

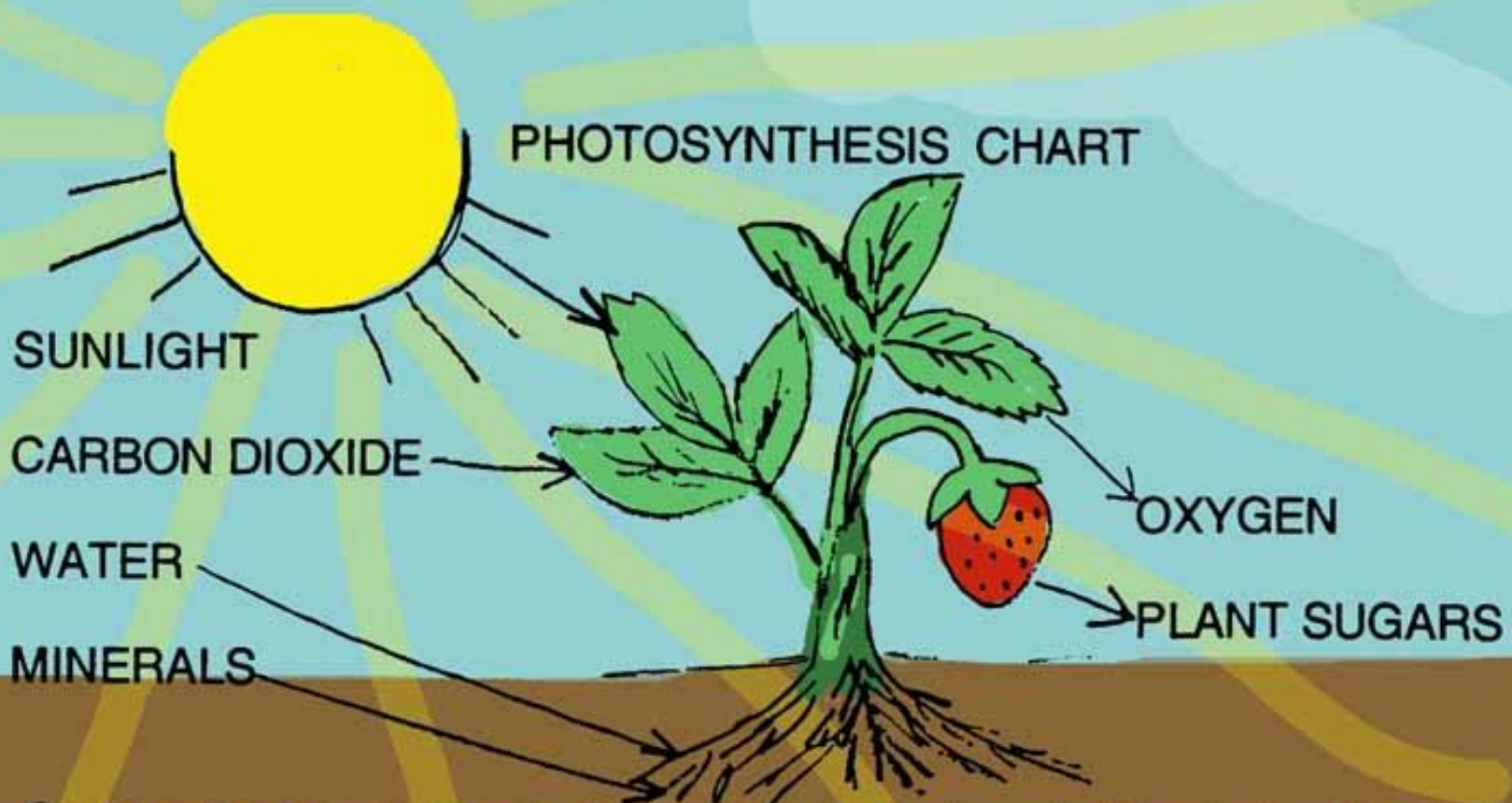
# Plants and People

**Prof. Dr. Selim ÇETİNER**  
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**[cetiner@sabanciuniv.edu](mailto:cetiner@sabanciuniv.edu)**

**Sabancı**  
**Üniversitesi**



# Harvesting the Sun



Carbon dioxide enters the leaves through stomata (tiny holes) in the leaves.

# *Carnivorous Plants*

(a)



*Dionaea muscipula*

(b)

