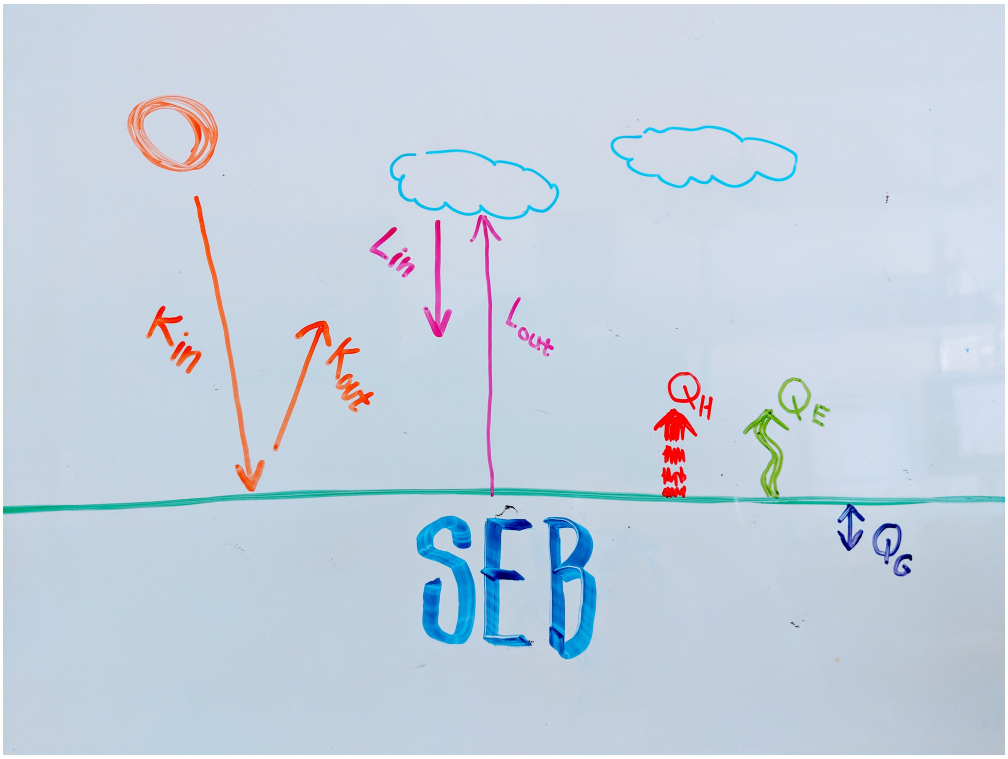
Homework1 Key

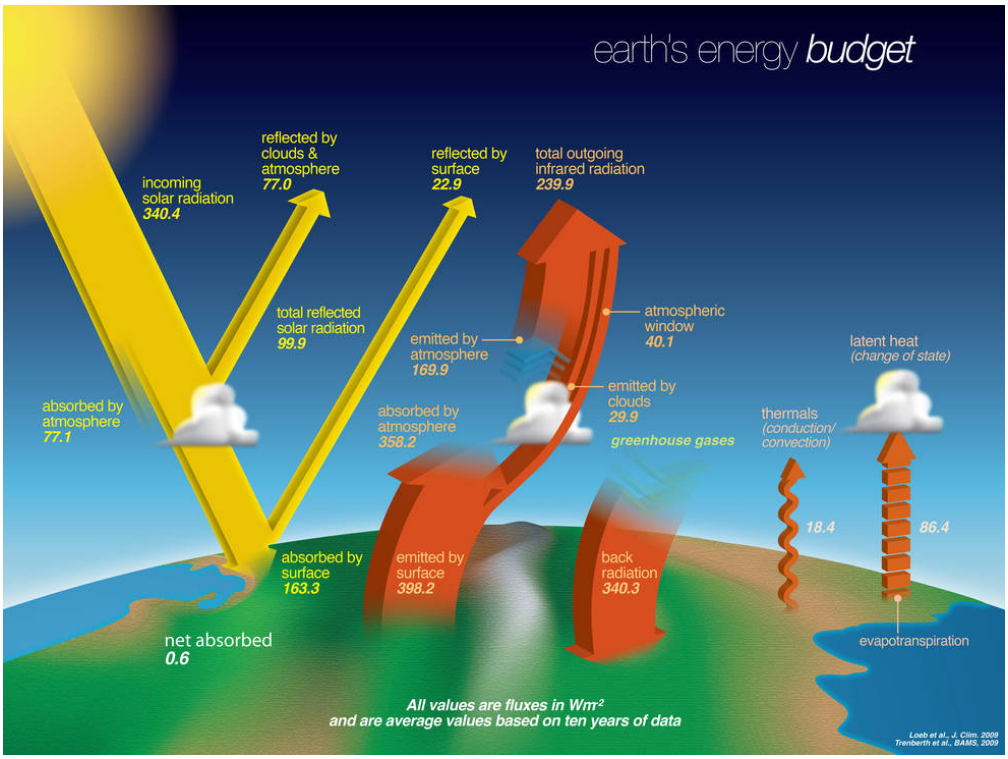
Part I

1. Surface Energy Balance must include the following components:
    - incoming shortwave (K_i) (or net shortwave shown as $K(1-\alpha)$)
    - outgoing shortwave (K_o)
    - incoming longwave (L_i)
    - outgoing longwave (L_o) (or net longwave going out)
    - sensible heat (Q_H)
    - latent heat (Q_E)
    - ground heat flux (Q_G)

For the relative magnitude of each flux, the radiative fluxes should be larger than the other heat transfers, and ground flux should be very small. Some examples are shown below:



example diagram of surface energy balance



example diagram of surface energy balance

2. Table of relative ragnitude for each flux
    - H = relatively higher
    - M = in the middle
    - L = relatively lowest

	Parking Lot	**Irrigated Lawn**	**non-irrigated lawn**
$K(1-\alpha)$	H	M	L
L_o	H	L	M
Q_H	H	L	M
Q_E	L	H	M

The main takeaway here should be the differences between latent and sensible heat!

Part II

1. Table of temperatures at each surface for day
2. Table of temperatures at each surface for night

	Parking Lot	**Irrigated Lawn**	**non-irrigated lawn**
day	35.9	28.8	31.89

	Parking Lot	Irrigated Lawn	non-irrigated lawn
