



Green Roof at City Hall

Ecology in Action

ROOFTOP GARDENS

WHY A ROOFTOP GARDEN?

- ✖ Reduce the “urban heat island effect”
- ✖ Reduce amount of greenhouse gas
- ✖ Provide more space for agriculture
- ✖ Reduce and clean storm water runoff
- ✖ Reduce energy consumption
- ✖ Increase the beauty of cities



URBAN HEAT ISLAND EFFECT

- ✖ A phenomenon in which the ambient air temperature in cities is higher than in its surrounding suburban and rural areas



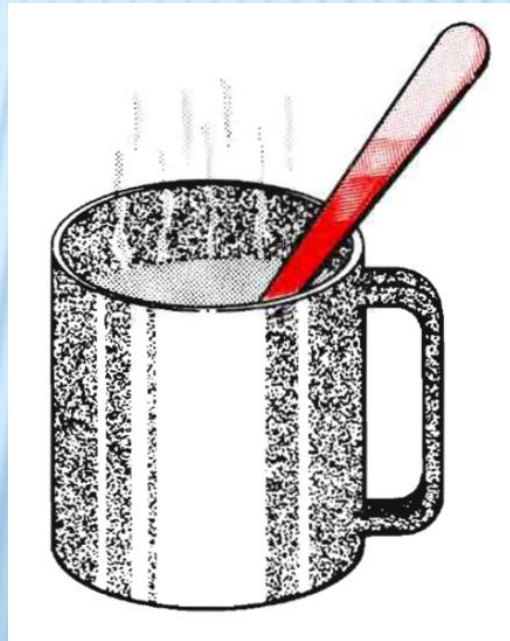
Causes:

- + Materials (such as concrete and asphalt) absorb and radiate more heat than natural surfaces found in rural settings
- + Tall buildings - more surfaces that reflect and absorb light and block wind
- + Waste heat from energy usage – includes cars, air conditioning, industries
- ✖ Creates higher energy demands to keep buildings cool
- ✖ Affects weather and climate

HEAT TRANSFER BASICS

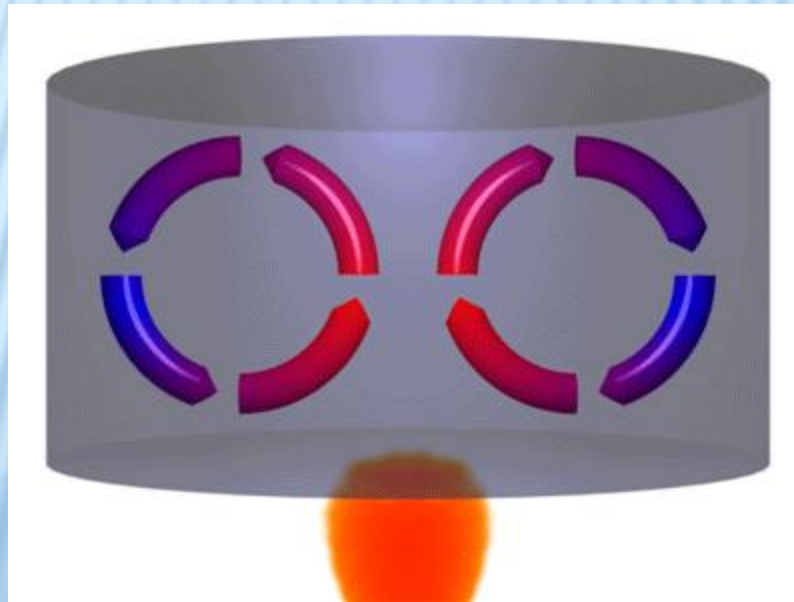
CONDUCTION

- ✖ Transfer of heat by direct contact of particles in matter
- ✖ In solids, close vibration of atoms next to each other



