Catch and store energy

Compost is key

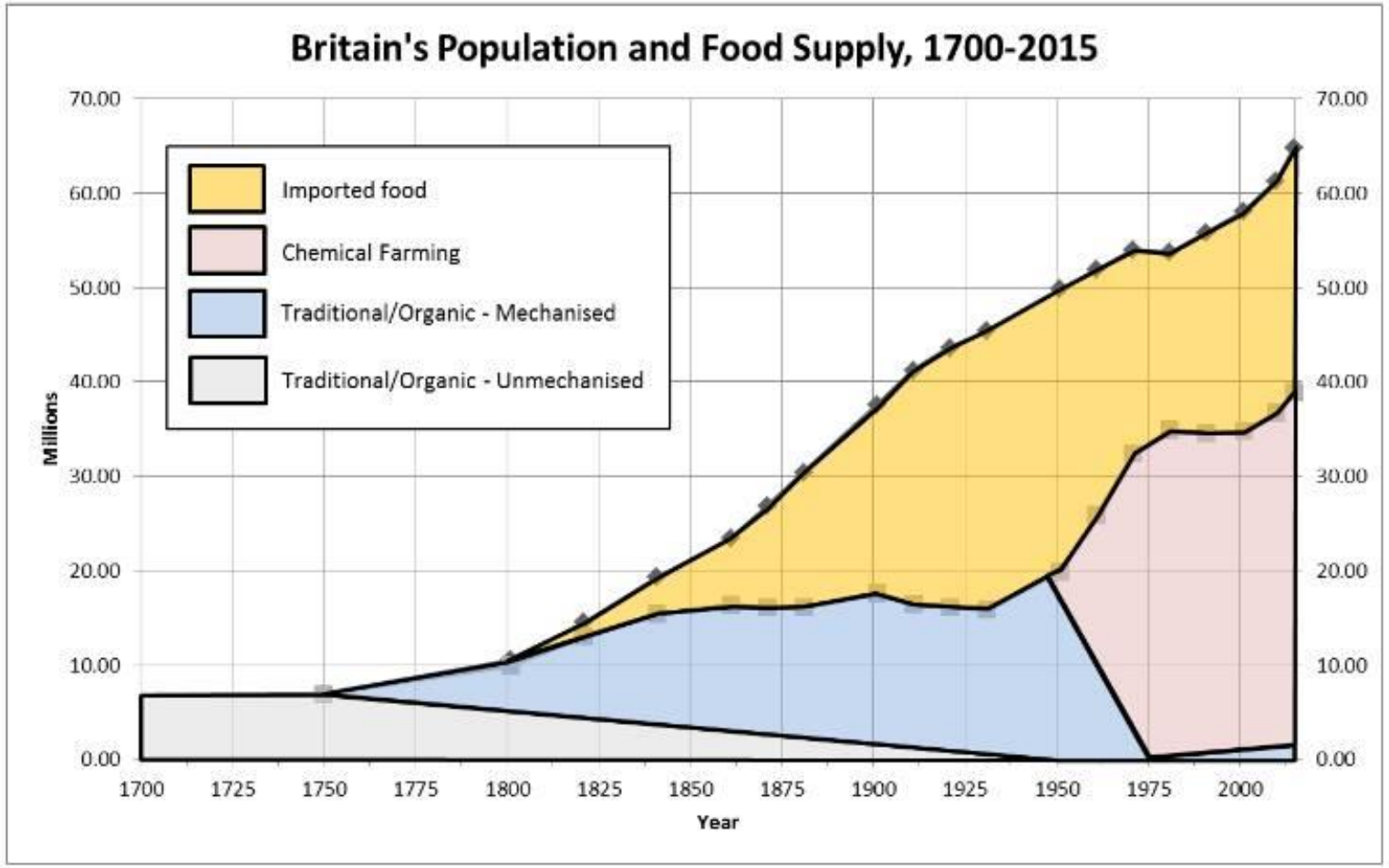
Soil

Third of Earth's soil is acutely degraded due to agriculture

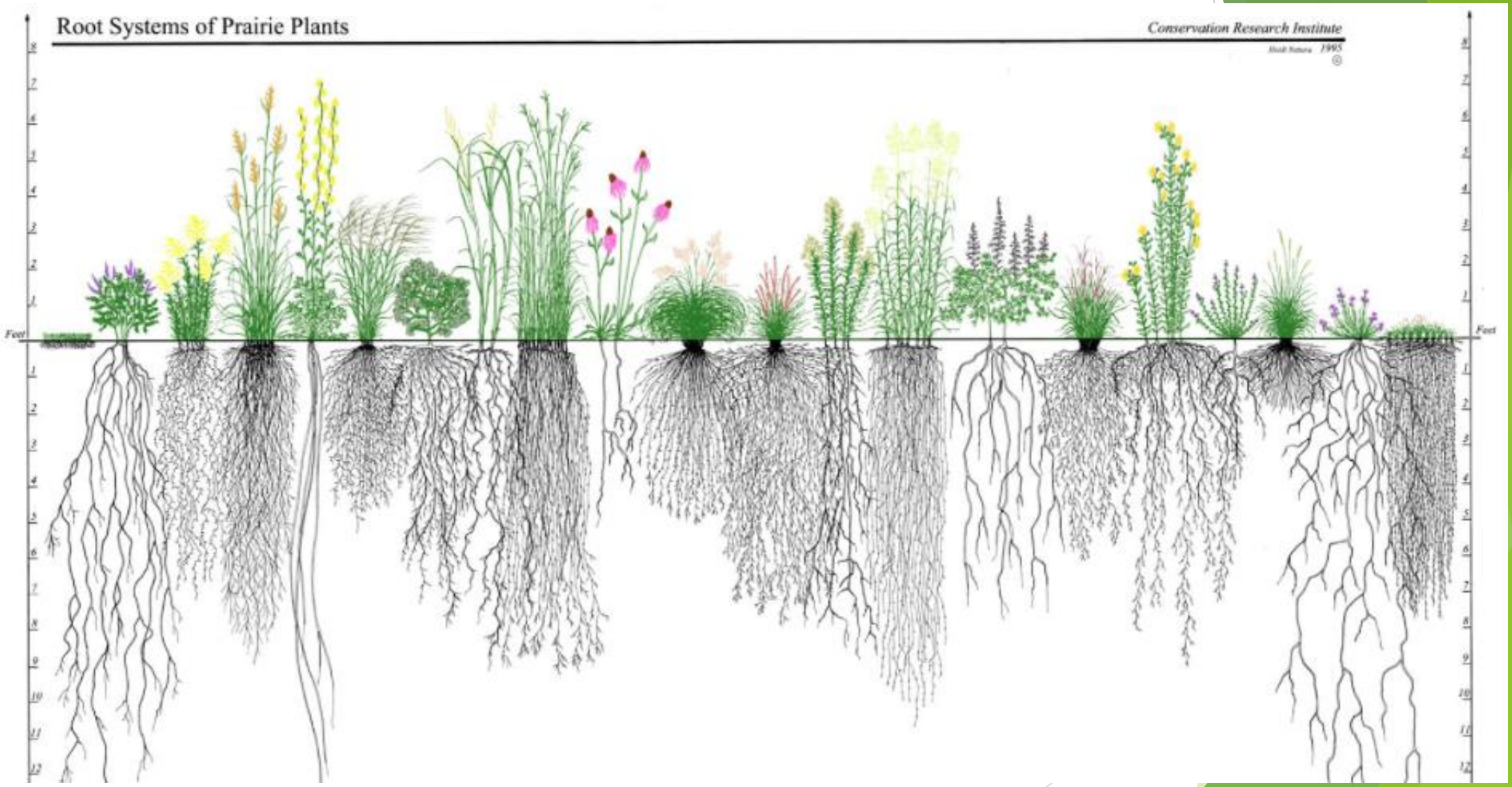
Fertile soil is being lost at rate of 24bn tonnes a year through intensive farming as demand for food increases, says UN-backed study

Jonathan Watts

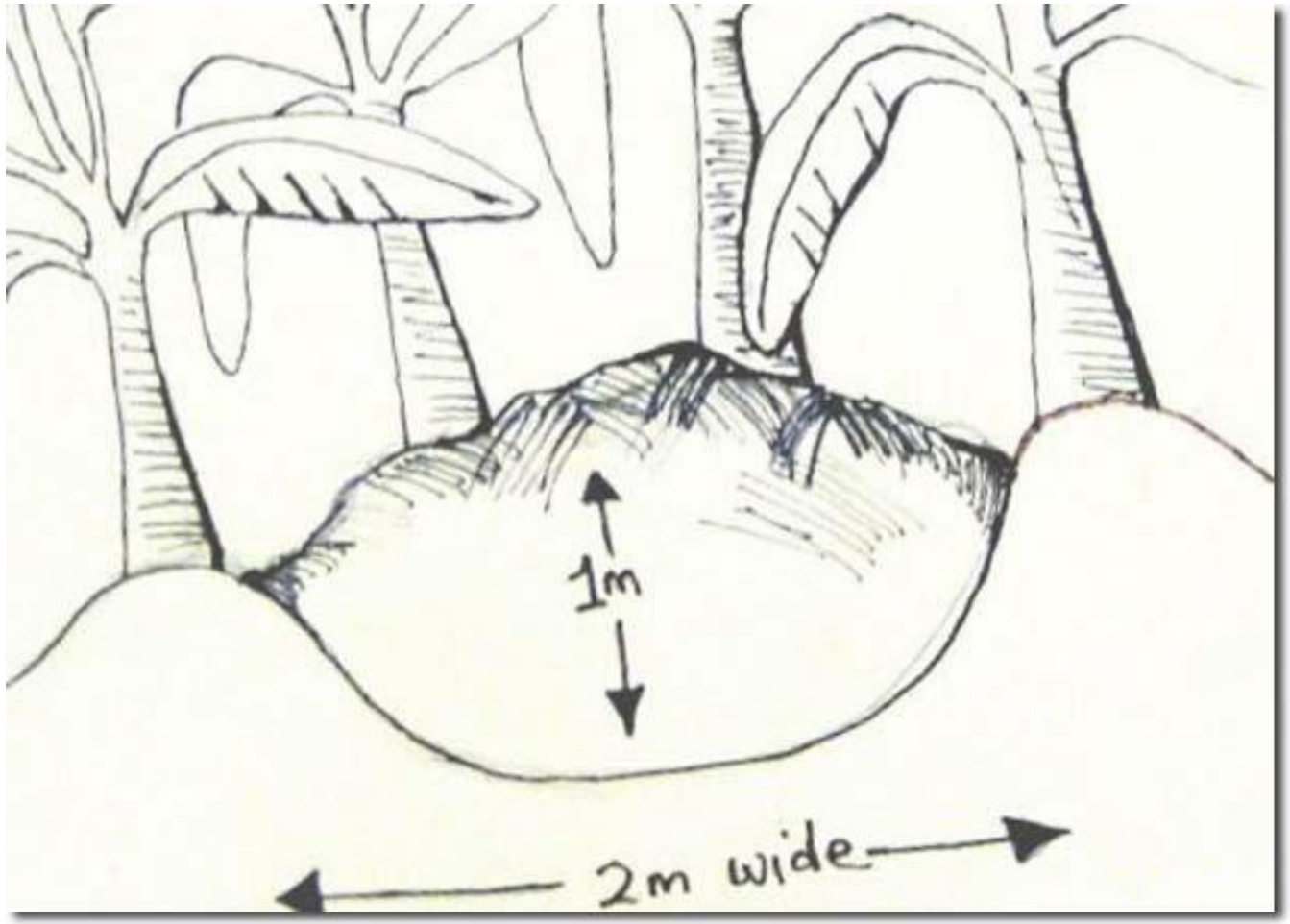
Tuesday 12 September 2017 18.18 BST


Britain's Population and Food Supply, 1700-2015
Imported food
Chemical Farming
Traditional/Organic - Mechanised
Traditional/Organic - Unmechanised
Millions
Year
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1700
1725
1750
1775
1800
1825
1850
1875
1900
1925
1950
1975
2000