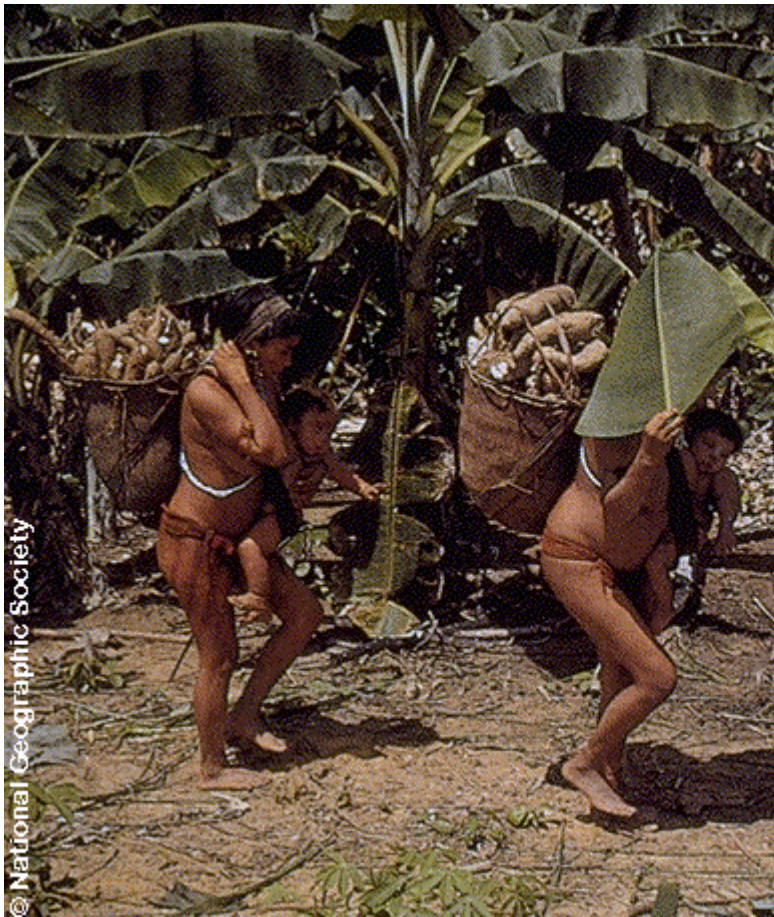


*Drosera rotundifolia*

# ***Root Nodules***



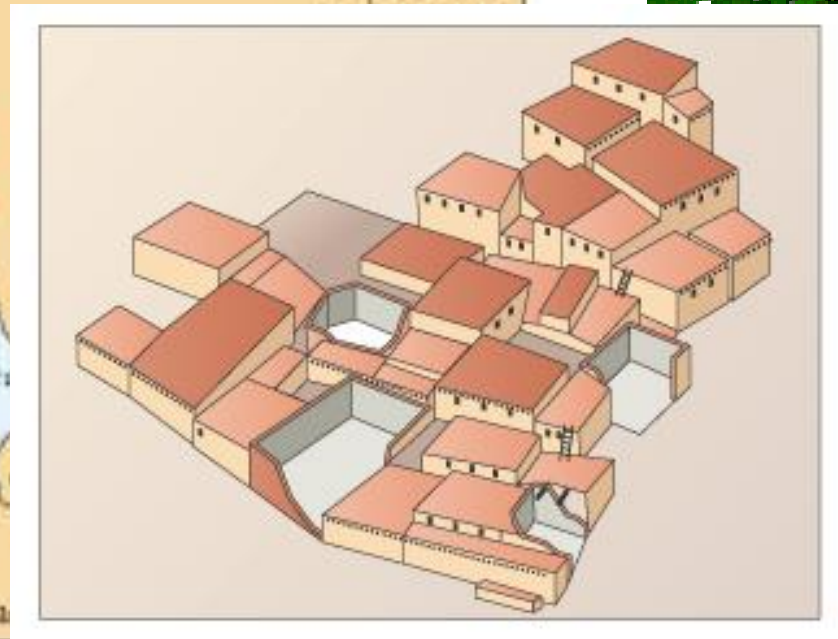
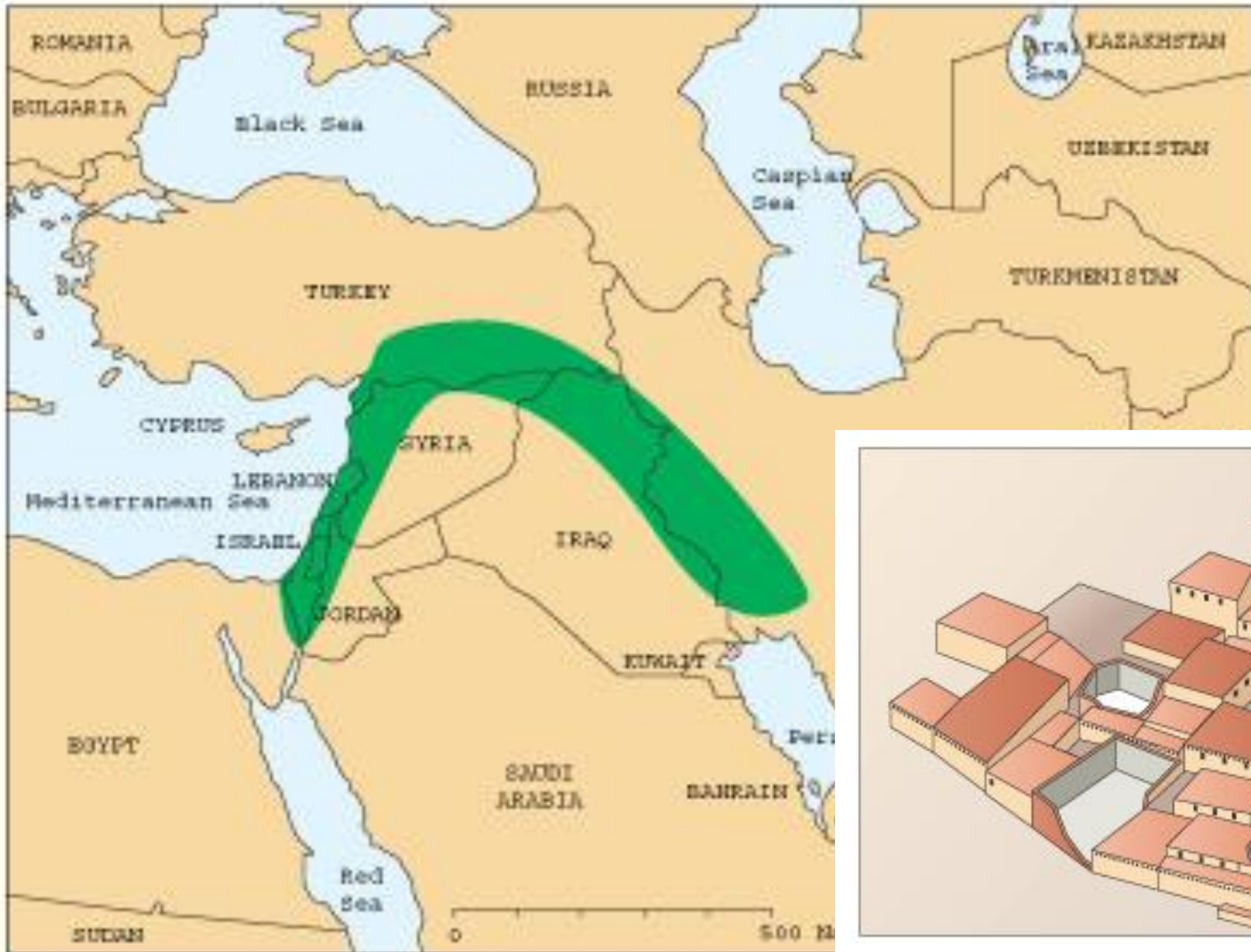
# Hunters and Gatherers



*Hunters cut up a peccary for distribution. The sharing of meat, a coveted food, is a traditional source of community solidarity.*  
Victor Englebert

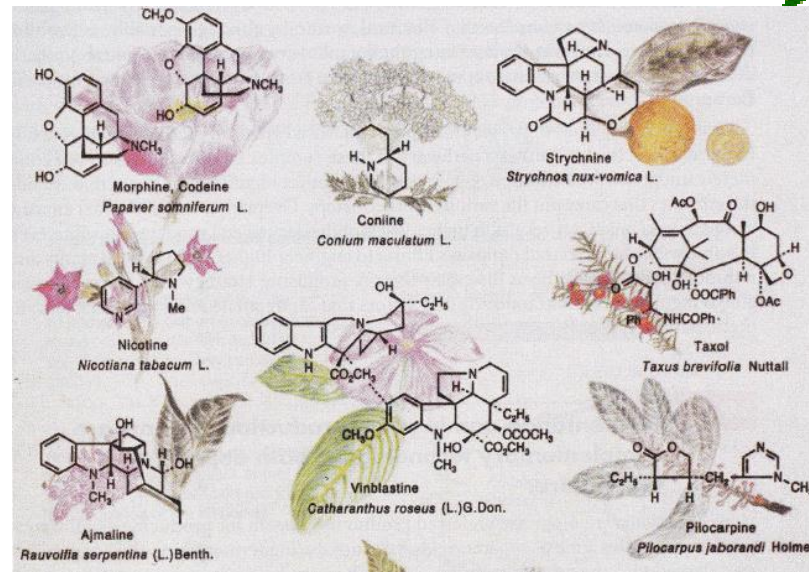


# The Fertile Crescent



# Plants provide:

- ★ Food and feed;
- ★ Fiber for dressing;
- ★ Building material;
- ★ Medicine;
- ★ Firewood;
- ★ Fossil fuels....



# Bread Wheat





## NATURAL "CORN", 7000 B.C.

PEEL IT BY HAMMERING  
REPEATEDLY WITH A  
HARD OBJECT

TASTES LIKE VERY  
DRY, RAW POTATO

19 MM

5-10 VERY HARD KERNELS

 8 KNOWN VARIETIES



ONLY FOUND  
IN CENTRAL  
AMERICA



75.0% WATER

1.9% SUGARS

23.1% OTHER  
MOSTLY STARCH

## ARTIFICIAL CORN, 2014

STEAM COOKS IN  
MINUTES

*Sweet,  
refreshing  
and juicy*



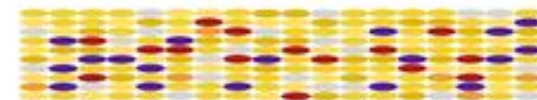
190 MM

EASY TO PEEL  
*No Hammer Required!*

*~1000 Times Larger*

AVAILABLE IN  
FIVE COLOURS:

- WHITE
- YELLOW
- DARK RED
- DEEP PURPLE
- BLUE-BLACK



~200 VARIETIES  
*67-Fold Increase*

*Annual Production:  
790 Million Tonnes*



*Grown in 69  
Countries*



73.2% WATER

6.6% SUGARS

20.2% OTHER

*2% Less Juicy*

*3.5x Sweeter*

*Still Rich in Starch!*



# Domestication (syndrome)

- ✦ Seed shattering
- ✦ Dormancy
- ✦ Growth habit and harvest index
- ✦ Adaptation to photoperiod
- ✦ Diversity of harvested organs
- ✦ Resistance to pests and diseases



