

**Welcome to Botany!**

**We love Plants!**



# What is botany?

- \* The scientific study of plants
- \* Also called Plant Science, Plant Biology, or Phytology.



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# INTRODUCTION to BOTANY Part I





# What is a plant?

- \* What distinguishes a plant from other forms of life?



**1** Multicellular eukaryote

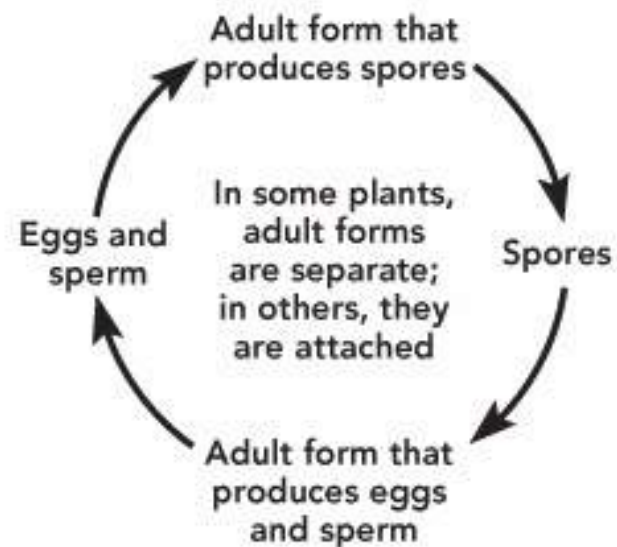
**2** Photosynthesis:  
Carbon dioxide + Water + Solar energy → Sugars