Single root depth = competition


Root Systems of Prairie Plants
Conservation Research Institute
1995
Foot
Foot

Community power


1m
2m wide


1991
PAPUA NEW

Organic matter

Banana

Cassava

Vetiver, Lemongrass, or Citronella

Sweet Potato

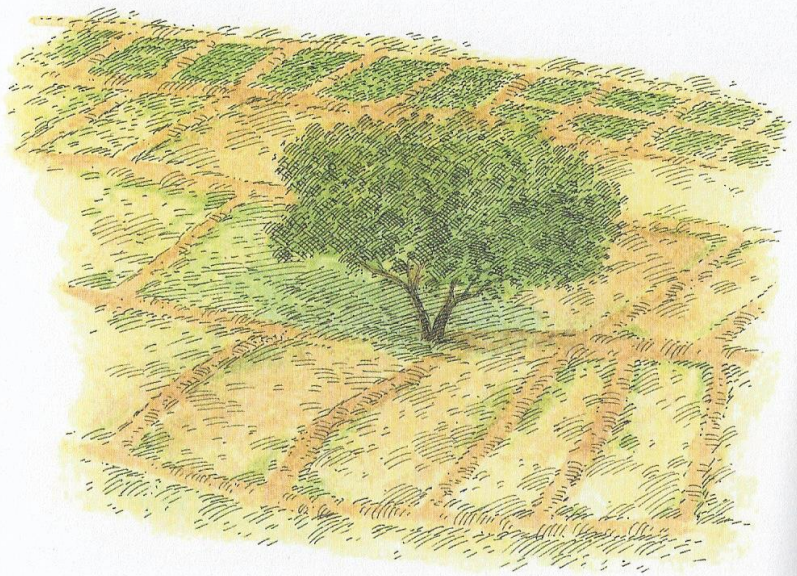
Taro

Yacouba Sawadogo – the man who stopped the desert


DESTA et al. 2005


Why Use Mulch?
tered
ThePermacultureStudent
Watered but Bare
Mulch
Watering only took bare soil from 140F/60
116F/46.6C, but 4-6”/10-15cm of mulch br
it down to 78F/25.5C.
Mulch was ~2x as effective as watering twi
—Matt Powers

Mulch



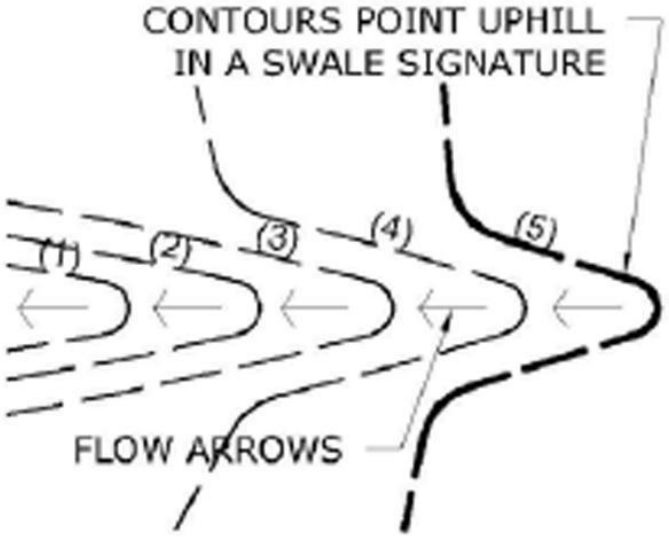
Grid gardens are often used to help capture rainfall in arid regions. Raised beds, developed for wet areas, are more widely known and promoted, but waffle-like sunken beds work better in dry lands. The ridges between basins are compacted, kept weed-free, and often paved with stones. They divert rain into the planted areas, while the depression of the soil in the basin captures water and allows it more time for deeper infiltration. The basin also reduces wind stress and evaporation.

The Anasazi people of the Southwest developed sophisticated rainwater harvesting systems with dams, reservoirs, and control gates. Crop yields were good in most years. Here is a farming terrace with a series of check dams at Mesa Verde.

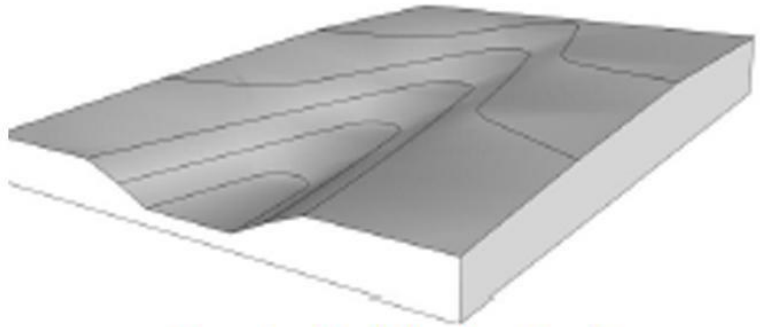
Curb Cuts

Street landscaping in Tucson is increasingly irrigated with rainwater. Curb cuts, which the city now allows with a permit, let water flow out of the street and into landscape plantings. These cuts can be done with hand tools or machines. A concrete cutting contractor would be helpful for multiple cuts. Rainwater harvesting from streets can transform a neighborhood from barren to fruitful.

Contour catchment



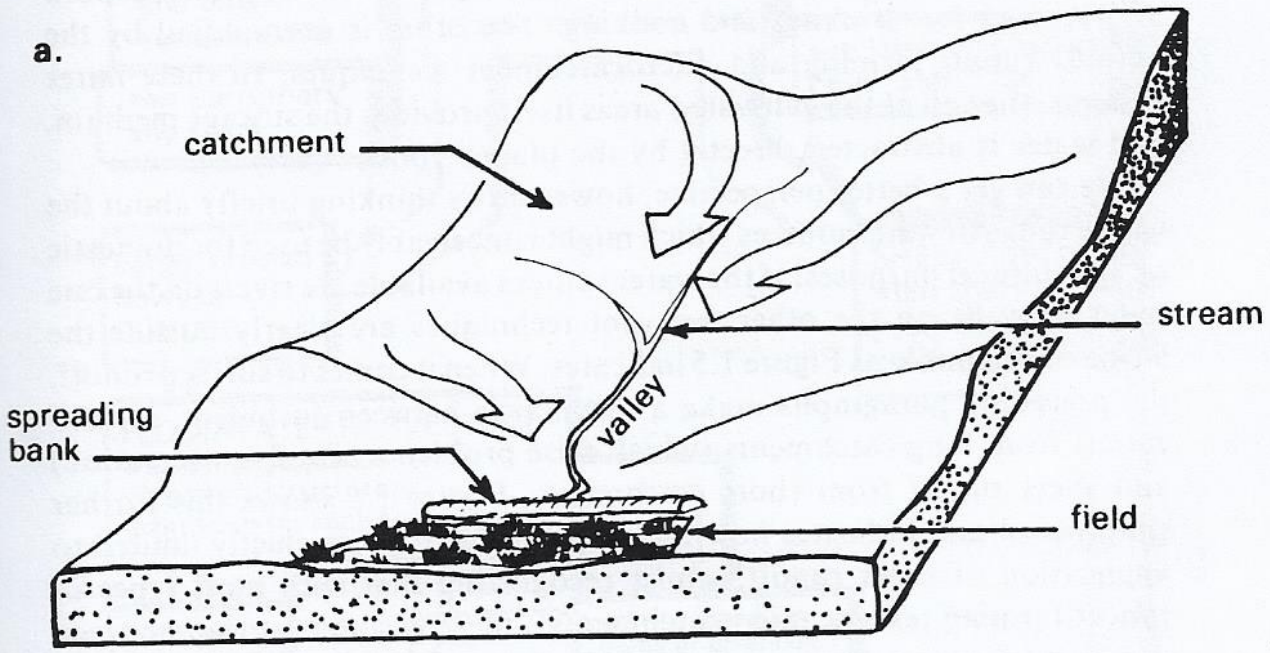
Swale Signature
1"=20' • Interval = 1'



Terrain Model of a Swale

Bhutan

harvesting'. This distinction can be emphasized by saying that in diagram 1.4i, the aim of both systems is to *concentrate* rainwater on cultivated areas, whereas in 1.4ii, it is necessary to *distribute* an already concentrated flood flow onto a field.