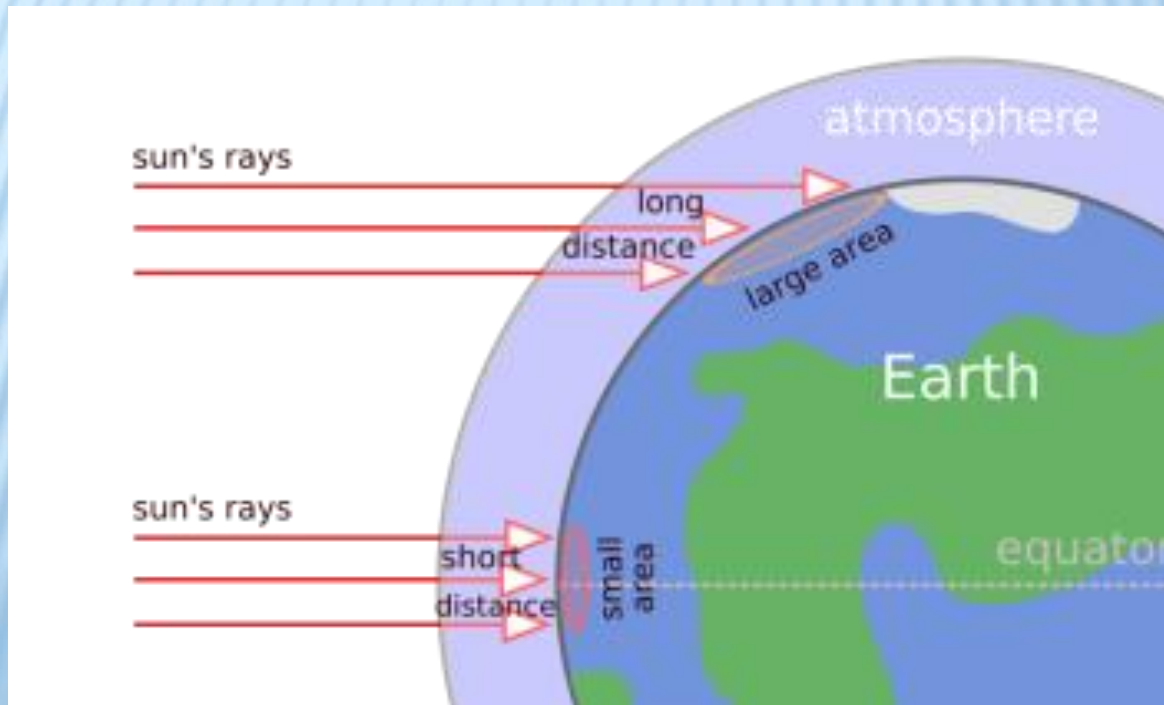
CONVECTION

- ✖ Transfer of heat by fluid or gas moving across a boundary
- ✖ Natural convection occurs by buoyancy forces



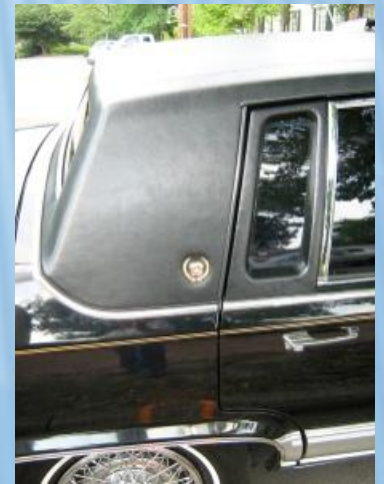
RADIATION

- ✖ Transfer of thermal energy through space
- ✖ This is how the sun heats the surface of the Earth!
- ✖ Radiation can be transmitted, reflected and emitted from a surface



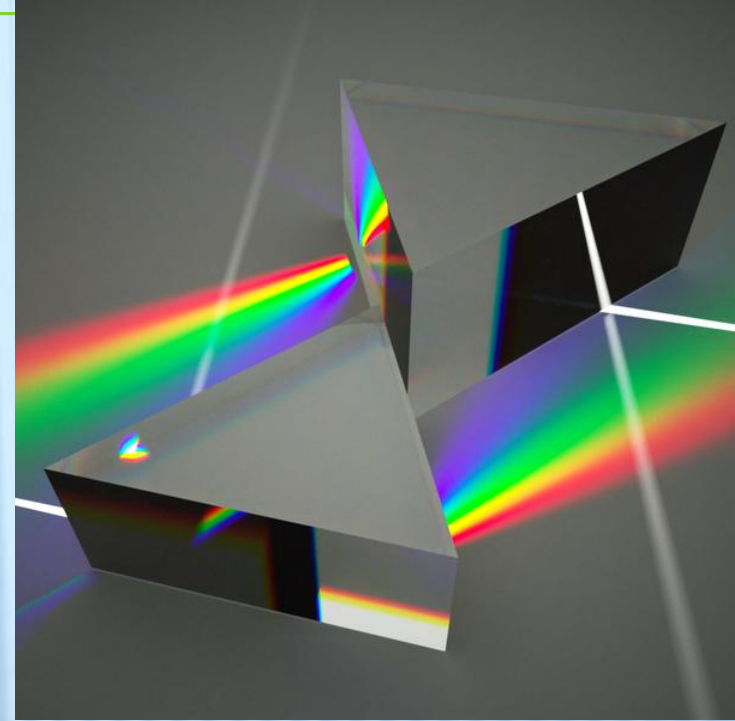
MATERIALS!