night	4.98	7.14	7.3

3. Painting the parking lot with a white cementitious coating lowered the surface temperature to **18.42 degrees C**.

4. Using surface temperature, calculate the latent energy flux for the irrigated lawn.

```
# Tetens
sat_vp <- function(T){
  e <- 0.61078*exp(17.27*T/(T+237.3))
  return(e)
  }

# vars from the last part
k_E = 100
T_a = 28
Ts = 26.8
RH_s = 1
RH = 0.4
# Latent Heat
LE = k_E*(sat_vp(Ts)*RH_s - sat_vp(T_a)*RH) # W/m^2
LE
```

```
## [1] 201.1682
```

a) How much water (in kg) would evaporate from each m^2 from 10am - 2pm?

```
# Latent energy of vaporization
cp = 2200*(10^3) # J/kg
# solve for amount of water
mass_flux = LE/cp # kg/s/m^2
# over 4 hours
water = mass_flux*3600*4
water # kg / m^2
```

```
## [1] 1.316737
```

b) How many gallons of water would be necessary to irrigate a 3,000 square foot lawn each day in August?

```
sqft = 10.76 #sqft/sqm
lawn = 3000 #sqft
gal = 3.79 #kg
# convert from kg/m^2 to gallons
gallons = water/0.7/sqft*lawn/gal
gallons
```

```
## [1] 138.3792
```

Part III

As long as you included a graph of either NDVI or temperature relating to a sociodemographic factor and wrote a paragraph explaining what you thought the relationship was, and why the relationship exists, you got full points!