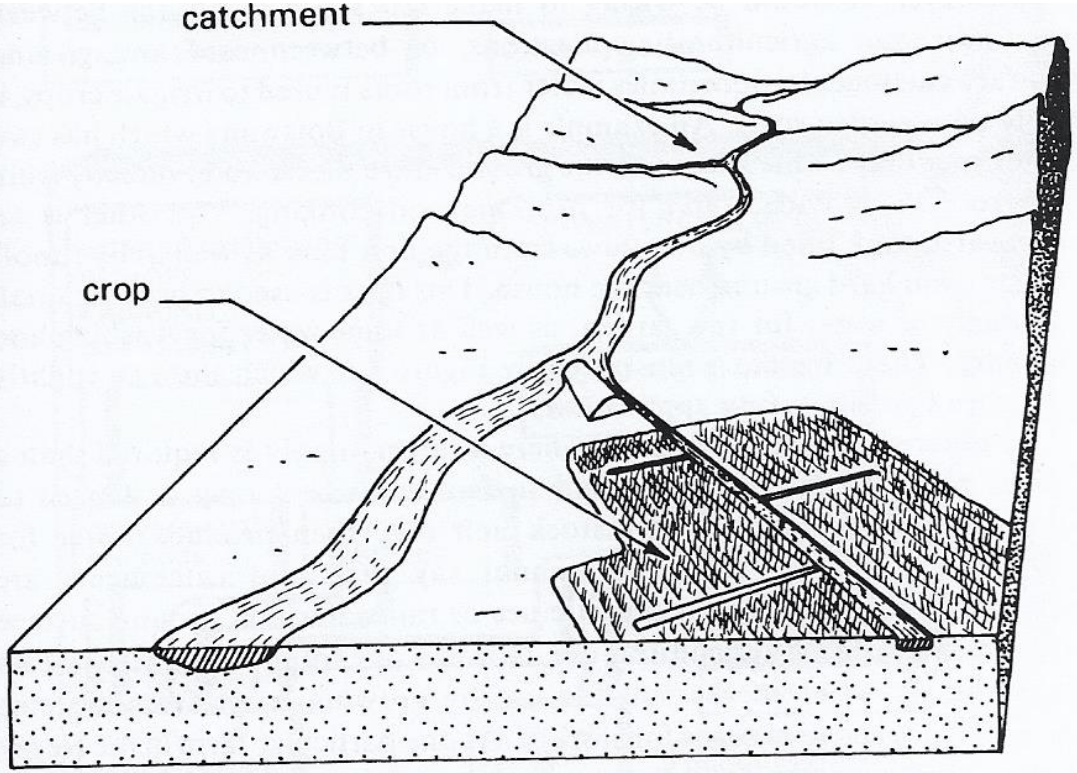
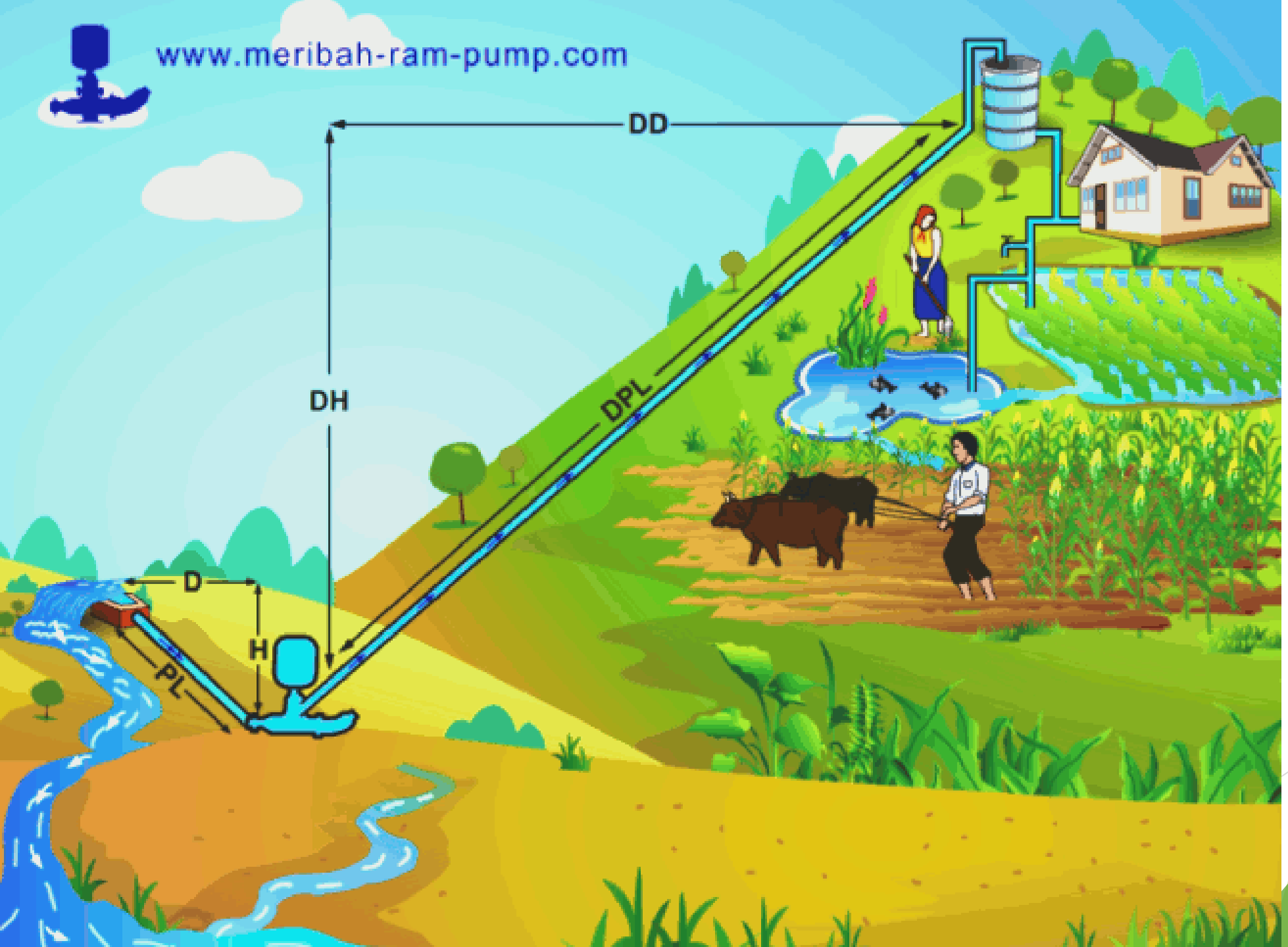
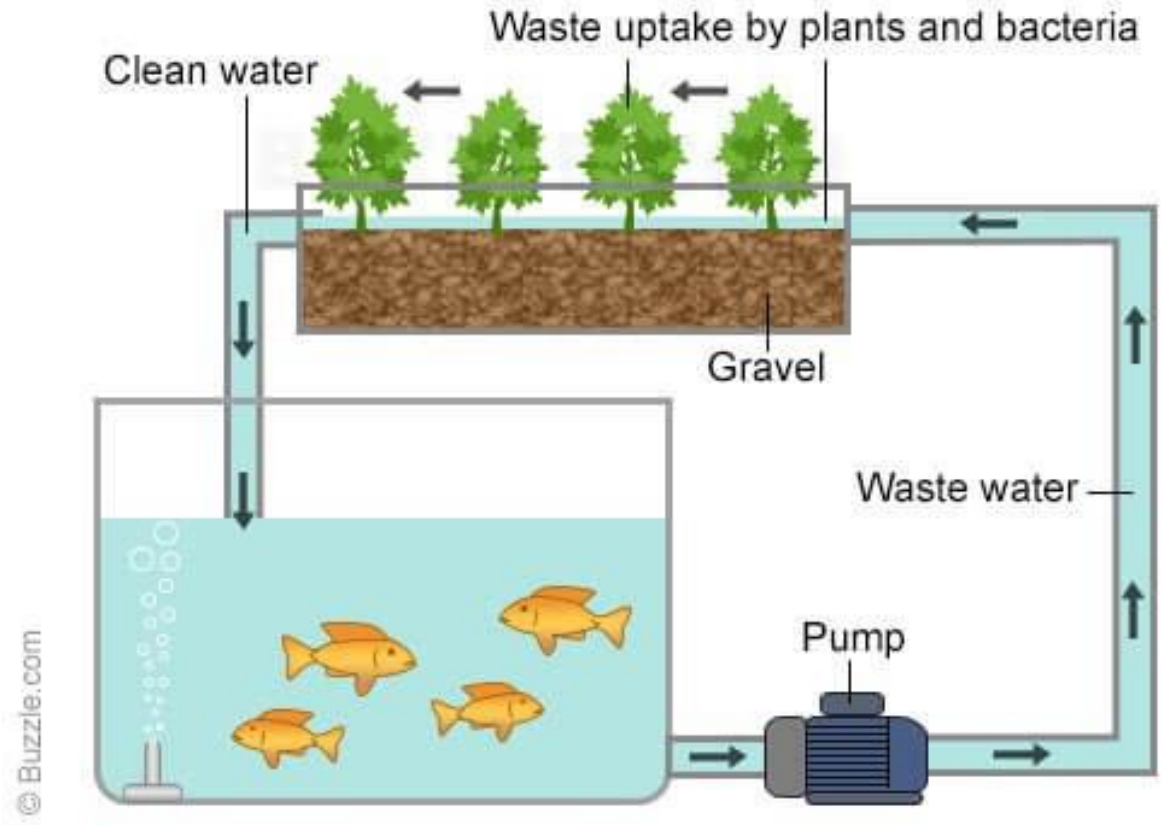


*Fig. 1.4 (ii) External catchments. Floodwater harvesting by water spreading (**a**) and diversion of spate flow (**b**). (Adapted from Kutsch 1982)*