**3** Cell wall  
made of cellulose






Nucleus  
containing  
DNA

**5** Embryo protected within  
mother plant

**4** Two adult forms:

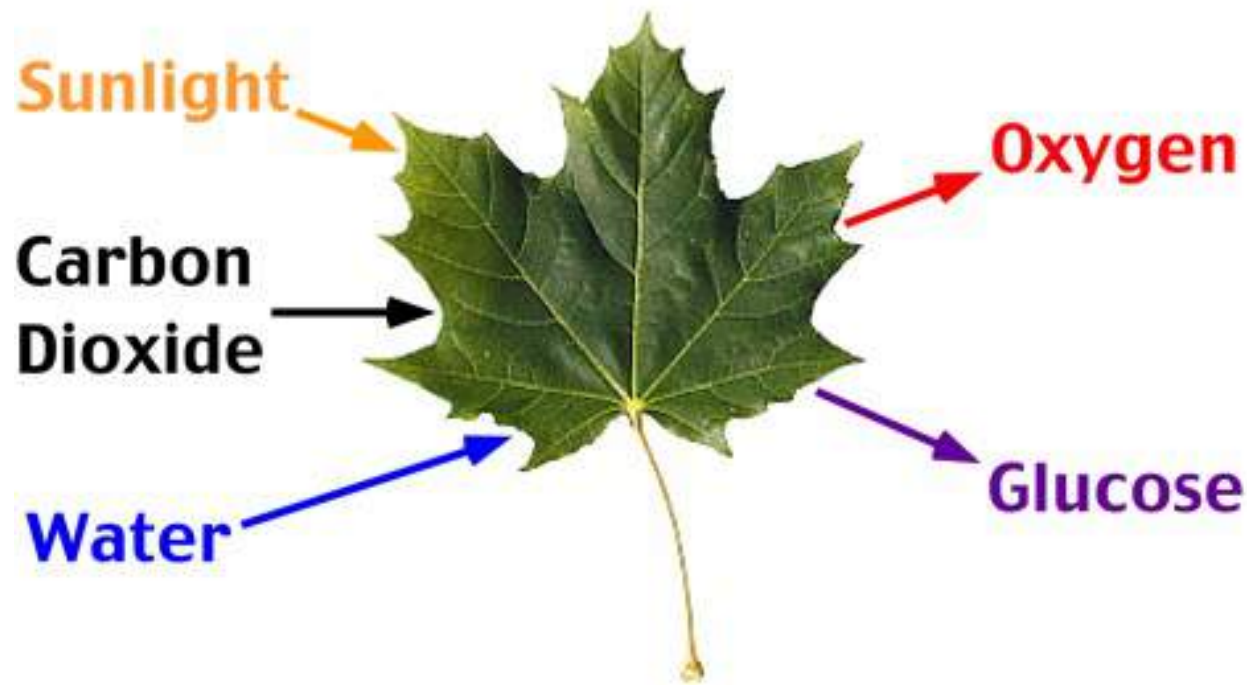




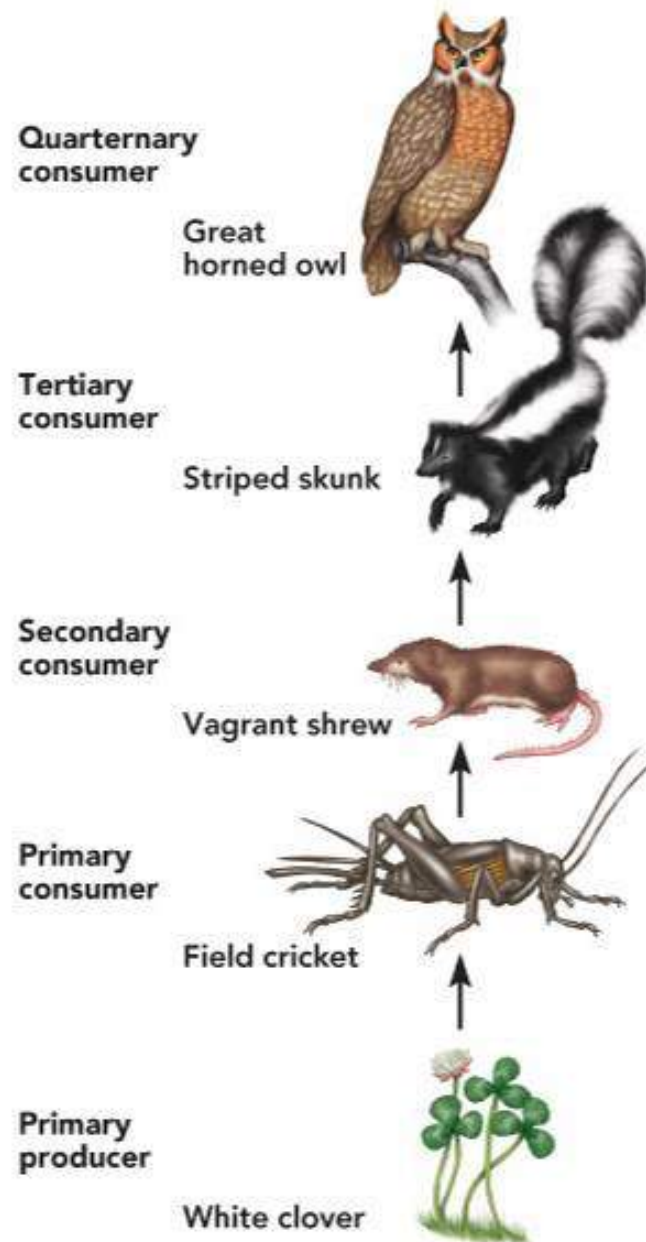
	 <b>Bacteria</b>	 <b>Algae</b>	 <b>Plants</b>	 <b>Fungi</b>	 <b>Animals</b>
<b>Cell type</b>	Prokaryotic; single-celled but may form colonies	Eukaryotic; single-celled and multicellular	Eukaryotic; multicellular	Eukaryotic; multicellular	Eukaryotic; multicellular
<b>Cell wall</b>	Cell walls do not contain cellulose	Cell walls of some species contain cellulose	Cell walls composed mainly of cellulose	Cell walls composed mainly of chitin	No cell walls
<b>Mode of nutrition</b>	Various; some photosynthetic autotrophs	Photosynthetic autotrophs	Photosynthetic autotrophs	Heterotrophs that absorb food	Heterotrophs that ingest food
<b>Reproduction</b>	Mostly asexual	Sexual and asexual; some species have two adult forms: one that produces spores and one that produces eggs and sperm	Sexual and asexual; two adult forms: one that produces spores and one that produces eggs and sperm; embryo protected within female parent	Sexual and asexual	Mostly sexual, some asexual; embryo protected within female parent in some species, including most mammals
<b>Growth</b>	Indeterminate	Indeterminate or determinate	Indeterminate or determinate	Indeterminate or determinate	Determinate

# Why is knowledge of plants important?

- \* We are dependent on plants



# Plants are producers





# Plants as a food source



# Photosynthesis and sugars



\* This equation is why you are alive!