# Globalization of Plants



## The Columbian Exchange

NORTH AMERICA

EUROPE

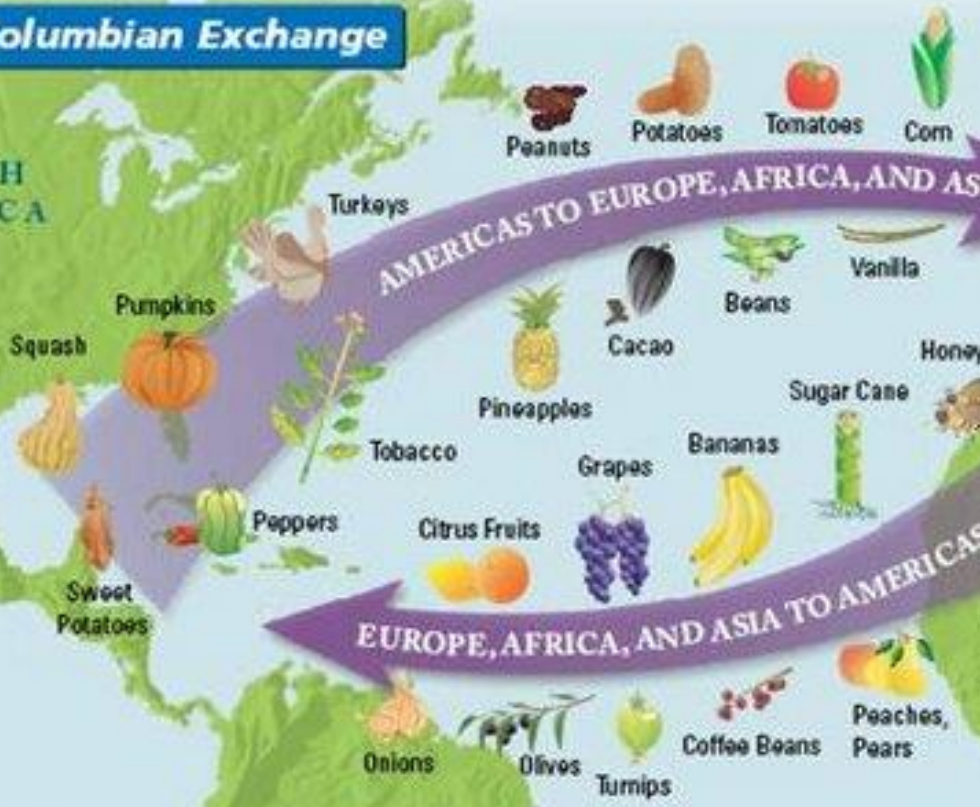


- Disease
- Smallpox
  - Influenza
  - Typhus
  - Measles
  - Malaria
  - Diphtheria
  - Whooping Cough
- Livestock
- Cattle
  - Sheep
  - Pigs
  - Horses

AFRICA

AMERICAS TO EUROPE, AFRICA, AND ASIA

EUROPE, AFRICA, AND ASIA TO AMERICAS







**Farming looks mighty easy when  
your plow is a pencil and you're a  
thousand miles from the corn field.**

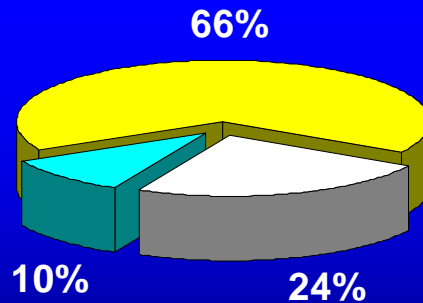
**D. Eisenhower**



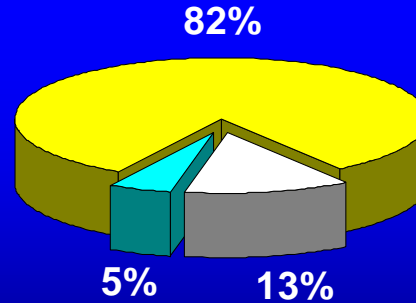
# Decreases in Record Yield Capacity of Crop Plants by Abiotic and Biotic Stress Factors



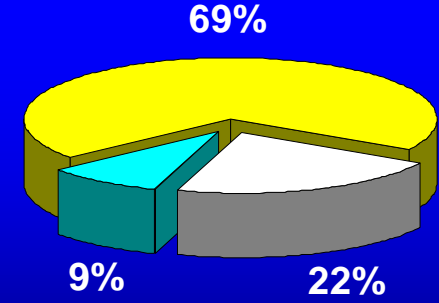
## CORN



## WHEAT



## SOYBEAN



Record Yield: 19.3  
(tonnes ha<sup>-1</sup>)