Note: *Diagrams are schematic and not to scale.*


www.meribah-ram-pump.com
DD
DH
DPL
D
H
PL

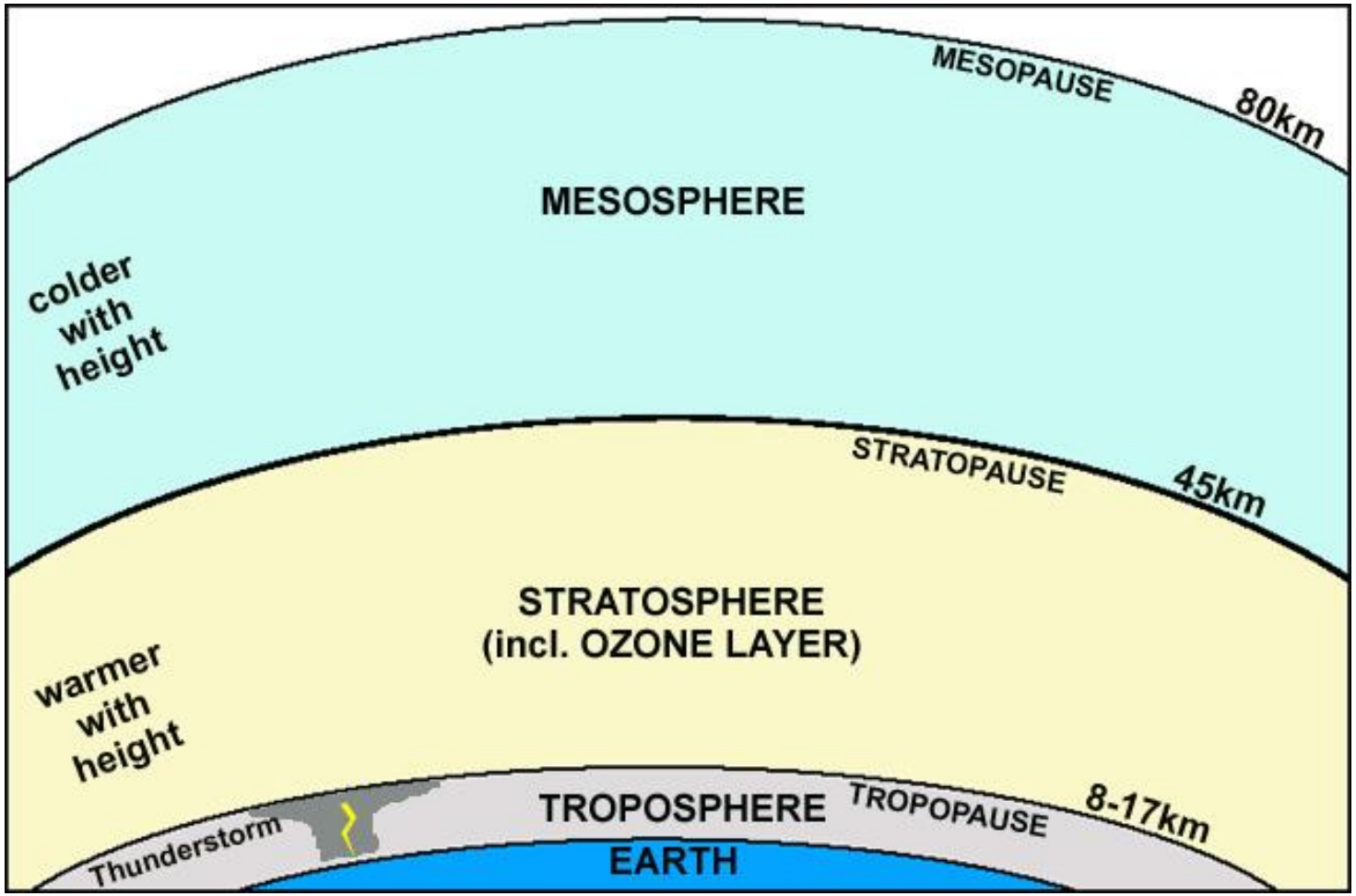
Media-based System




1
2
3
4

Systems

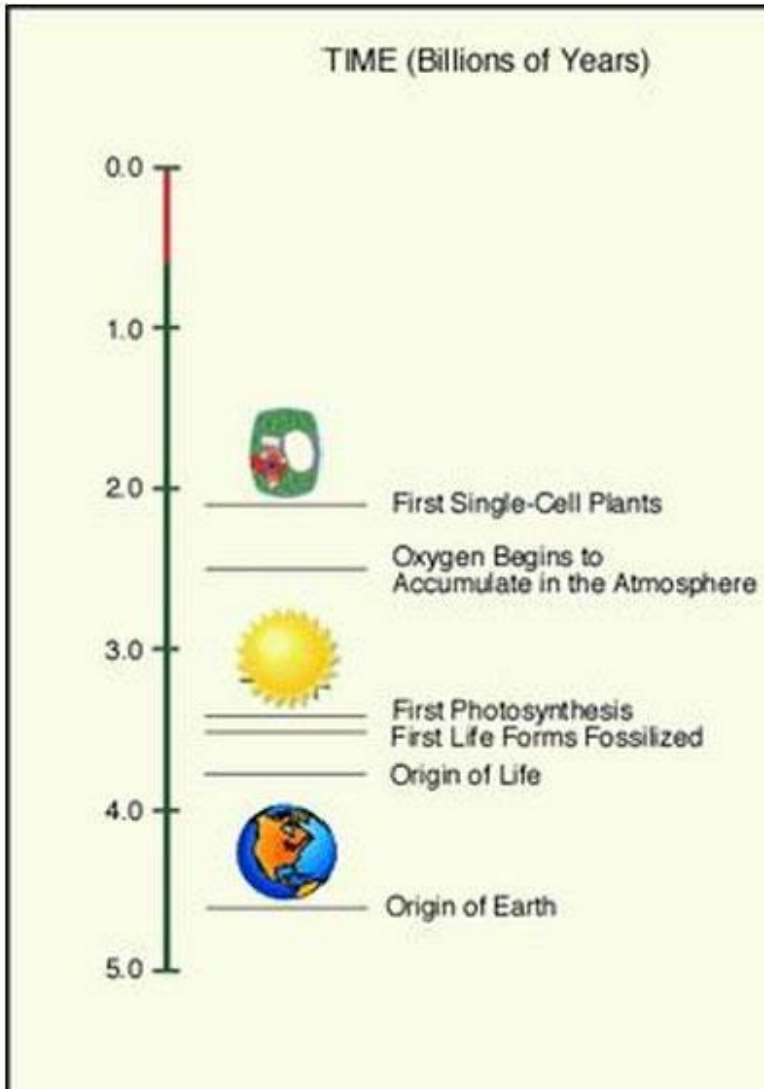
- 3333333333333333333333333333333333333333333333333333333333333333


MESOPAUSE
80km
MESOSPHERE
colder with height
STRATOPAUSE
45km
STRATOSPHERE
(incl. OZONE LAYER)
warmer with height
TROPOPAUSE
8-17km
TROPOSPHERE
Thunderstorm
EARTH

Evolution

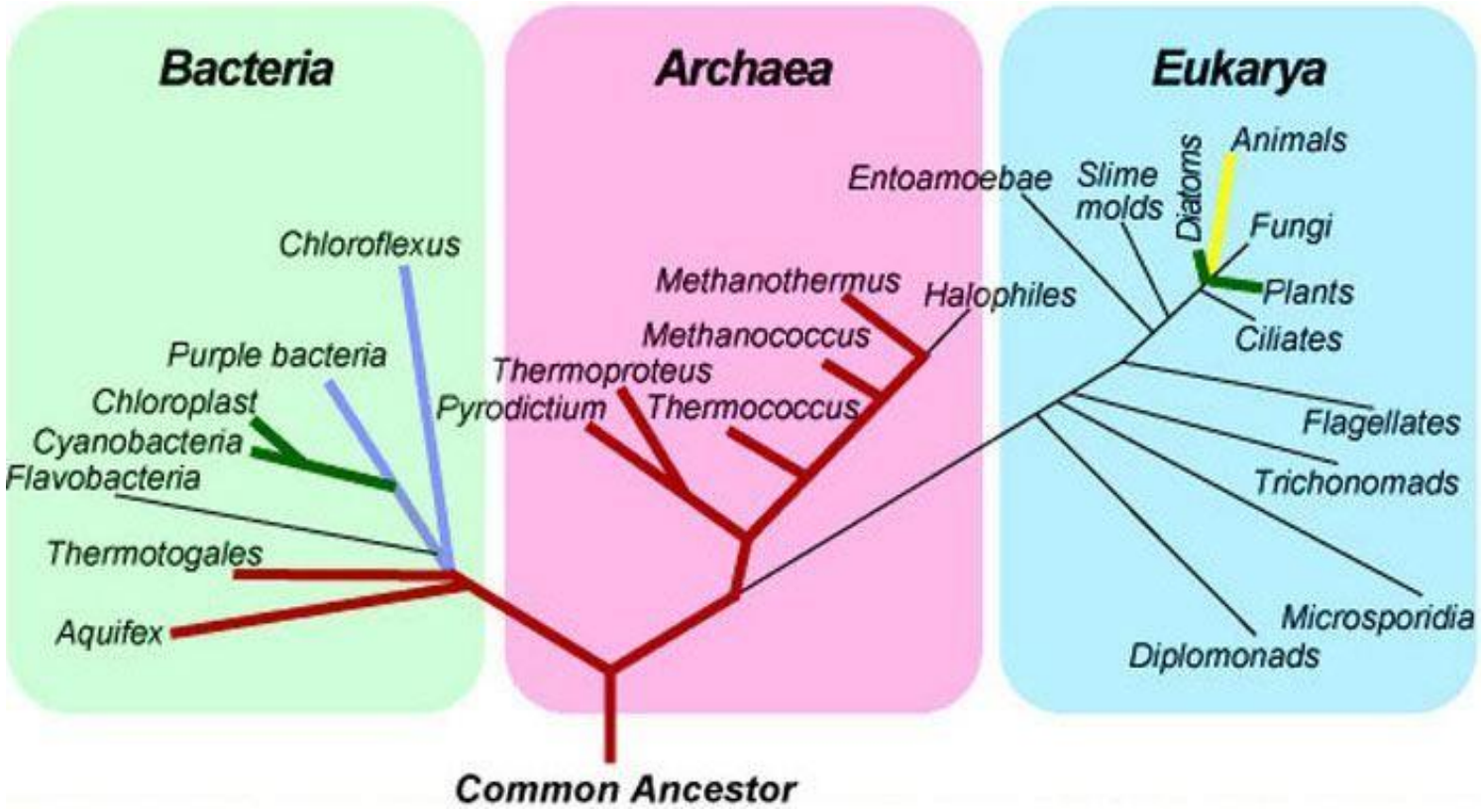
Over time nature builds ever more complex systems

There have been several mass extinctions, but each time diversity is restored a new and in greater number

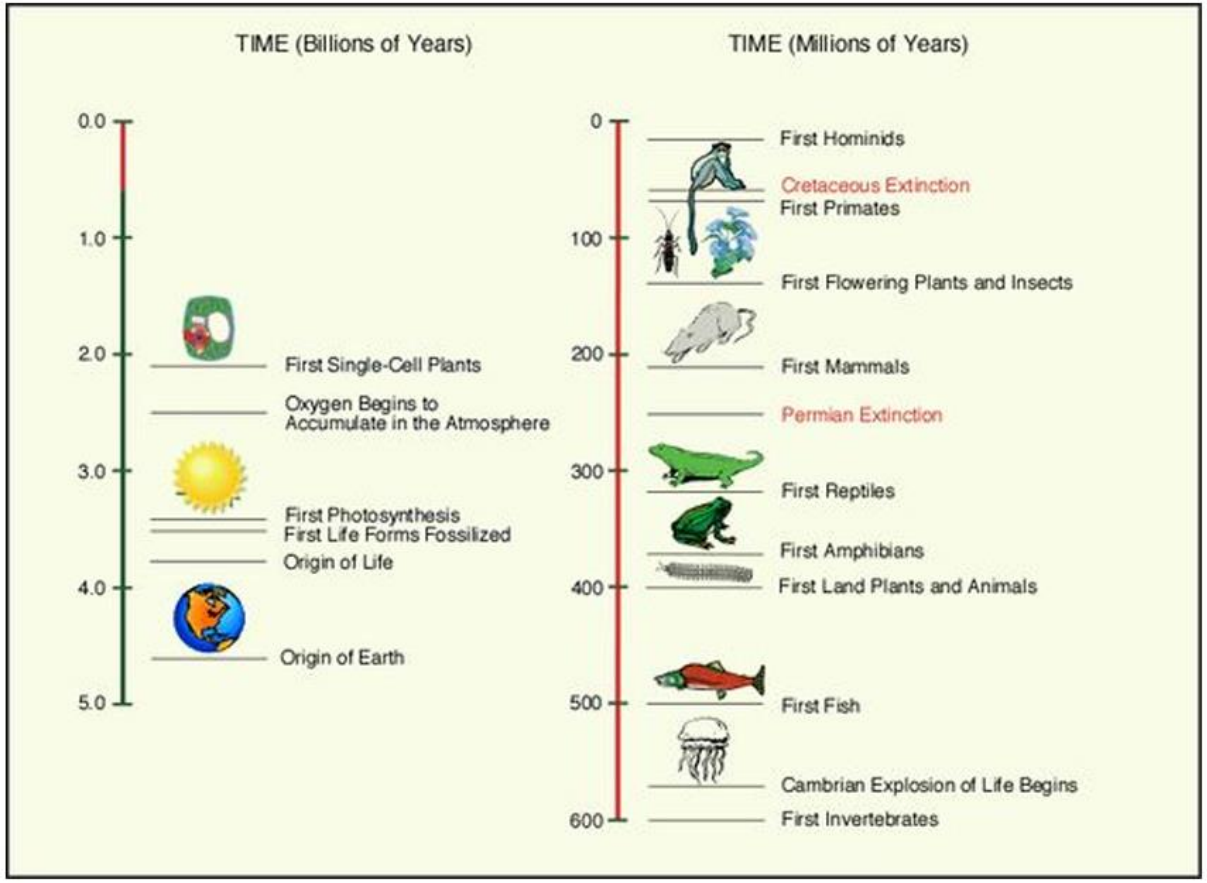

TIME (Billions of Years)
0.0
1.0
2.0
3.0
4.0
5.0
First Single-Cell Plants
Oxygen Begins to Accumulate in the Atmosphere
First Photosynthesis
First Life Forms Fossilized
Origin of Life
Origin of Earth