- ✖ Insulators
 - materials that reduce the rate of heat transfer
- ✖ Absorbers
 - materials that take up the energy of light
- ✖ Reflectors
 - materials that change the direction of light waves



COLOR, LIGHT, AND HEAT

- ✖ All colors absorb light and reflect only the wavelengths of their color
- ✖ White reflects all wavelengths of light
- ✖ Black absorbs all wavelengths of light
- ✖ The energy of the absorbed light is transferred into heat energy...
 - ➔ Black surfaces get **hotter** than other colors!



PLANTS TO THE RESCUE

HOW DO PLANTS REDUCE TEMPERATURE?

- ✖ Provide an alternative to common roof materials
- ✖ Absorb CO_2 and sunlight during photosynthesis
- ✖ Create shade

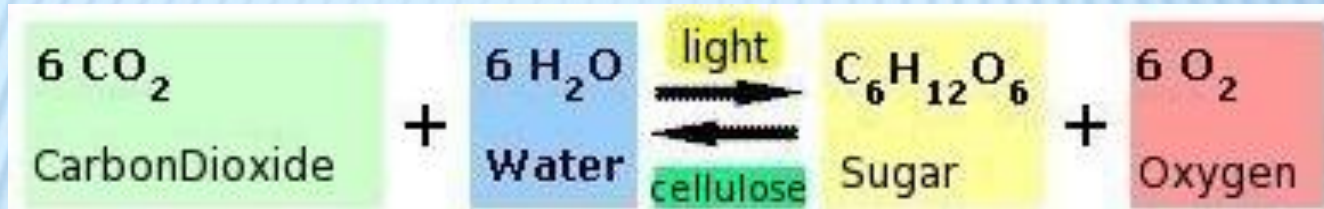


PHOTOSYNTHESIS

✖ Photosynthesis: how plants feed themselves

+ Occurs in the leaves of plants

+ Represented by the equation:



+ Uses carbon dioxide and energy from the sun

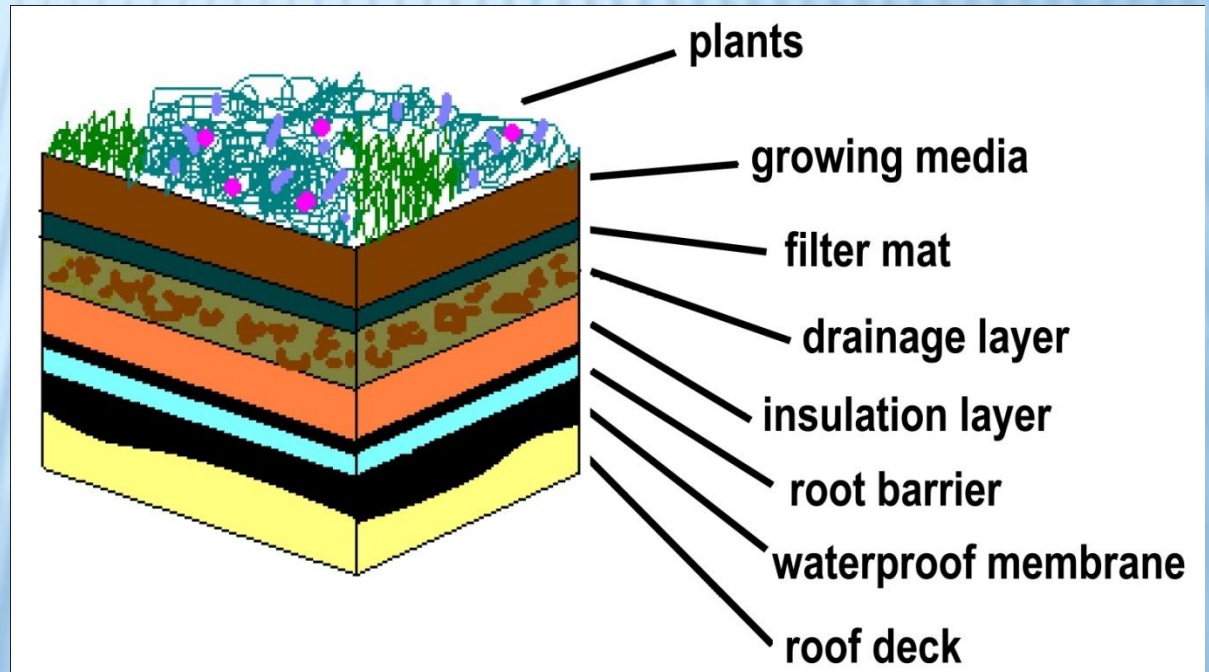
+ Produces oxygen

✖ Additional benefit: Photosynthesis helps reduce global warming by converting carbon dioxide molecules (a greenhouse gas)