14.5

7.4



Seed shape



Spherical



Dented

Seed color



Yellow



Green

Flower color

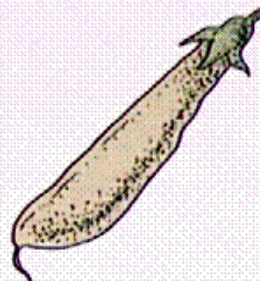


Purple

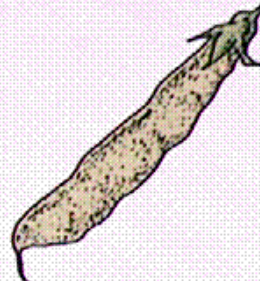


White

Pod shape

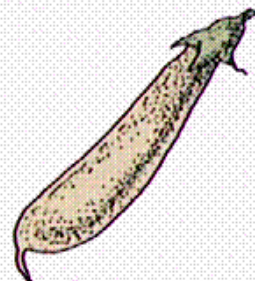


Inflated

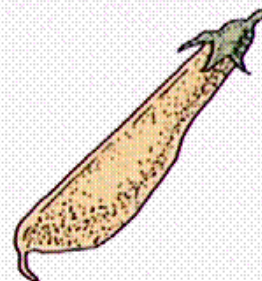


Constricted

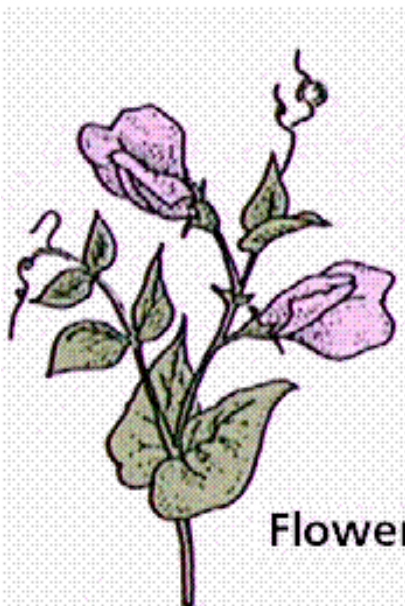
Pod color



Green

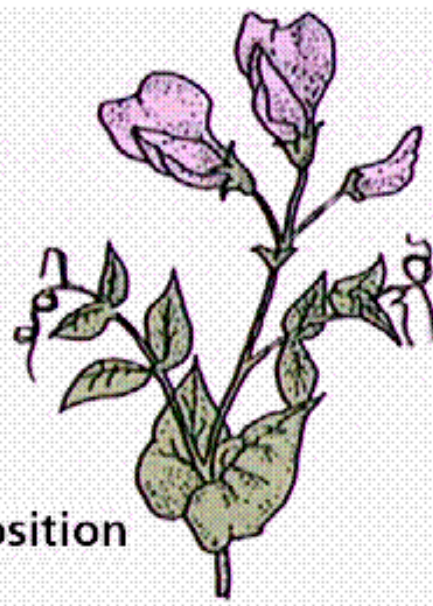


Yellow



Flower position

Axial

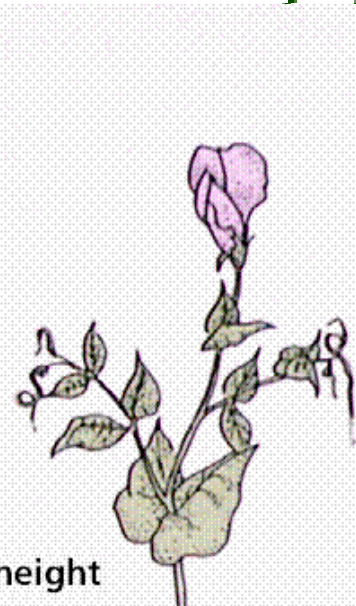


Terminal



Stem height

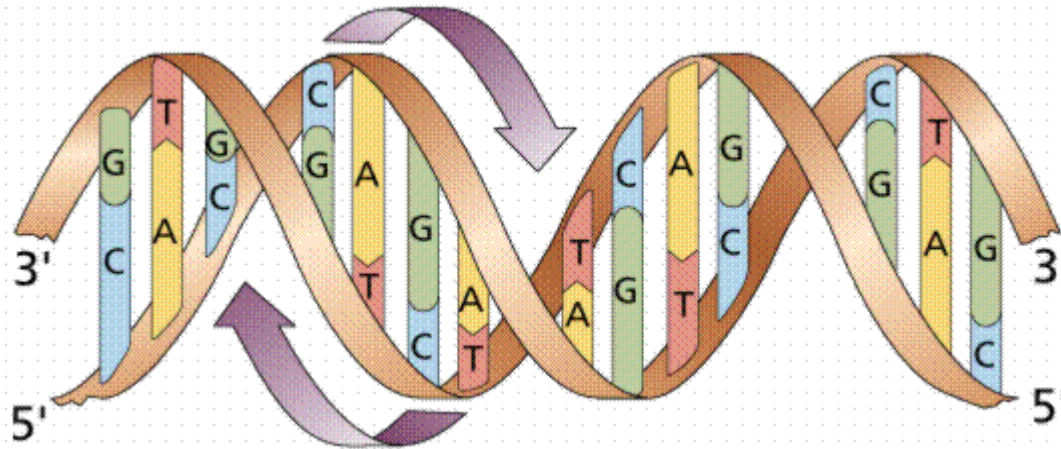
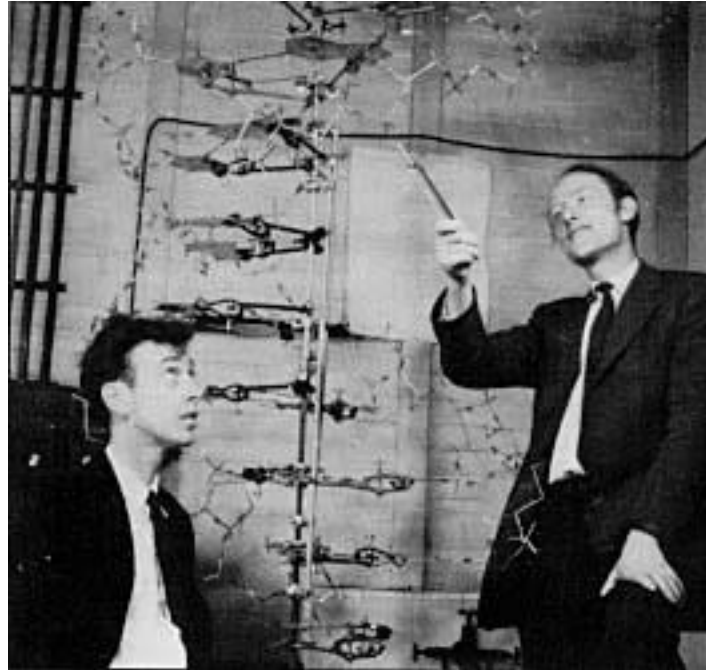
Tall