S

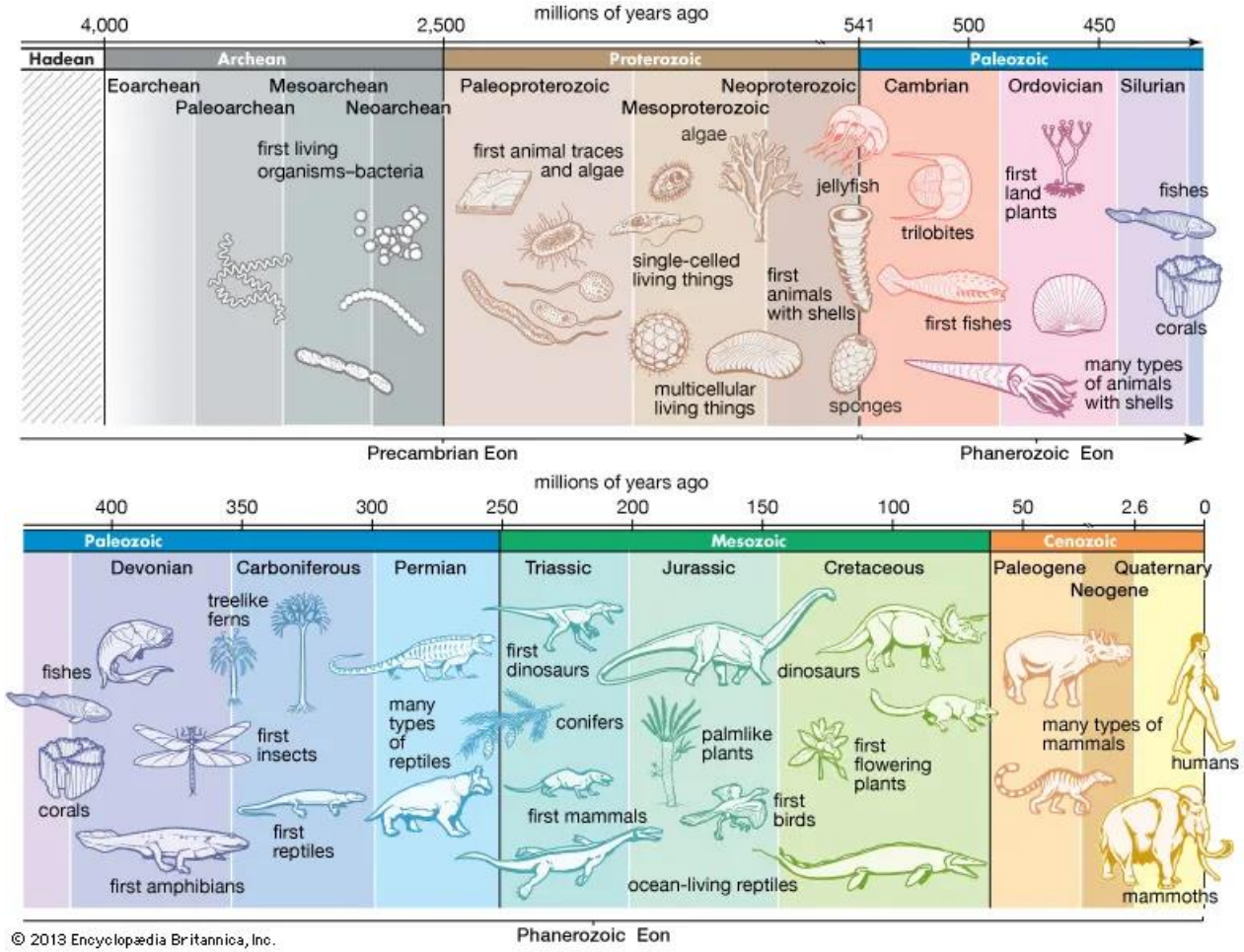
-
- ils
-
-
- of life


Bacteria
Archaea
Eukarya
Chloroflexus
Purple bacteria
Chloroplast
Cyanobacteria
Flavobacteria
Thermotogales
Aquifex
Methanothermus
Halophiles
Methanococcus
Thermoproteus
Pyrodictium
Thermococcus
Entoamoebae
Slime molds
Diatoms
Animals
Fungi
Plants
Ciliates
Flagellates
Trichonomads
Microsporidia
Diplomonads
Common Ancestor

Evidence suggests the Earth is more than 4.5 billion years old. Life began in very simple forms surprisingly soon afterwards, less than one billion years later. The oldest fossils are about 3.7 billion years old and show simple structures that were already changing the biochemistry of the planet - most notably by producing oxygen. As the atmosphere developed so did the planet's capacity to support complex lifeforms.

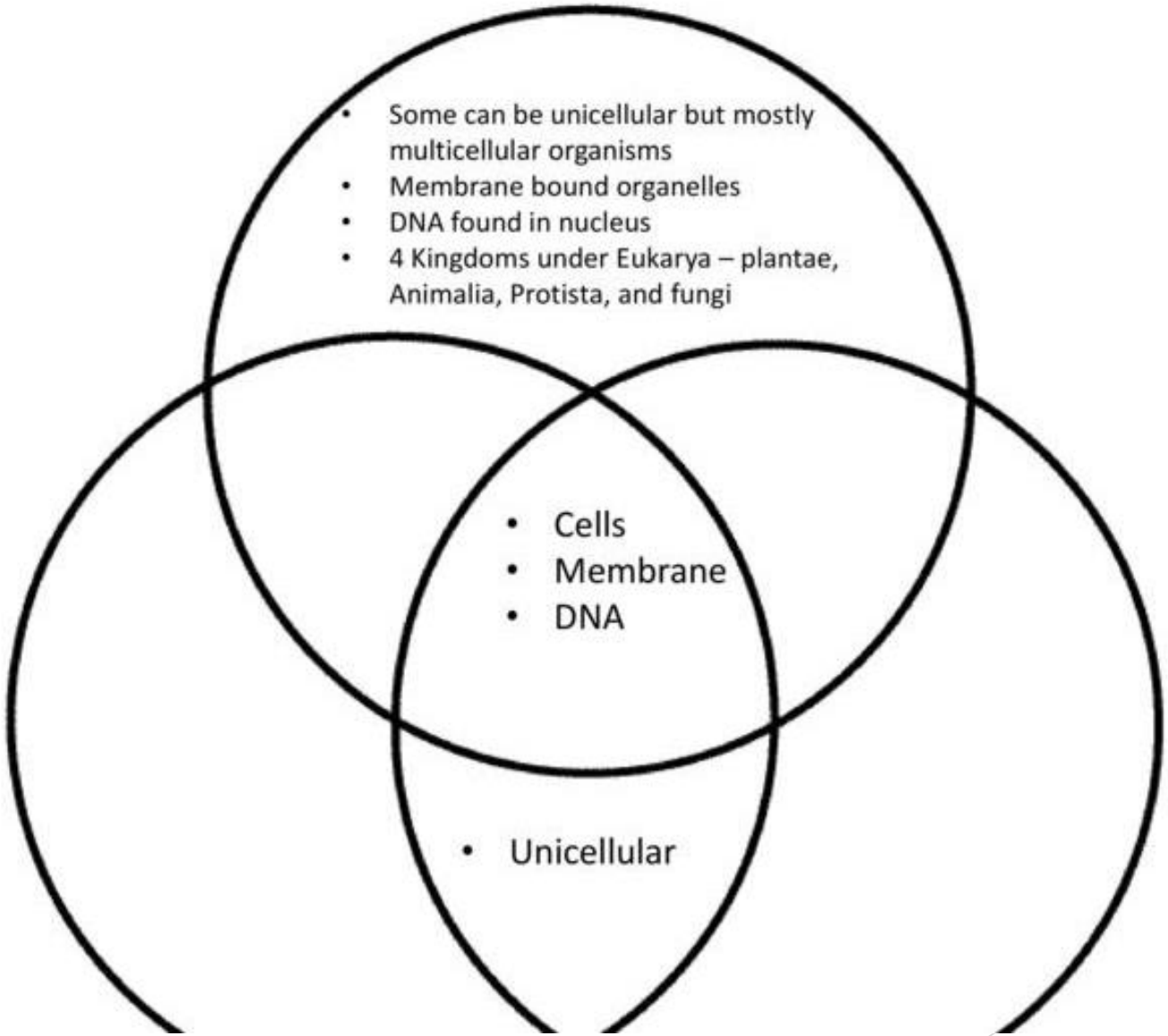


It is interesting to also note tha life began in the sea and didnt arrive on land until 400 million years ago Paul Stamets has suggested that the first organisasm to move onto land was fungi and that they have been largely responsible for creating the soils and other habitats on which ohter pecies depend.


millions of years ago
4,000
2,500
541
500
450
Hadean
Archean
Proterozoic
Paleozoic
Eoarchean
Paleoarchean
Mesoarchean
Neoarchean
Paleoproterozoic
Mesoproterozoic
Neoproterozoic
Cambrian
Ordovician
Silurian
first living organisms–bacteria
first animal traces and algae
algae
jellyfish
trilobites
first land plants
fishes
single-celled living things
first animals with shells
first fishes
corals
multicellular living things
sponges
many types of animals with shells
Precambrian Eon
Phanerozoic Eon
millions of years ago
400
350
300
250
200
150
100
50
2.6
0
Paleozoic
Mesozoic
Cenozoic
Devonian
Carboniferous
Permian
Triassic
Jurassic
Cretaceous
Paleogene
Neogene
Quaternary
treelike ferns
fishes
first dinosaurs
dinosaurs
many types of reptiles
conifers
palmlike plants
first flowering plants
many types of mammals
humans
first insects
corals
first birds
first mammals
first reptiles
first amphibians
ocean-living reptiles
mammoths
Phanerozoic Eon
© 2013 Encyclopædia Britannica, Inc.