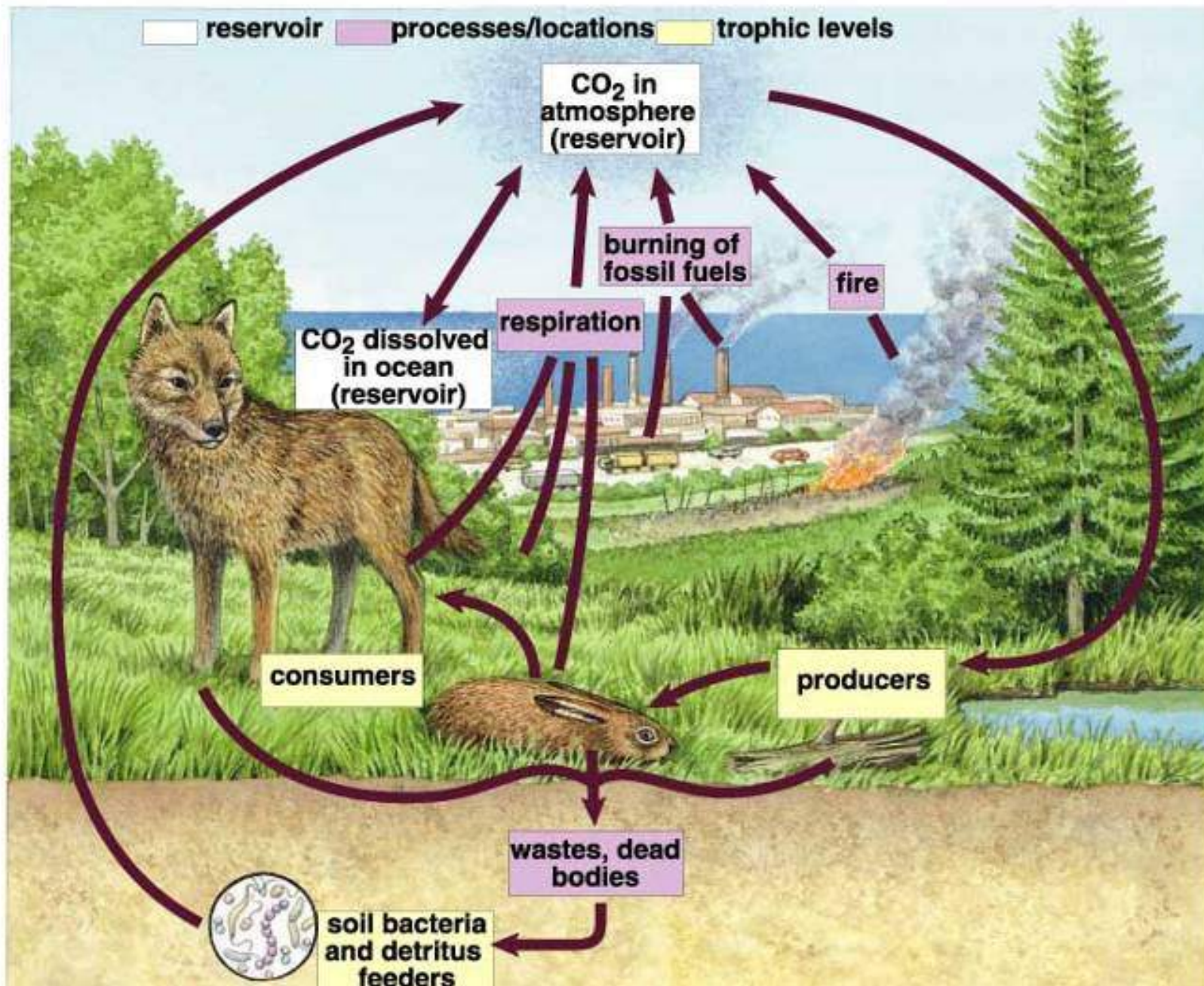


# Cacao - chocolate





# Plants & the Carbon cycle



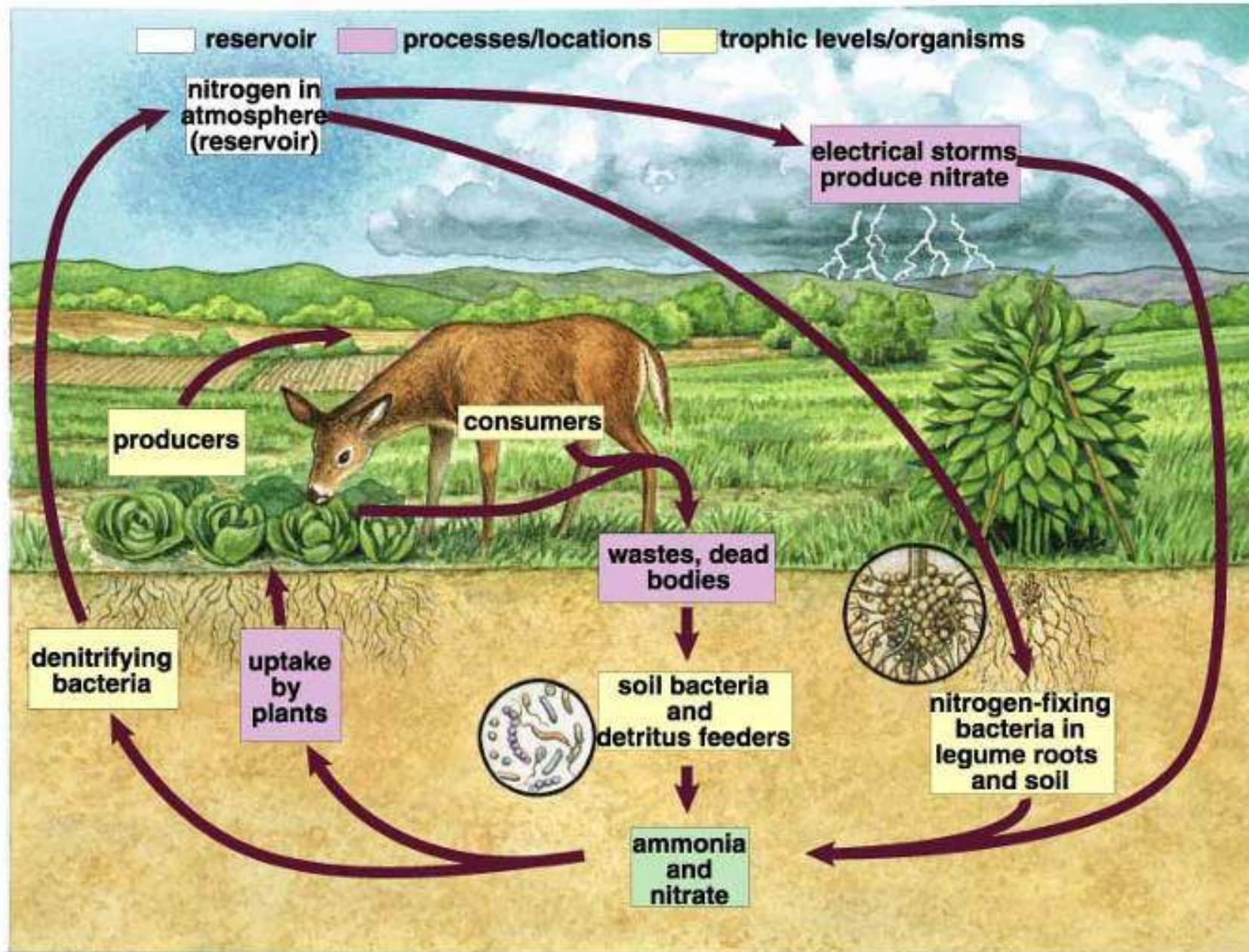


# Photosynthesis and oxygen



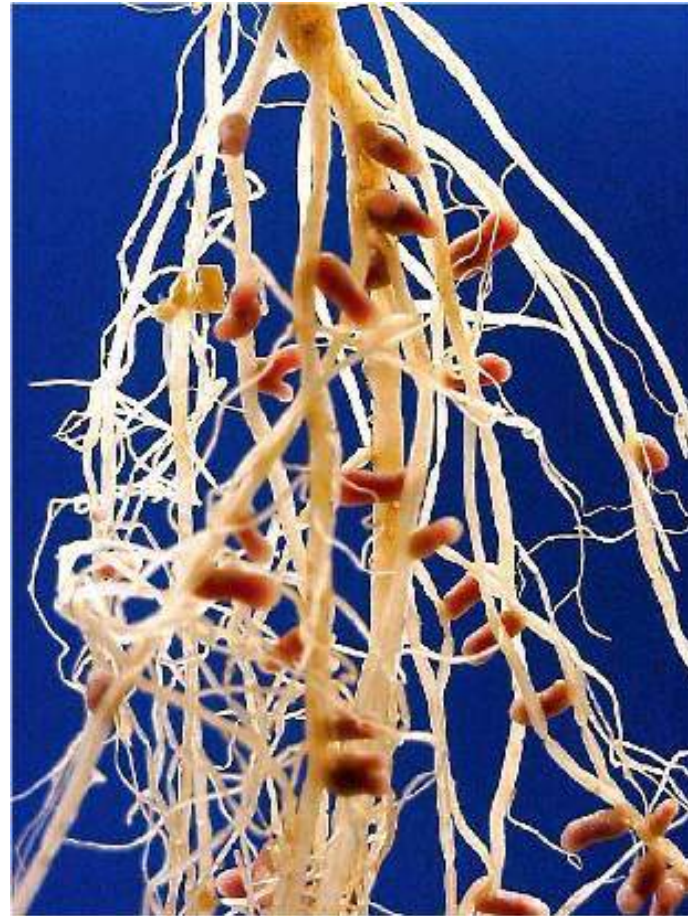


# Plants & the Nitrogen cycle





# Legumes & rhizobium





# Beverages



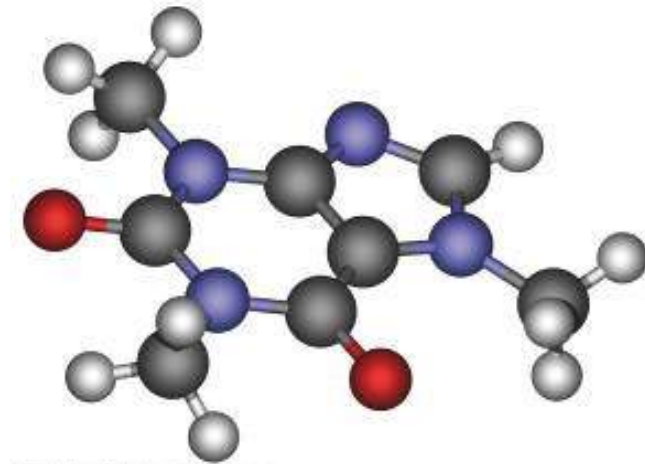
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- \* Coffee - \$65B retail US sales
  - 25 million coffee producing family farms
  - Provides for non-intoxicating social interaction