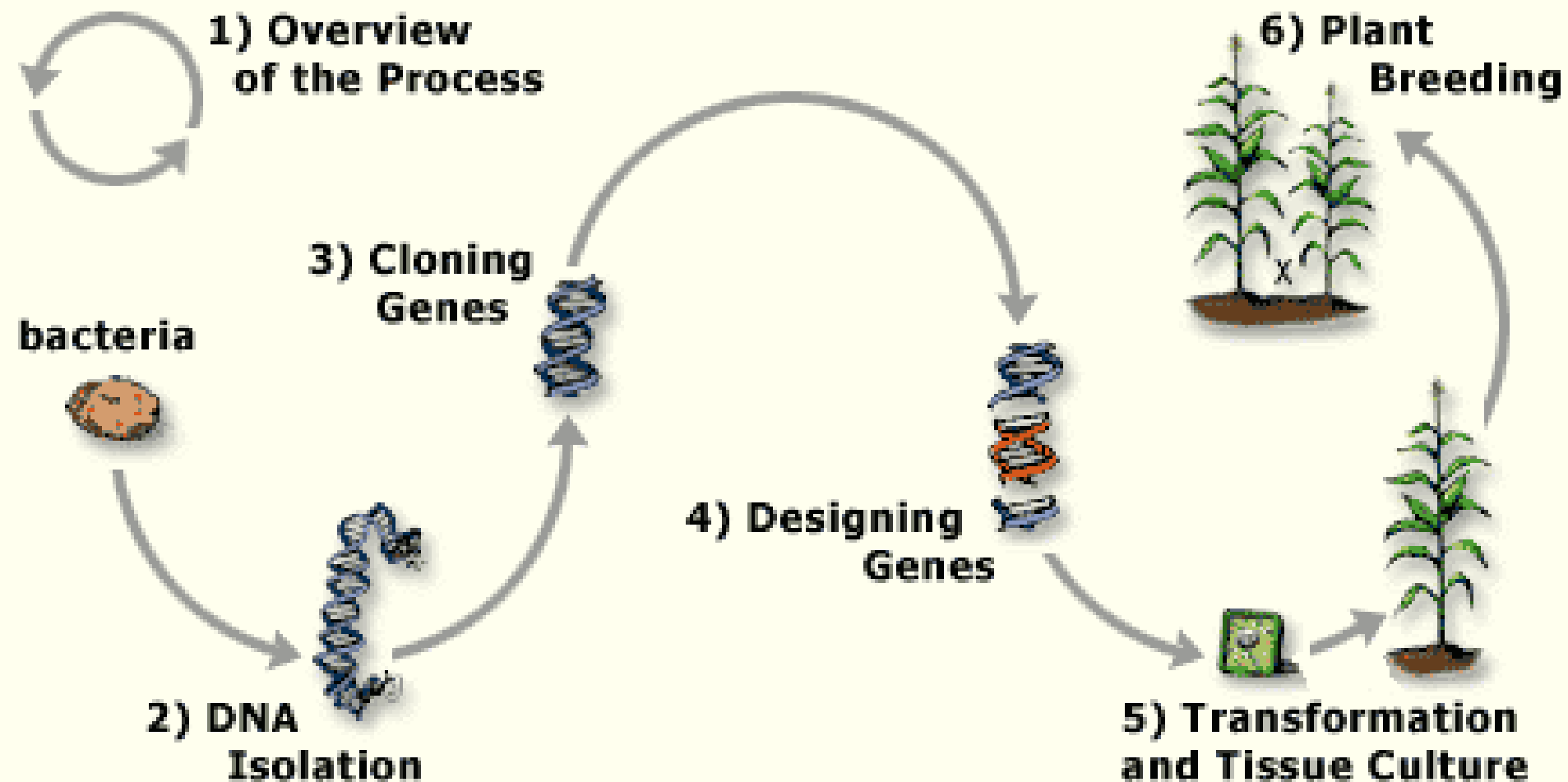
Dwarf



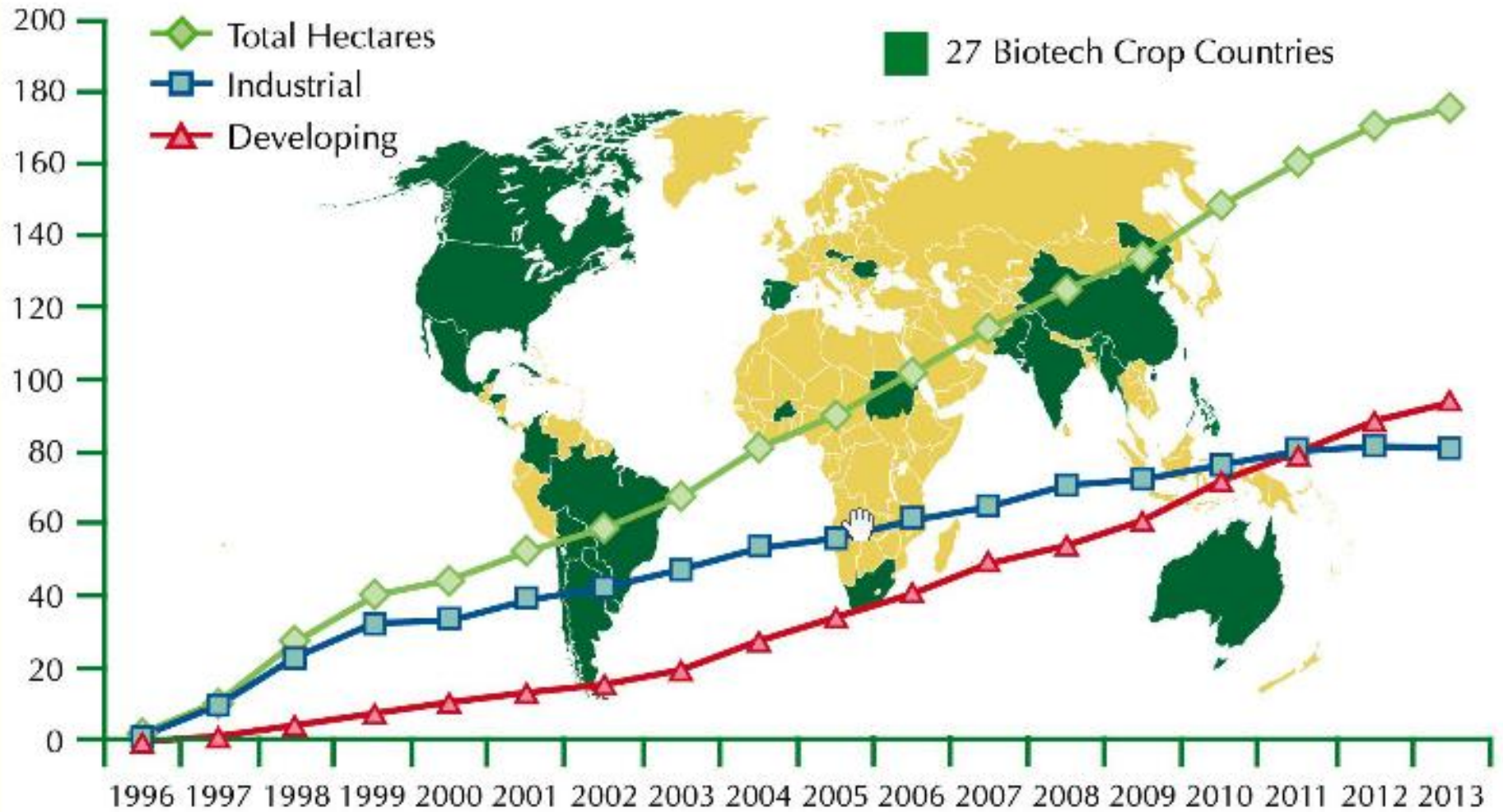
# Discovery of Double Helix



# How is Genetic Modification Done?



# GLOBAL AREA OF BIOTECH CROPS Million Hectares (1996-2013)



*A record 18 million farmers, in 27 countries, planted 175.2 million hectares (433 million acres) in 2013, a sustained increase of 3% or 5 million hectares (12 million acres) over 2012.*

# Golden Rice



# Public concerns on GMOs

- ★ Food safety
  - Allergenicity
  - Toxicity
  - Gene transfer
- ★ Environmental impacts
  - Nontarget organisms
  - Gene flow
- ★ Dislike of multinationals
- ★ Socio-economical
- ★ Ethical, ideological, other issues



**GMO's are dangerous for the  
human health and the  
environment!**

**WRONG!**



**GMO's have no negative  
affects on human health and  
the environment!**

**WRONG!**





# Truth of the Matter

- ★ Each GMO is different from the other;
- ★ Each one of these GMOs has to go through scientific risk analysis;
- ★ GMOs that are approved by the risk assessment authorities are at least as safe as their conventional counterparts.
- ★ No ill affect of GMOs has been recorded during the last 19 years since their first introduction.



# Nutrition Basics

- ★ Nutrients: components of that are indispensable to the body's functioning
  - Roles:
    - ★ Provide energy
    - ★ Building material
    - ★ Maintenance and repair
    - ★ Support growth



# Malnutrition:

- ★ Deficiencies, excess, and imbalances of nutrients lead to diseases of malnutrition
- ★ 805 million people food insecure
- ★ 1.2 billion people overweight



# HEALTHY EATING PLATE

Use healthy oils (like olive and canola oil) for cooking, on salad, and at the table. Limit butter. Avoid trans fat.



Drink water, tea, or coffee (with little or no sugar). Limit milk/dairy (1-2 servings/day) and juice (1 small glass/day). Avoid sugary drinks.

The more veggies – and the greater the variety – the better. Potatoes and French fries don't count.

VEGETABLES

WHOLE GRAINS

Eat a variety of whole grains (like whole-wheat bread, whole-grain pasta, and brown rice). Limit refined grains (like white rice and white bread).

Eat plenty of fruits of all colors.

FRUITS

HEALTHY PROTEIN

Choose fish, poultry, beans, and nuts; limit red meat and cheese; avoid bacon, cold cuts, and other processed meats.



**STAY ACTIVE!**

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Harvard School of Public Health  
The Nutrition Source  
[www.hsph.harvard.edu/nutritionsource](http://www.hsph.harvard.edu/nutritionsource)

Harvard Medical School  
Harvard Health Publications  
[www.health.harvard.edu](http://www.health.harvard.edu)



# Not so healthy diet: but...



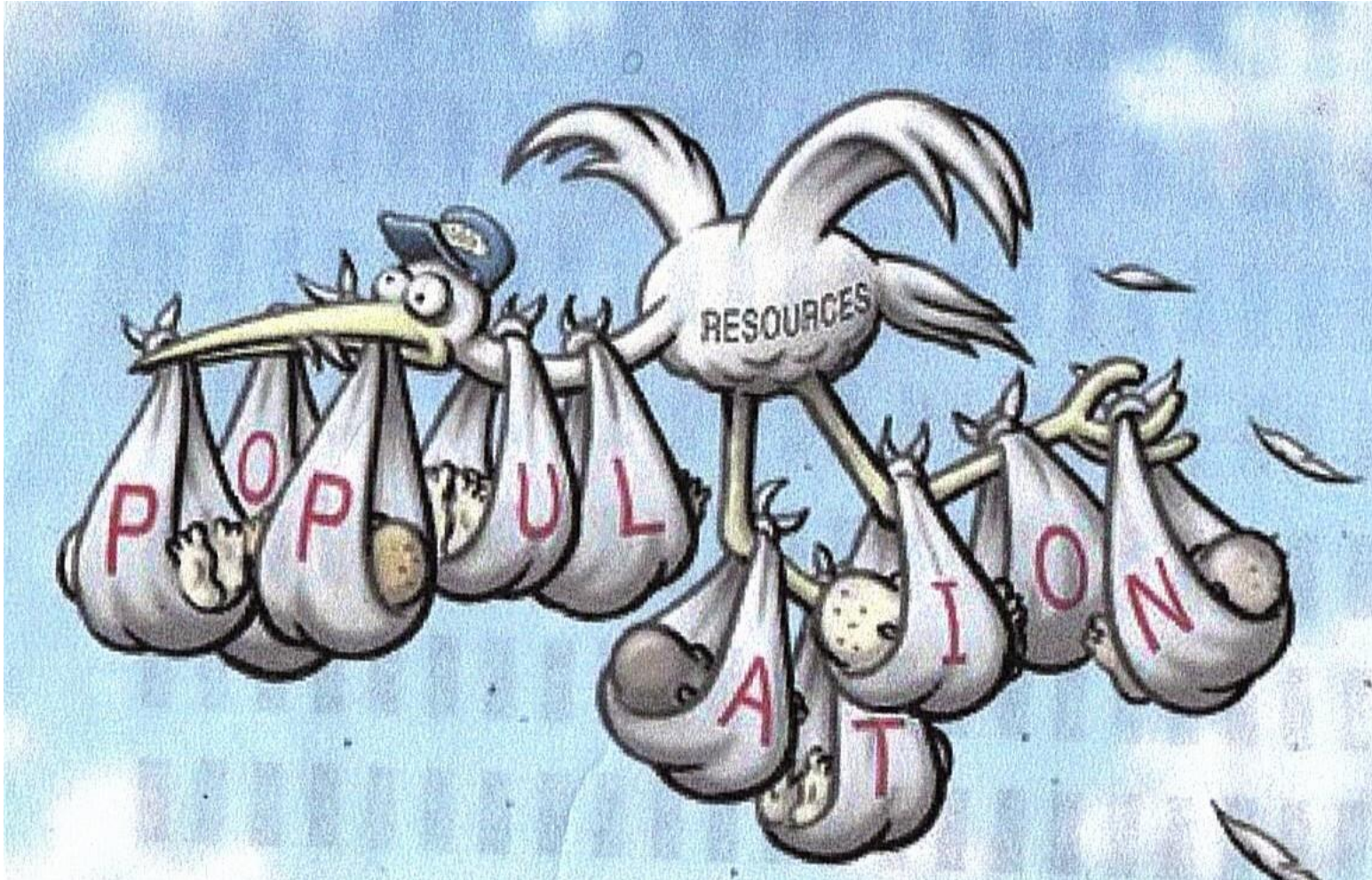
# A Healthy Diet; but...