Eukarya

- Some can be unicellular but mostly multicellular organisms
- Membrane bound organelles
- DNA found in nucleus
- 4 Kingdoms under Eukarya – plantae, Animalia, Protista, and fungi



- DNA found free floating in cell
- Membrane coated with peptidoglycan
- Found in almost all places on Earth
- Can cause disease and illness
- Can be helpful in digestion

Bacteria

- Live in harsh environments
- Made up of different chemicals than bacteria
- Hot springs , volcanoes, really salty water

Archaea

Evolution: life on Earth is one big extended family

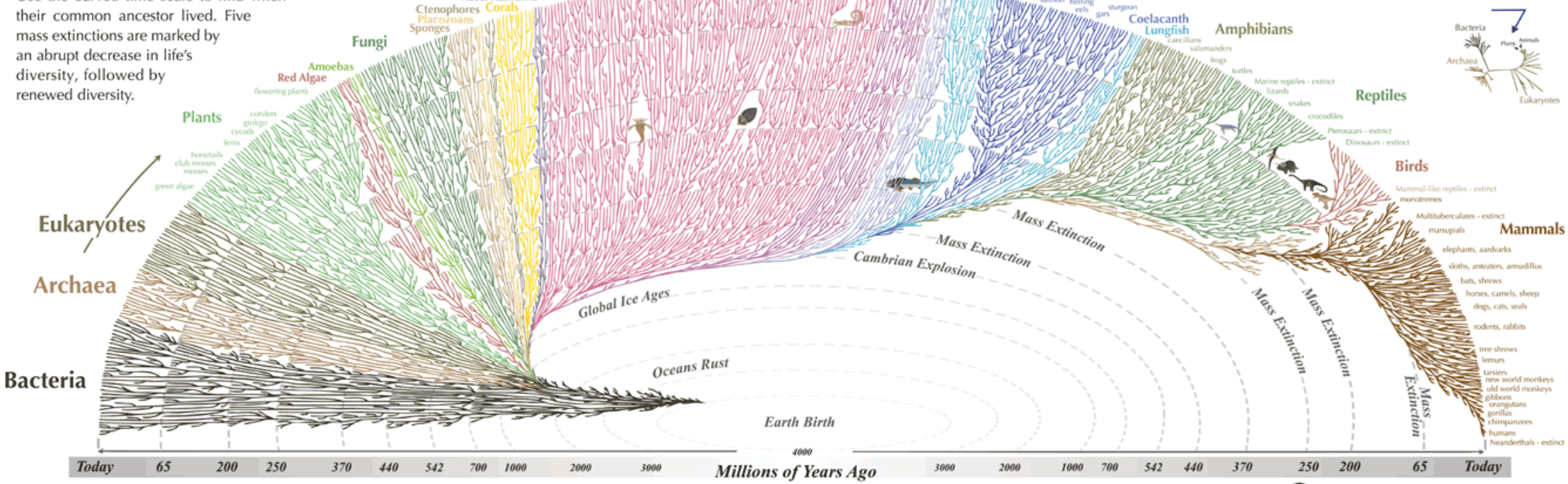
In 1858, Charles Darwin and Alfred Russel Wallace independently proposed a theory of biological evolution to explain the diversity of life on Earth. Since then the fossil record and DNA studies have added, and continue to add, overwhelming support for this view of life's history. Evolution today is one of the best documented and widely accepted principles of modern science.

Life on Earth has changed dramatically through time. The theory of evolution proposes that through the process of natural selection and other natural events stretching over millions of generations, living things diversify, branching from one species into many. This means that all living things are related to one another through common ancestry with earlier, different life forms. In other words, if you follow your family tree far enough back in time, you will find a common ancestor not only with every other living thing, but with every thing that ever lived.

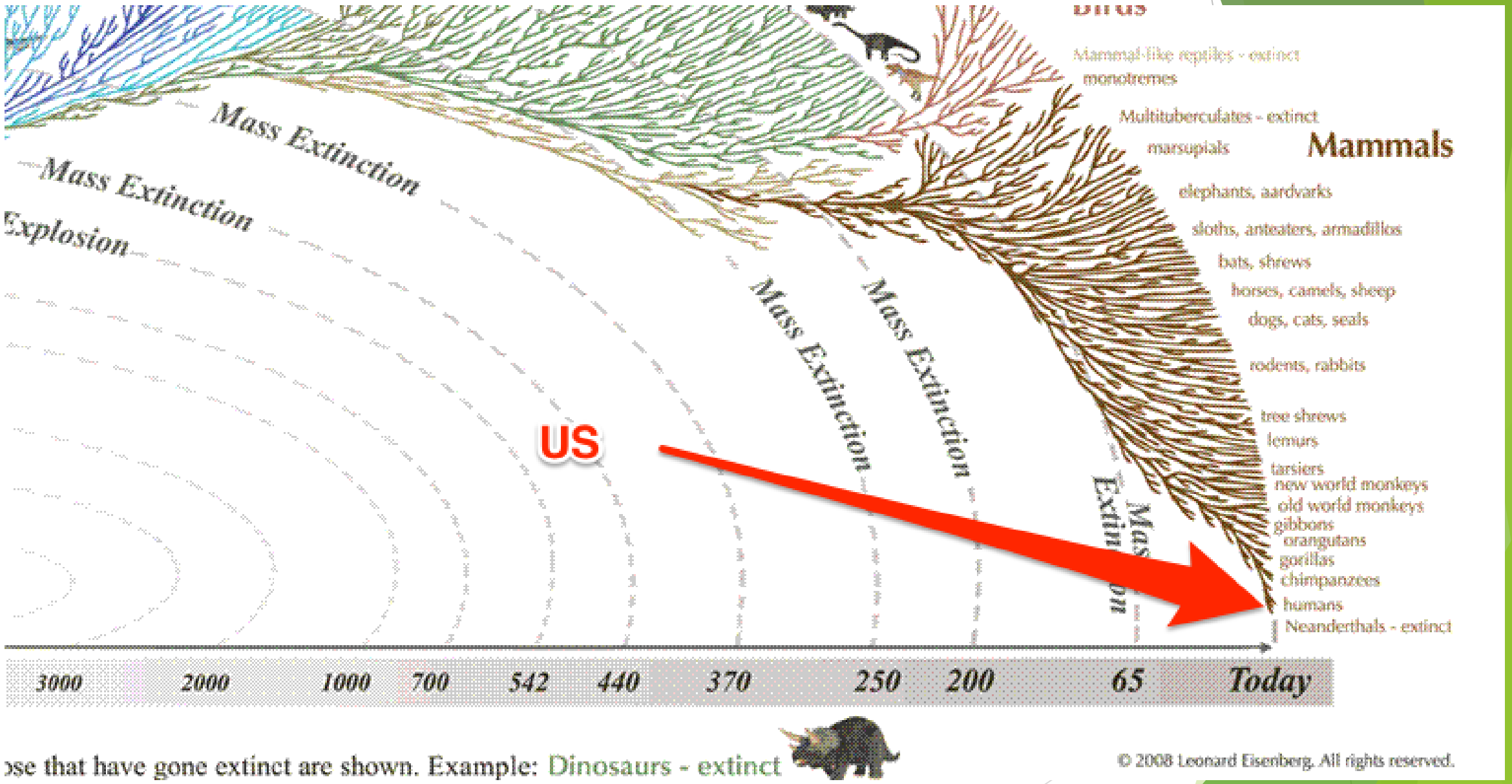
Life's Family Tree

Trace any branch back through time to see how it connects to any other of life's major branches. Use the curved time scale to find when their common ancestor lived. Five mass extinctions are marked by an abrupt decrease in life's diversity, followed by renewed diversity.

This Tree of Life is drawn from the human point of view. That is why humans are the final branch and most Tree of Life details are found in vertebrates (animals with a backbone). A Tree of Life drawn from a bacterial point of view would look very different!



All the major and many of the minor living branches of life are shown on this diagram, but only a few of those that have gone extinct are shown. Example: Dinosaurs - extinct


Mass Extinction
Mass Extinction
Explosion
Mass Extinction
Mass Extinction
Mass Extinction
US
Birds
Mammal-like reptiles - extinct
monotremes
Multituberculates - extinct
marsupials
Mammals
elephants, aardvarks
sloths, anteaters, armadillos
bats, shrews
horses, camels, sheep
dogs, cats, seals
rodents, rabbits
tree shrews
lemurs
tarsiers
new world monkeys
old world monkeys
gibbons
orangutans
gorillas
chimpanzees
humans
Neanderthals - extinct
3000
2000
1000
700
542
440
370
250
200
65
Today
ose that have gone extinct are shown. Example: Dinosaurs - extinct
© 2008 Leonard Eisenberg. All rights reserved.

Gaia theory

- Arguing the earth is a self-regulating living system that maintains the conditions for the perpetuation of life, James Lovelock advanced *the Gaia Hypothesis* (1970s).
- Although not intended as an 'ethics,' a biosphere-centered (large-ecocentric) ethics has been deduced from it, claiming:
  - **People ought not degrade this wonderful system in such a way that it can not**

What is the Gaia Hypothesis?

Both living and dead organisms, as well as inorganic material, all form part of a constantly moving system that makes up the biosphere.

James Lovelock

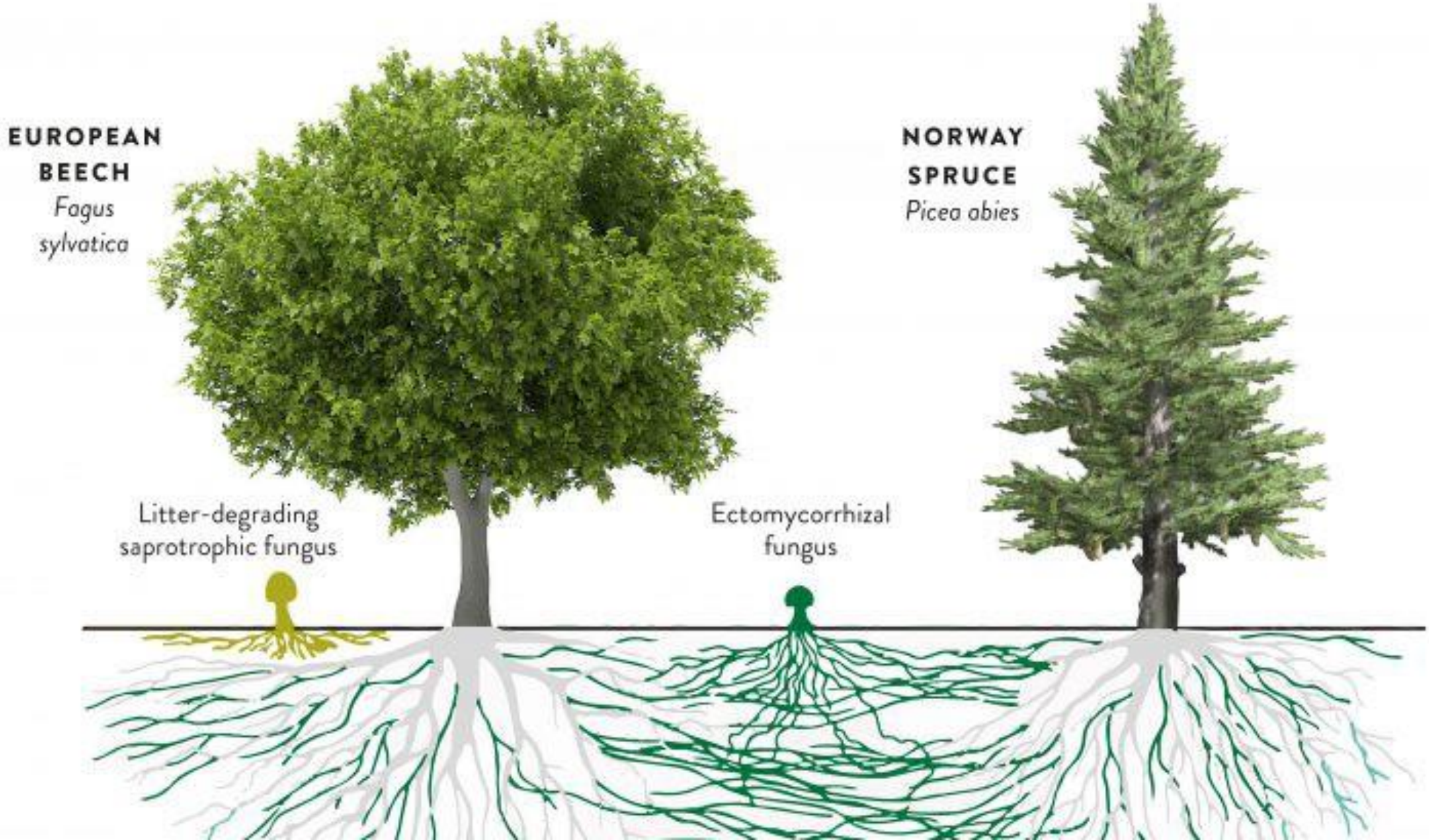
Lynn Margulis

The Gaia Hypothesis was initially put forward by James Lovelock and later co-developed with Lynn Margulis.

