorbed by the surface, it is then radiated as long wave or _____ _____ energy, which humans can feel as _____ _____. Since this energy moves upward from the ground surface, another term is _____ _____. This upward moving heat is then absorbed by gasses in the atmosphere, primarily _____ _____ and _____ _____. This heat energy is then _____: part of it goes out to space, but part of it is directed back towards the surface. This is called _____ _____ and keeps the lower atmosphere warmer than it would otherwise be. Since the earth's atmosphere is relatively transparent with respect to light, but somewhat "opaque" with respect to heat, the analogy is often made to a _____.

Human activity can modify the rate at which these energy transfers take place. Burning of _____ _____ (_____, _____ and _____ _____) to generate electricity (among other things) pours more carbon dioxide into the atmosphere. This _____ radiant heat loss (to space) and makes the lower atmosphere _____ with no change in the amount of solar energy coming in.

Human intervention affects both the lower atmosphere (_____) and the upper atmosphere (_____). A particular class of chemicals vital to modern industry known as _____ destroys ozone in the stratosphere. With less ozone to absorb dangerous ultraviolet radiation, the potential health consequences are higher rates of _____ _____ and eye problems such as _____. Less UV absorption would also result in a cooler stratosphere.

Finally, human activity modifies the surface of the earth and thus the energy transfers there. The clearing of _____ _____ _____ lowers the absorption of _____ used in photosynthesis. Such clearing also modifies the surface energy budget and surface water budget. While claims that tropical rain forests will become _____ are exaggerated, there is less no question that this clearing increases the potential for _____ _____. With the soil less able to hold moisture, there is less water _____ from the surface. Since evaporation is a _____ _____, the ground temperature would rise. Less water evaporating from the soil would also result in less water vapor in the atmosphere, so _____ _____ would decrease. In terms of _____ _____, such changes represent _____ feedbacks where one change accelerates another change.

troposphere	warmer	fossil fuels
sensible heat	cataracts	deserts
soil erosion	ground radiation	evaporated
re-emitted	thermal infrared	cloud cover
carbon dioxide	water vapor	systems theory
CFCs	coal, oil, natural gas	positive
skin cancer	tropical rain forest	retards
counter-radiation	stratosphere	cooling process

greenhouse CO_2