# GM or what?

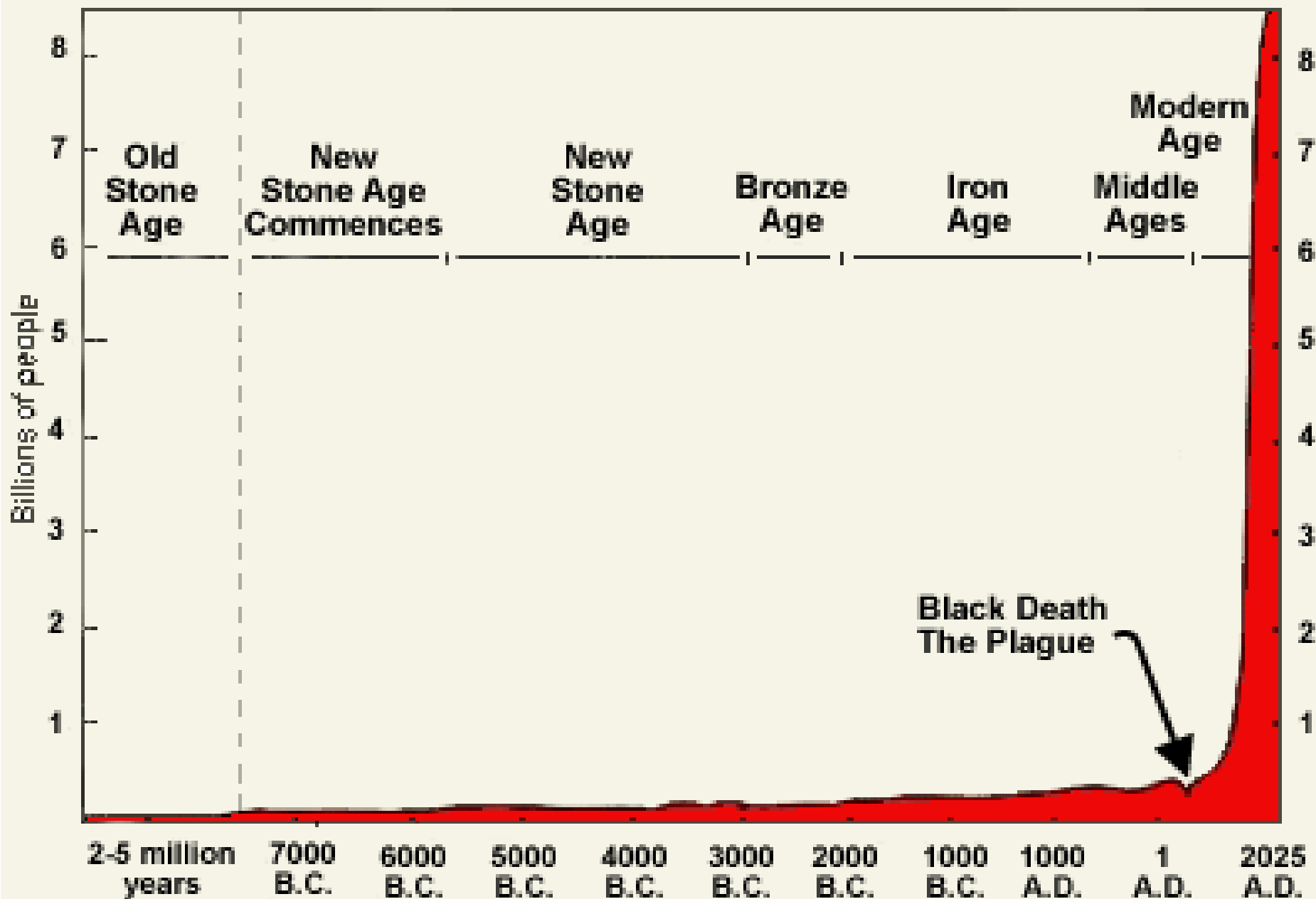


# Resources under strain

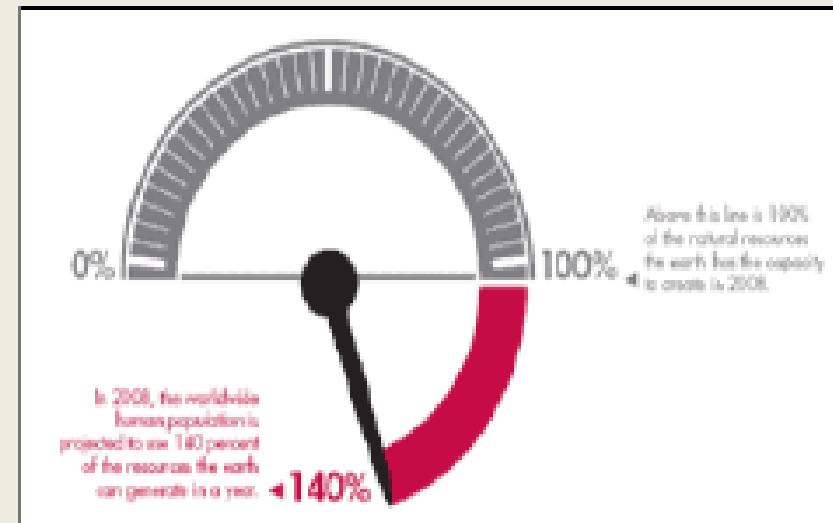
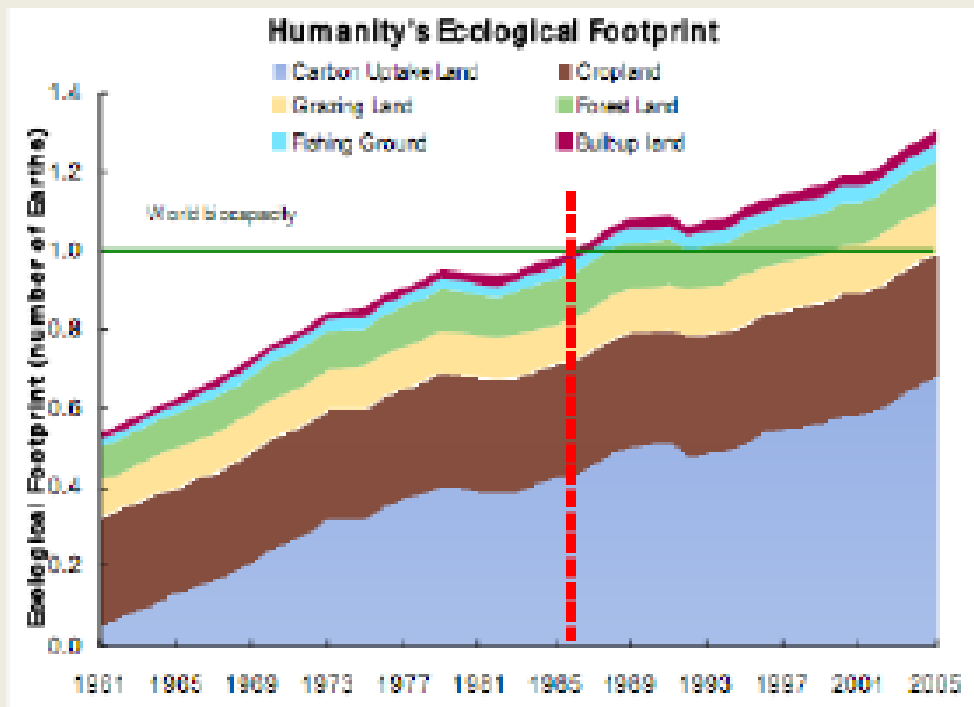