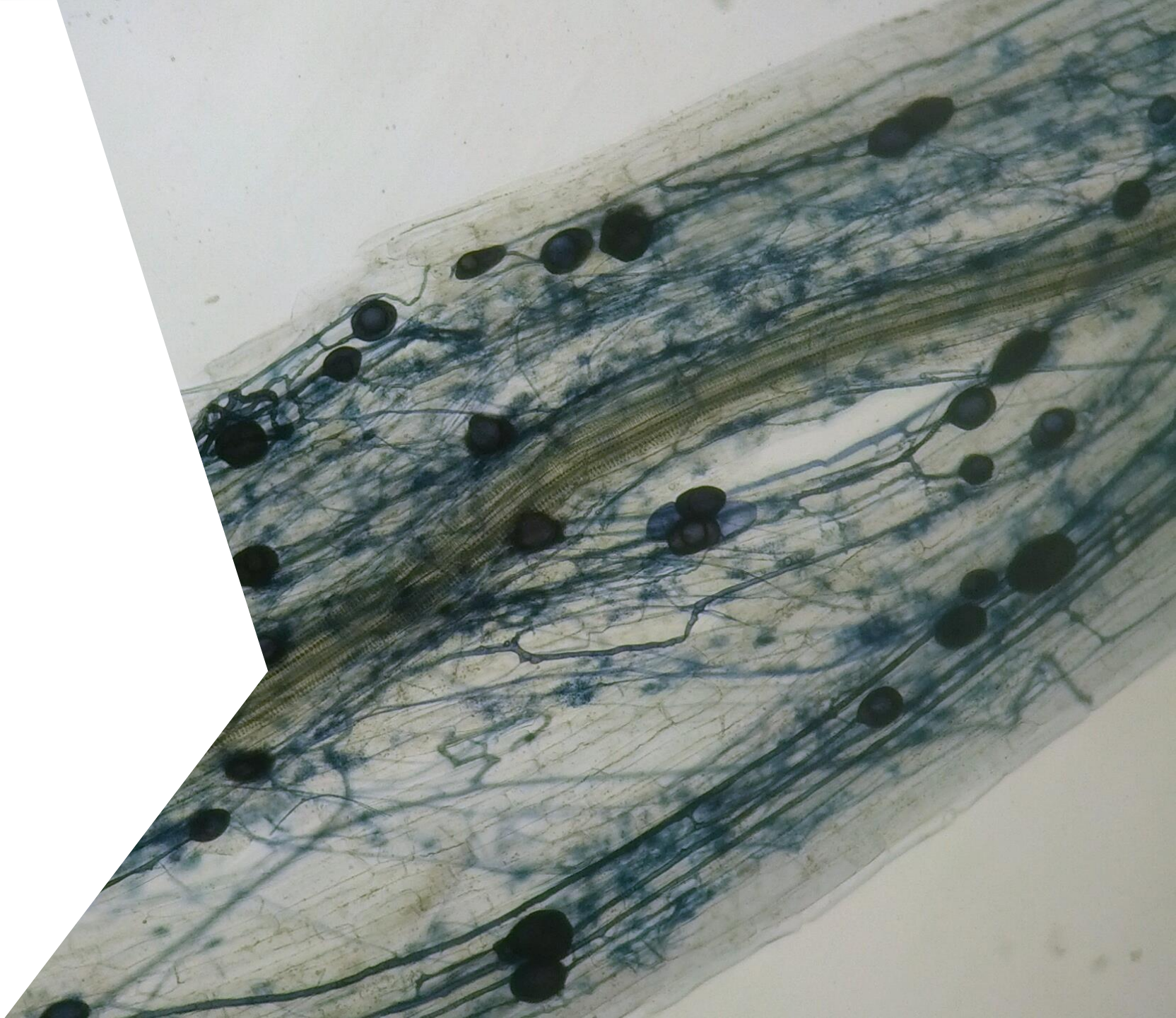
A hypothesis that Earth is like a huge self-regulating organism

- This controversial idea about Earth and its complex workings was developed by British biochemist James Lovelock in 1972.
- The central theme of the hypothesis is that Earth is viewed as a ***single living organism***.
- In the 4.6 billion years of its existence, the hypothesis states that Earth has developed into a self-evolving, self-

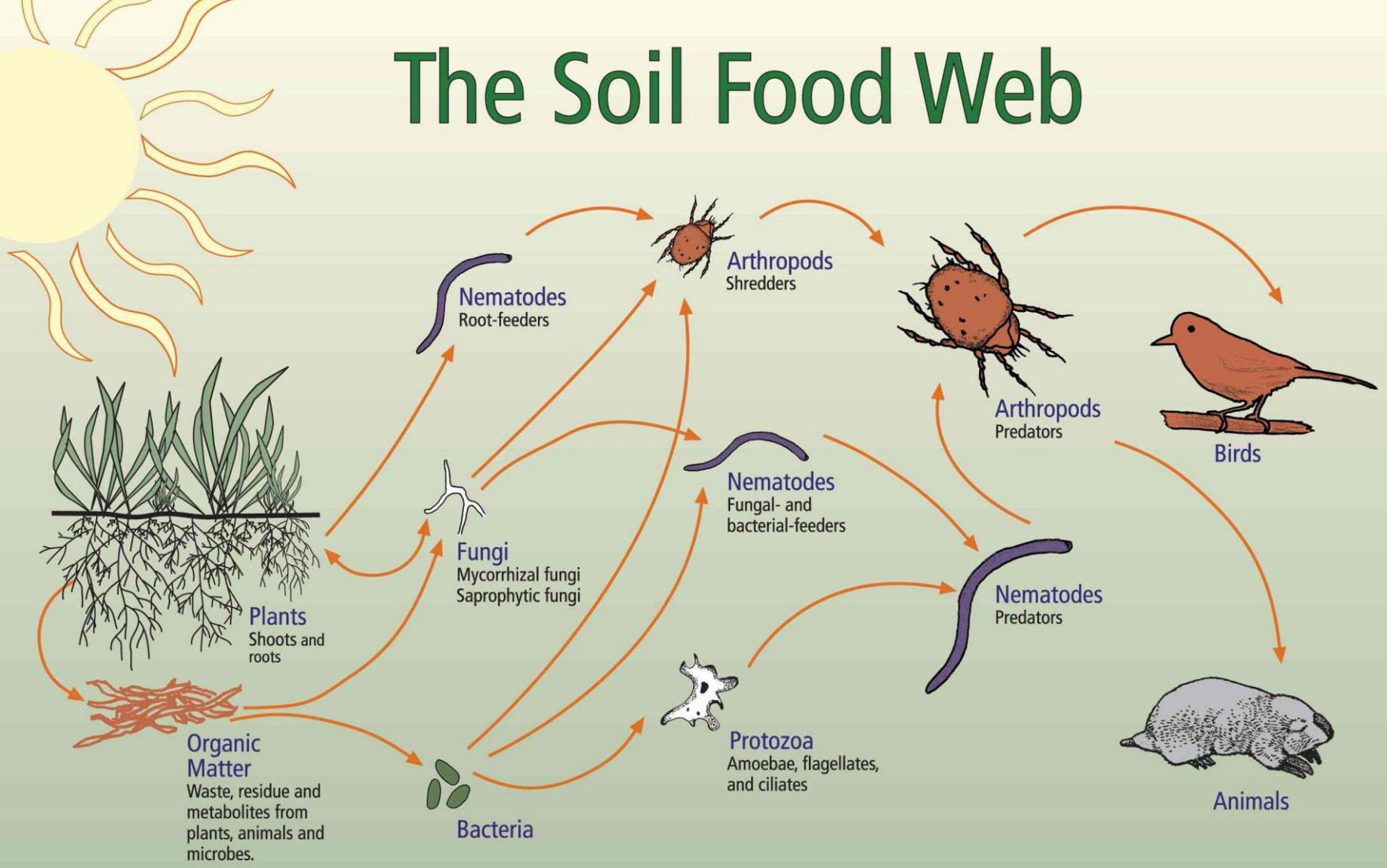
Is everything connected?


EUROPEAN BEECH
Fagus sylvatica
NORWAY SPRUCE
Picea abies
Litter-degrading saprotrophic fungus
Ectomycorrhizal fungus

Plant fungi relationship



The Soil Food Web



First trophic level:	Second trophic level:	Third trophic level:	Fourth trophic level:	Fifth and higher trophic levels:
Photosynthesizers	Decomposers Mutualists Pathogens, Parasites Root-feeders	Shredders Predators Grazers	Higher level predators	Higher level predators

Designed Visions Permaculture Design Course Handout

LIMITING FACTORS IN DESIGN (BUILDING BLOCKS)

These factors ultimately decide our strategies in design

"Limits are the foundation of creativity"