CONSTRUCTING A ROOFTOP GARDEN

CONSTRAINTS OF A ROOFTOP GARDEN

- ✖ Condition of the roof
- ✖ Structural capacity of the roof
- ✖ Access to the roof
- ✖ Cost
- ✖ Irrigation
- ✖ Drainage



EXAMPLE

- ✖ This demonstration plot on a sidewalk in Portland, OR, shows the exact composition of the “green roof” on the building above it.



OUR ROOFTOP GARDEN PROJECT

✕ Team objectives:

- + Construct two identical model buildings
 - ✕ One with a black tar roof
 - ✕ One with a rooftop garden
- + Measure the temperatures inside and on the roof of the buildings while under a heat lamp (sun)
- + Graph the data



END

IMAGE SOURCES



http://www.explorechicago.org/city/en/about_the_city/green_chicago/Green_Roofs_.html



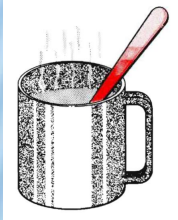
http://www.explorechicago.org/city/en/things_see_do/attractions/tourism/pepsico_rooftop_garden.html



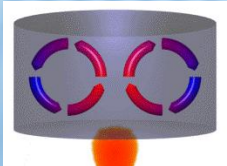
http://commons.wikimedia.org/wiki/File:Rockefeller_Center_Rooftop_Gardens_by_David_Shankbone.JPG



http://www.cityofchicago.org/content/dam/city/depts/doe/general/GreenBldRoofsHomes/GuidetoRooftopGardening_v2.pdf

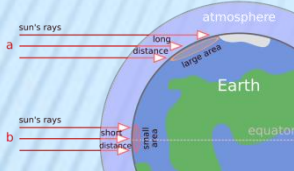


http://commons.wikimedia.org/wiki/File:Cup_for_Heat_Conduction_2010-08-17.png public domain image)



<http://commons.wikimedia.org/wiki/File:Convection.gif>

IMAGE SOURCES



Peter Halasz

http://commons.wikimedia.org/wiki/File:Oblique_rays_02_Pengo.svg



Thingermejig

http://commons.wikimedia.org/wiki/File:Polyisocyanurate_insulation_boards.jpg



Julo

<http://commons.wikimedia.org/wiki/File:Lupa.na.encyklopedii.jpg>



Sparkla

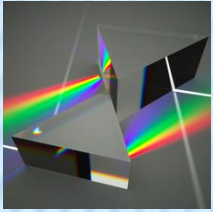
http://commons.wikimedia.org/wiki/File:Aluminium_foil_micrometer.jpg



CZ Martin

http://commons.wikimedia.org/wiki/File:1991_Cadillac_Fleetwood_gold-edition_black_vr.jpg

IMAGE SOURCES



<http://commons.wikimedia.org/wiki/File:Prism.png>



http://commons.wikimedia.org/wiki/File:Rooftop_Garden_in_Lalbagh_Fort.jpg

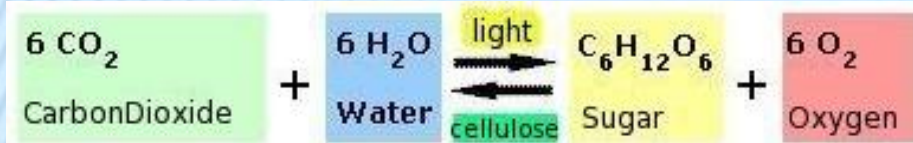


http://commons.wikimedia.org/wiki/File:Rooftop_garden_NYC.jpg



http://commons.wikimedia.org/wiki/File:LEAVE_24_0314.jpg

IMAGE SOURCES



<http://commons.wikimedia.org/wiki/File:Photosynthesis.jpg>
Original uploader was Joeriee at nl.wikipedia. Original uploader was Rmstock at en.wikipedia



Carleigh Samson, ITL Program, College of Engineering and Applied science



Denise W. Carlson, ITL Program, College of Engineering and Applied science