# World Population Growth Through History



# ... leading to "overshoot" of our Ecological Carrying Capacity



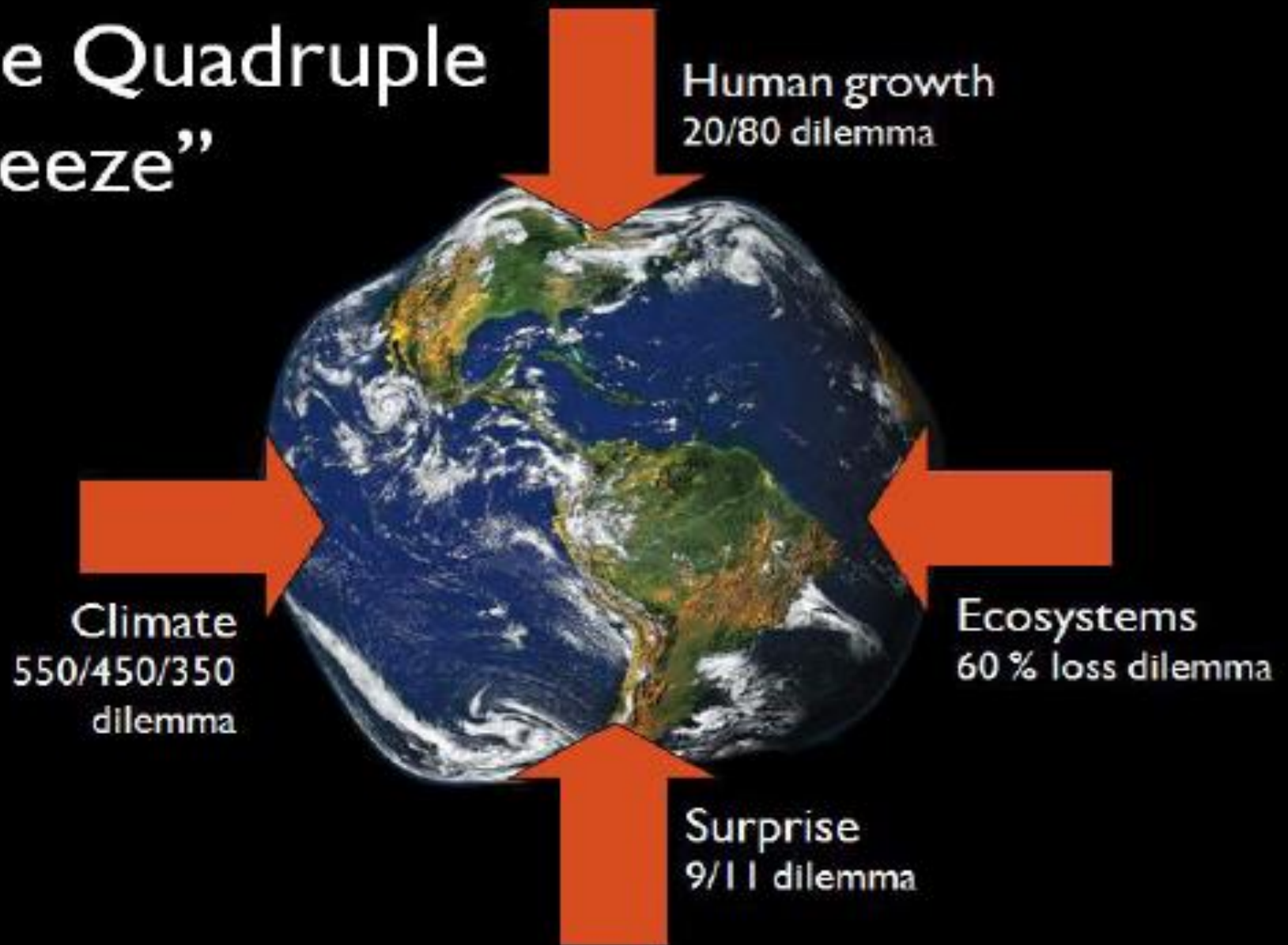
“The human population is now so large that the amount of resources needed to sustain it exceeds what is available at current consumption patterns” (Achim Steiner, UNEP Executive Director).

Source: Global Footprint Network - <http://www.globalfootprintnetwork.org/>

Source: UNEP



# "The Quadruple Squeeze"



Source: UNEP



# What can we do?

- ★ Understand sustainable intensification;
- ★ Reduce food waste;
- ★ Change our diets;
- ★ Produce our own food...

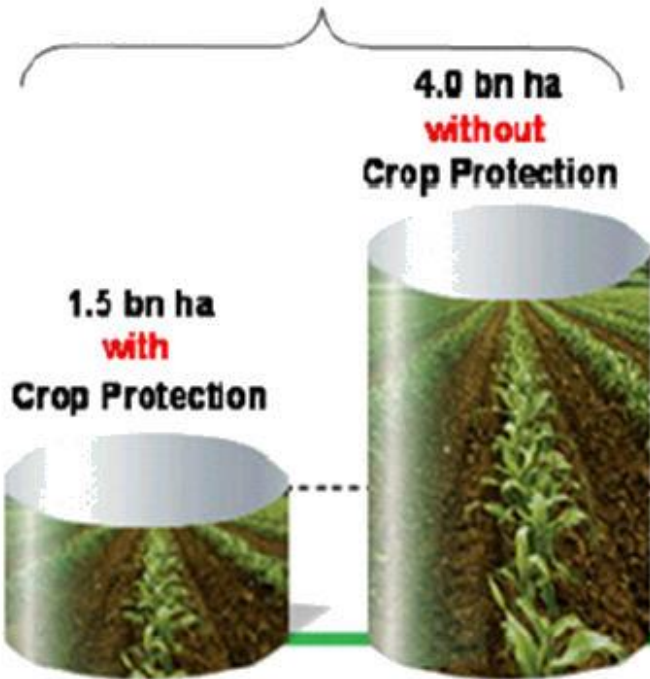


# Landuse and Crop Protection

**Theoretical Potential:**  
Earth's surface area: 13 bn ha

**Status Quo**  
**Year 2000**

World population:  
6.0 bn people



**Year 2025**  
World population:  
8.0 bn people

5.9 bn ha  
**without**  
Crop Protection



4.3 bn ha  
Desert,  
Glaciers,  
Mountains

3.8 bn ha  
Forest,  
Steppe

3.4 bn ha  
Grassland,  
Prairie

1.5 bn ha  
Arable land

1 Hectare (ha) = 10 000 m<sup>2</sup>

"Ronald and Adamchak's clear, rational approach is refreshing, and the balance they present is sorely needed in our increasingly polarized world."

—Schmitz

# Tomorrow's Table



**Organic  
Farming,  
Genetics,  
and the  
Future of  
Food**

Pamela C.  
**RONALD**

**&**

Raoul W.  
**ADAMCHAK**



Ronald, P.C. & Adamchak, R.W. (2008)  
Tomorrow's Table: Organic Farming,  
Genetics, and the Future of Food Oxford  
University Press, USA (April 18, 2008) IS:  
ISBN-10: 0195301757 ISBN-13: 978-  
0195301755 pp 232