LIMESTONE FARM – May 2017

Transition to permaculture

- Sector
- Zone
- Elevation

Priorities

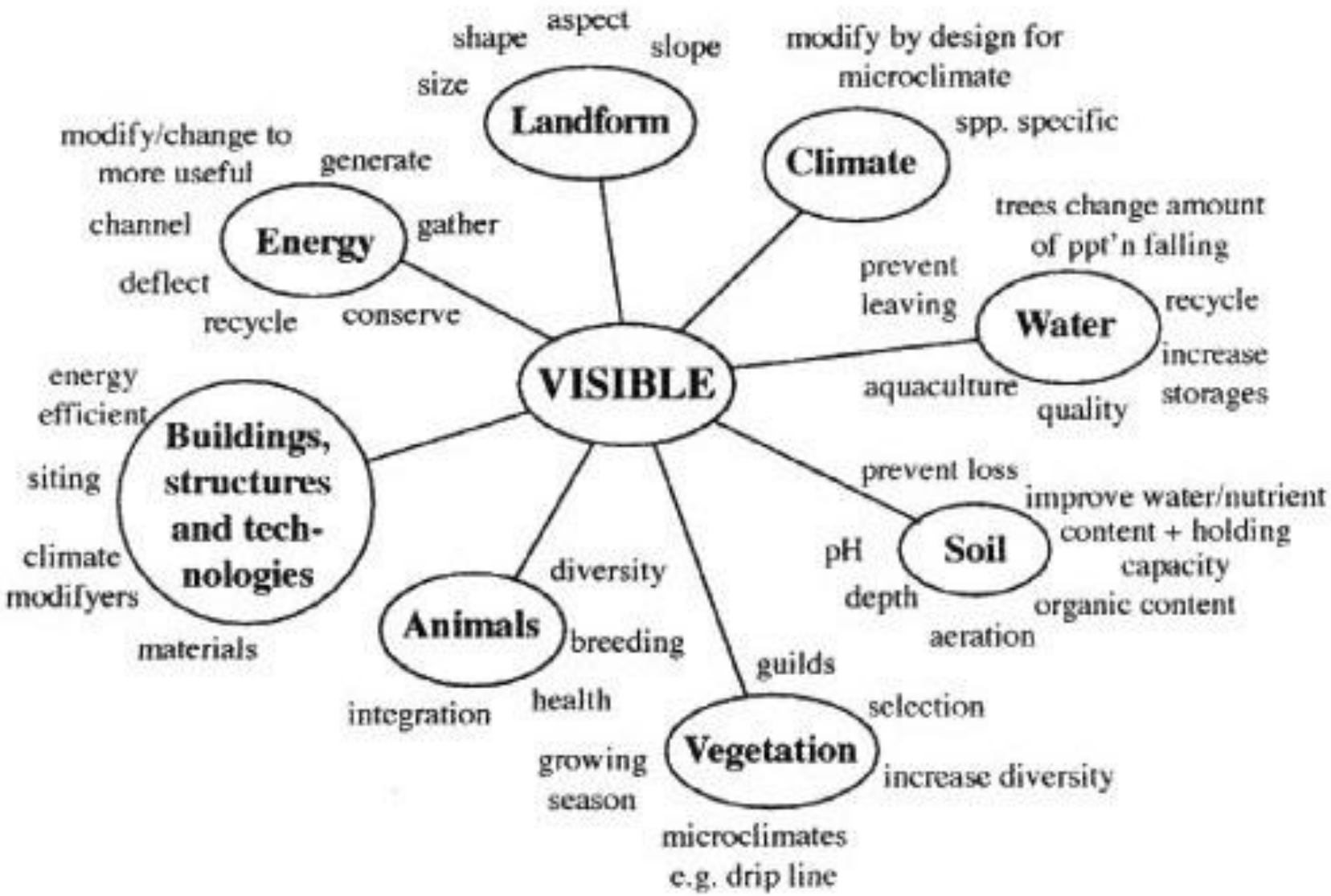
Access

boundary

water

slope

buildings


VISIBLE
Landform
shape
aspect
slope
size
Climate
modify by design for microclimate
spp. specific
Energy
modify/change to more useful
generate
channel
gather
deflect
recycle
conserve
Water
trees change amount of ppt'n falling
prevent leaving
recycle
increase storages
aquaculture
quality
Buildings, structures and tech-nologies
energy efficient
siting
climate modifyers
materials
Soil
prevent loss
improve water/nutrient content + holding capacity
pH
depth
organic content
aeration
Animals
diversity
breeding
integration
health
Vegetation
guilds
selection
growing season
increase diversity
microclimates
e.g. drip line

Source: © Chris Evans 2003

Top Shed
- Butchery & Cool room
- Propagation & Seed saving

Nursery Garden
- Carob [Canopy]
- Old hamii [Canopy]
- Shang-eye Peach [Canopy]
- Bush Fire peach [Sub-canopy]
- Purple Guava [Shrub layer]
- Finger Limes [Shrub layer]
- Rhubarb [Herbaceous layer]
- Passionfruit [climber]

Poultry Pen Layout
- Muscovy Breeding Enclosure with run.
- Chicken Breeding Enclosure

Silt Trap Swale Garden
- Cavendish Bananas [Canopy]
- Bana grass & Old Hamii Bamboo [Canopy]
- Black Genoa Figs [Sub-canopy]
- Arrowroot [Sub-canopy]
- Shang-eye Peach [Sub-canopy]
- Tahitian Lime [Shrub layer]
- Guava [Shrub layer]
- Sweet potato [Ground cover]

- Native bee Hives > ☐
- 20, 21, 22, 23 = Zones
- BM—Black Mulberry (canopy tree)
- SMPT—'Schinus Molle' Pepper tree
- WS—White Sapote (Canopy tree)

NOTES:
- *Pathways in Kitchen Garden / Orchard on Swales & Market gardens will be 100mg Weed Mat.*
- *Comfrey to line all garden zones where possible to minimise grass & weed spread.*
- *All Market Gardens, Terraces & Swales to be on contour to provide maximum surface water harvesting potential.*
- *Transition over to tank water from town supplied water.*
- *Transition over to Solar Energy from supplied electricity.*
- *Outdoor Kitchen for Farmgate preparation & homesteading workshops.*
- *Indoor & Outdoor 'Seasonal' education classrooms to be used instead of heating & cooling.*
- *Main area around Farmgate left open for customer parking.*

Banra Native Garden
- Floridahome Pear [Canopy]
- Lemon tree [Canopy]
- Tahitian Lime [Canopy]
- Lemon Myrtle [Canopy]
- Dwarf Tangelo [Shrub layer]
- Dwarf Mandarin [Shrub layer]
- Finger Limes [Shrub layer
- Comfrey [Herbaceous layer]
- Native Celery [Herbaceous layer]
- Lemon Thyme [Ground Cover]

Education Hut Gardens
- Lady Fingers Bananas [Canopy]
- Cavendish Banana [Sub-canopy]
- Bana grass & Sugar cane [Sub-canopy]
- Black genoa fig [Shrub layer]
- Custard Apple [Shrub layer]
- Black Sapote [Shrub layer]
- Guava [shrub layer]
- Nasturtiums [Ground cover]

Central Poultry Run
- Rotated between chickens and ducks.
- Populated with Tagasaste & Mulberry fodder trees.

Khaki Campbell Duck Pen
- Black Mulberry x 2 (BM)
- White Shahtoot Mulberry (WSM)
- Acacia—Blackwood wattle
- Shinus molle—Pepper tree (SMPT)
- Bana Grass
- Jacaranda tree (shade)

Khaki Campbell Ducks Layout
- Three pens (Laying, Breeding & Grow-out)
- Populated with Bana grass & Mulberry fodder trees.

Northern Front Boundary Edible Windbreak
- Macadamia tree
- Loquat x 2
- Sugar Plum
- Washington Navel orange
- Guava – Hawaiian
- Guava – Yellow cherry

Poultry Garden
- White Shahtoot Mulberry x 3
- Old Hamii Bamboo
- Tagasaste
- Carob tree
- Black Genoa Fig
- Chia / Golden Amaranth
- White Cedar

Outdoor Oven & Sensory Garden
Compass Swale & Native Garden
- Paulownia [Canopy tree]
- Macadamia [Canopy]
- Jacaranda [Canopy]
- White Aspen [Canopy]
- Firewheel tree [Sub-canopy]
- Bay Leaf tree [Sub-canopy]
- Bohemia tree [Sub-canopy]
- Almond—Garden Prince [Sub-canopy]
- Broad-leaf Paper bark tree [Sub-canopy]
- Honey Gem Grevillea [Shrub layer]
- Coastal Banksia [Shrub layer]
- Lemon Scented tea tree [Shrub layer]
- Manuka tea tree [Shrub layer]
- Tahitian lime [Shrub layer]
- Finger Limes [Herbaceous layer]
- Comfrey [Herbaceous layer]
- Finger Limes [Shrub layer]
- Comfrey [Herbaceous cover]
- Strawberries [Ground cover]

Kitchen Garden Windbreak
- Lillypilly mixed varieties
- Elderflower
- Paulownia tree
- Kiwi fruit
- Lemongrass

Southern Front Boundary Edible Windbreak
- Norfolk Island Pine tree
- Flowering Plum
- Guava – Hawaiian
- Guava – Yellow cherry
- Feijoa – Pudy

Muscovy Duck & Rabbit Gardens
- Cox's Orangin Pippin apple
- Golden Delicious apple
- Huonville Crab apple
- Beurre Superfin pear
- Conference pear
- Rival apple
- Greensleeves apple
- Fuji semi-dwarf apple

NZ Rabbits Pen
- 2x protected Rabbit Tractors.
- Rabbit fodders around tractor.
- Self watering feeders

Swales 4 & 5 > Sub-Tropical zone
- White Sapote (Canopy) (WS)
- Ice Cream Bean [Canopy]
- Jaboticaba [Sub-canopy]
- Mango [Sub-canopy]
- Japanese Raisin [Sub-canopy]
- Cavendish Banana [Sub-canopy]
- Tagasaste [Sub-canopy]
- Eureka Lemon [Shrub layer]
- Lisbon Lemon [Shrub layer]
- Tahitian Lime [Shrub layer]
- Imperial Mandarin [Shrub layer]
- Clementine Mandarin [Shrub layer]
- Silverhill Mandarin [Shrub layer]
- Lanes Late naval orange [Shrub layer]
- Tamarillo [Shrub layer]
- Loquat [Shrub layer]
- Wampee [Shrub layer]
- Comfrey [Herbaceous layer]
- Nasturtiums [Ground cover]
- Sweet Potato [Ground cover]

Swales 1,2 & 3
Espaliered Apples & Pears
- Granny Smith apple
- Red Delicious apple
- Anna apple / Tropic apple
- Bonza apple / Dorset apple
- Braeburn apple / Jonathan apple
- Red Fuji apple / Vista Bella apple
- Rome Beauty apple / Lady Williams
- Sensation pear / Packham pear
- Beurre bosc pear / Josephine pear / Nashi pear

Raised bed Terraces 1 & 2
- Lapins cherry
- Star Krimson cherry
- Stella cherry
- Azapa olive
- Barnea olive
- Coratine olive
- Correggiola olive
- Fuji semi-dwarf apples

Goat Fodder Row
- Highly nutritious plants available for browsing.
- Wind & Sun protection.

Goat Pen—Wind & Sun Protection
- Shahtoot Mulberry
- Bana grass & Tagasaste

Goat Vertical Fodder Row
- Tagasaste
- Black Mulberry (BM)
- Banksia
- Honey Gem Grevillea
- Casuarina
- Jacaranda
- Oldman Salt Bush

Southern Market Gardens Wind & Sun Protection
- Bana grass

Southern Market garden
- Annual Vegetables
- Small Forest Garden

Bio-region Summary

Limestone Farm is a 1 acre NE facing property located in Stroud Road Village within the *Gloucester Sub-region* of the *North Coast Bio-region* of NSW Australia.

- Receives approx. 1100mm rain annually.
- Has a 'Warm Temperate Climate' (4SC > -4C)
- Damaging winds predominantly from NW to SW.
- Gentle cooling winds from SE to NE
- Property is on the west side of Mammy Johnson Creek & east side of the Karuah River & is located within the Karuah River Catchment.
- Closest Towns in our sub-region are Stroud & Gloucester.
- Limestone Farm is sited on aboriginal 'Worimi' country.

Final Design = Culmination of:
- Initial Personal & Family assessment.
- Footprint / Energy Auditing
- Dreams & Vision Statement.
- Site Sector Analysis
- The Ethics & Principles of Permaculture.

LIMESTONE PERMACULTURE

Limestone Farm Design
Brett & Nicole Cooper

LIMESTONE FARM – May 2017