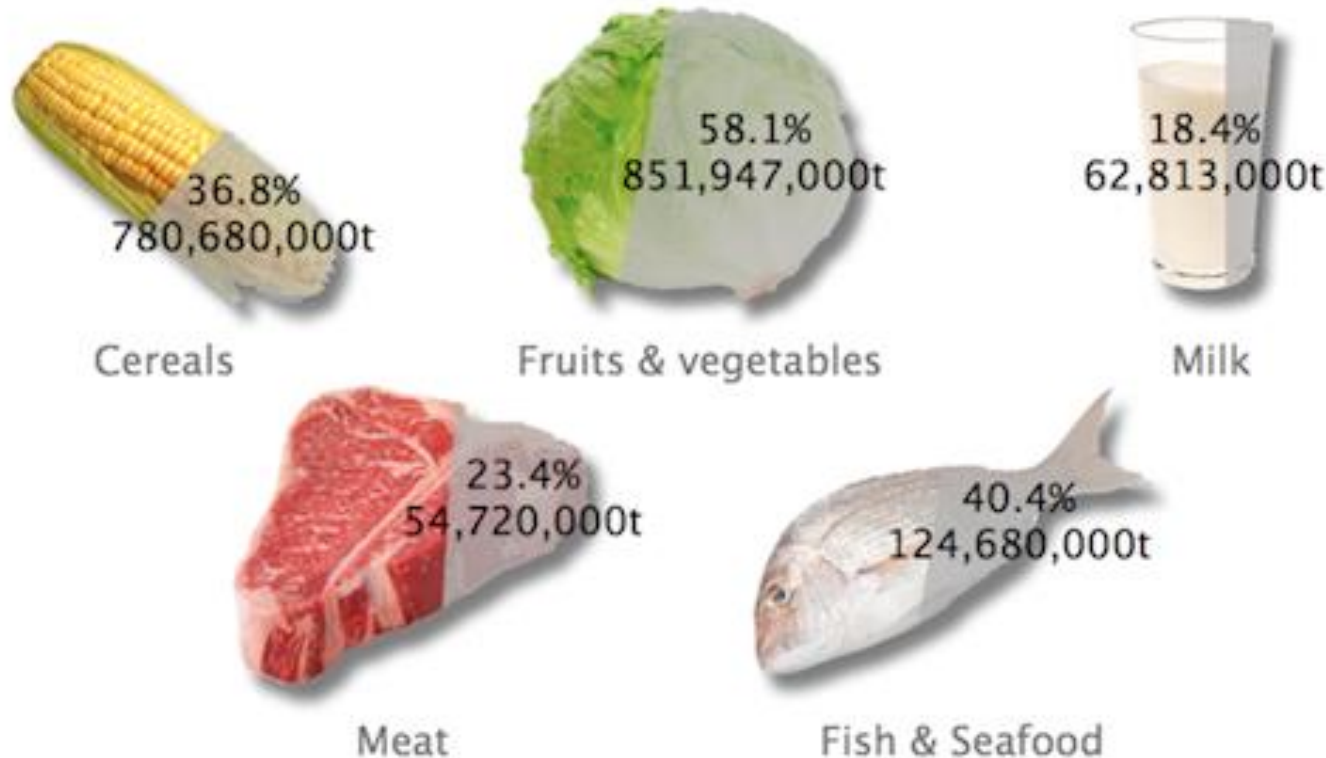
Book review by J. Gressel 2009

<http://www.botanischergarten.ch/Gressel-Book-Ronald-2009.pdf>

# Reduce Food Waste

## World food wastage

About 1/3 of the food produced in the world for human consumption every year gets lost or wasted.



# Consider Alternative Diets

- ★ Beef needs more land and water
- ★ Plants can provide all the nutrients
- ★ Fish especially fresh water fish could be a healthy alternative



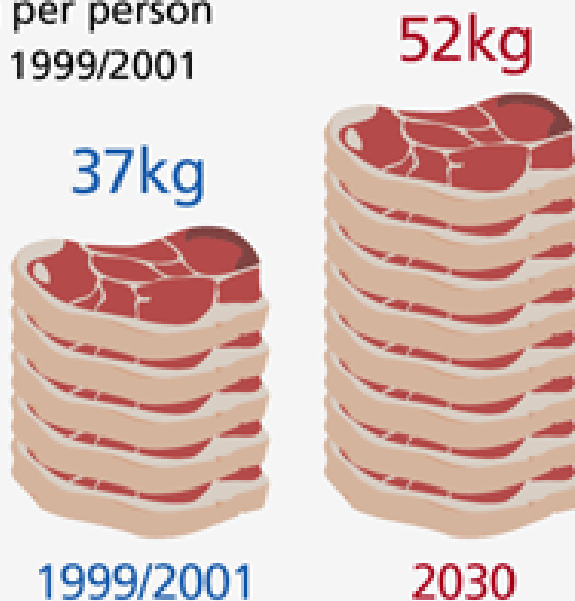


# Red meat consumption



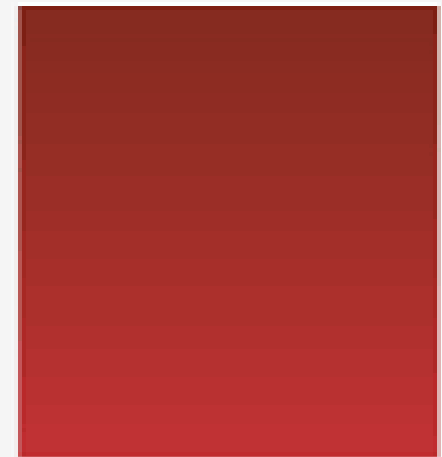
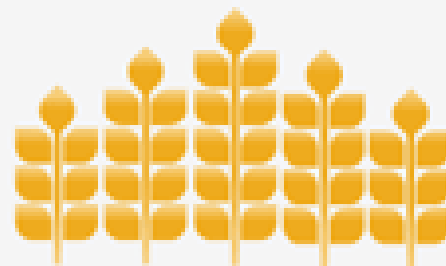
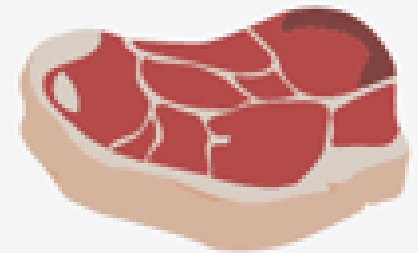
## Meat consumption expected to rise

Meat consumption in developed countries is expected to rise from **37 kg** per person per year in 1999/2001 to **52 kg** in 2050



## Substantially more water required for meat

Producing 1 kg of **grain** requires approximately **1,500** litres of water while 1 kg of **beef** requires **15,000** litres.



# Water Efficiency in Production (measured in gallons per ton)



# Feed Conversion (grain:flesh)

- Beef cattle on feedlot 8:1
  - Swine 3.3:1
  - Poultry 2.25:1
  - Rainbow trout 1.5:1
  - Tilapia 1.25:1
- 
- fish are so efficient!



# Recommended daily intake of energy and protein for people

	Age, Stage, Lifestyle	Kilocalories Per Day	Protein (grams/Day)
<b>Children</b>	1-2 years	1,000	40
	5-6 years	1,400	50
<b>Girls</b>	11-12 years	2,200	65
	13-17 years	2,500	70
<b>Boys</b>	11-12 years	2,000	60
	15-18 years	3,000	80
<b>Women</b>	Sedentary	1,800	55
	Very active	2,500	65
	Pregnant	Add 400	85
	Lactating	Add 900	95
<b>Men</b>	Sedentary	2,200	60
	Very active	3,000	70

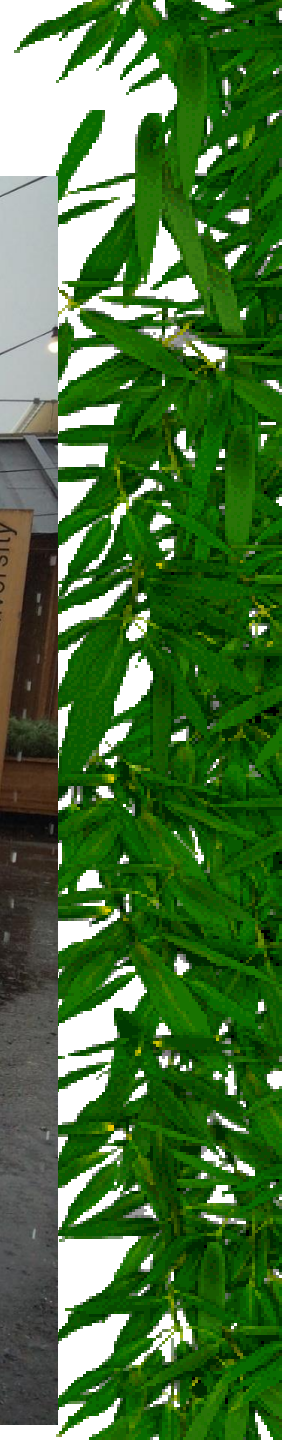


# Protein score and protein content of various mixtures of staples

Cereal	Supplement	Percentage of Protein	Protein Score
Wheat	None	11.2 %	62
	Groundnut	14.2	67
	Soybean	13.8	76
Maize	None	9.5	49
	Groundnut	12.6	58
	Soybean	12.2	67
Rice	None	6.7	69
	Groundnut	10.0	73
	Soybean	9.6	77



# Urban Agriculture



# Produce of SU Campus



# Take home messages:

- ★ Life on earth depends on plants and photosynthetic microorganisms;
- ★ The world's resources are limited and stressed;
- ★ Sustainable intensification using all available tools are crucial;
- ★ Food waste should be eliminated;
- ★ We should consume more plant proteins;
- ★ We should start producing our own food;
- ★ We all share the same planet...