# Wines





# Cork



# Spices



- \* \$2 billion retail sales
- \* U.S. – largest producer & consumer of spices





# Plants & health

## \* Natural compounds

- Lycopene
- Yohimbine
- Medicines
  - \* taxol



# Saponins

## \* Ginseng

- Stomach disorders
- Nervous disorders





# Alkaloids

## \* Ephedrine



*Ephedra* – Mormon tea plant

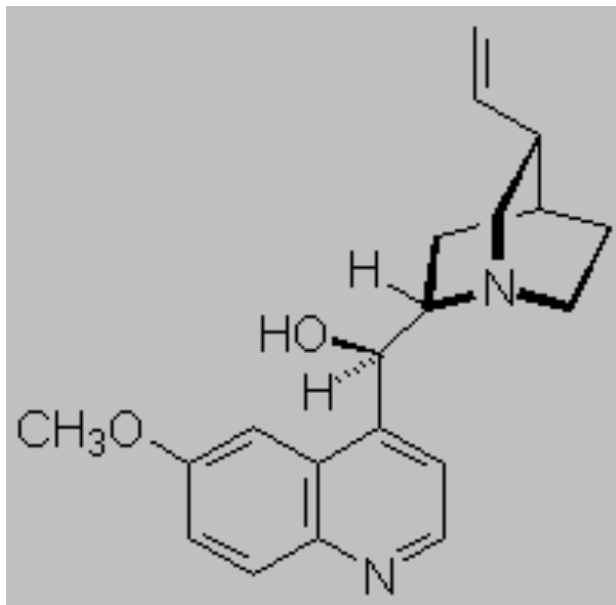


# Alkaloids

- \* Quinine (feverbark tree)
  - Anti-malarial
  - \* 2-3 million deaths per year



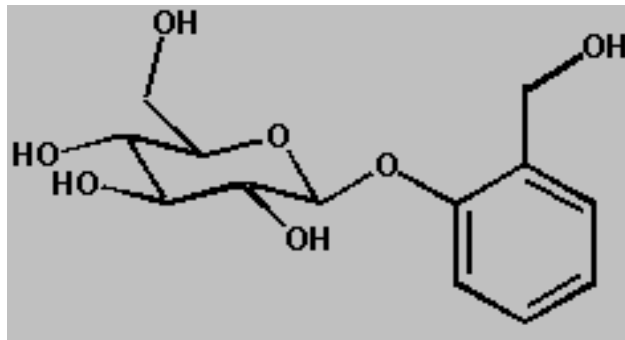
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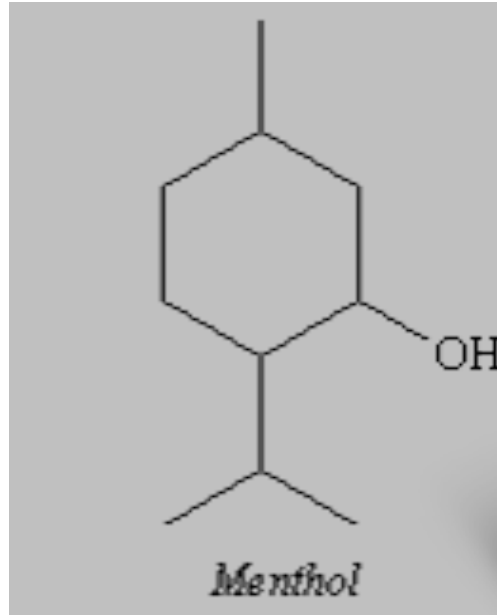
# Phenolics

- \* Salicin
  - Aspirin precursor



# Essential oils

- \* Menthol (Eucalyptus)
- \* Mint





# New antibiotics

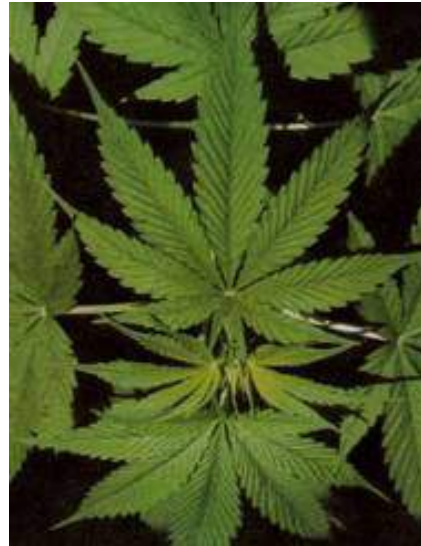
- \* Oregon grape
  - Berberine & 5-methoxyhydrnocarpin



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# Recreational Drugs





# Wood products





# Paper



\* 10.3 million tons wood pulp (US, 2003)



# Textiles





# Plants & transportation



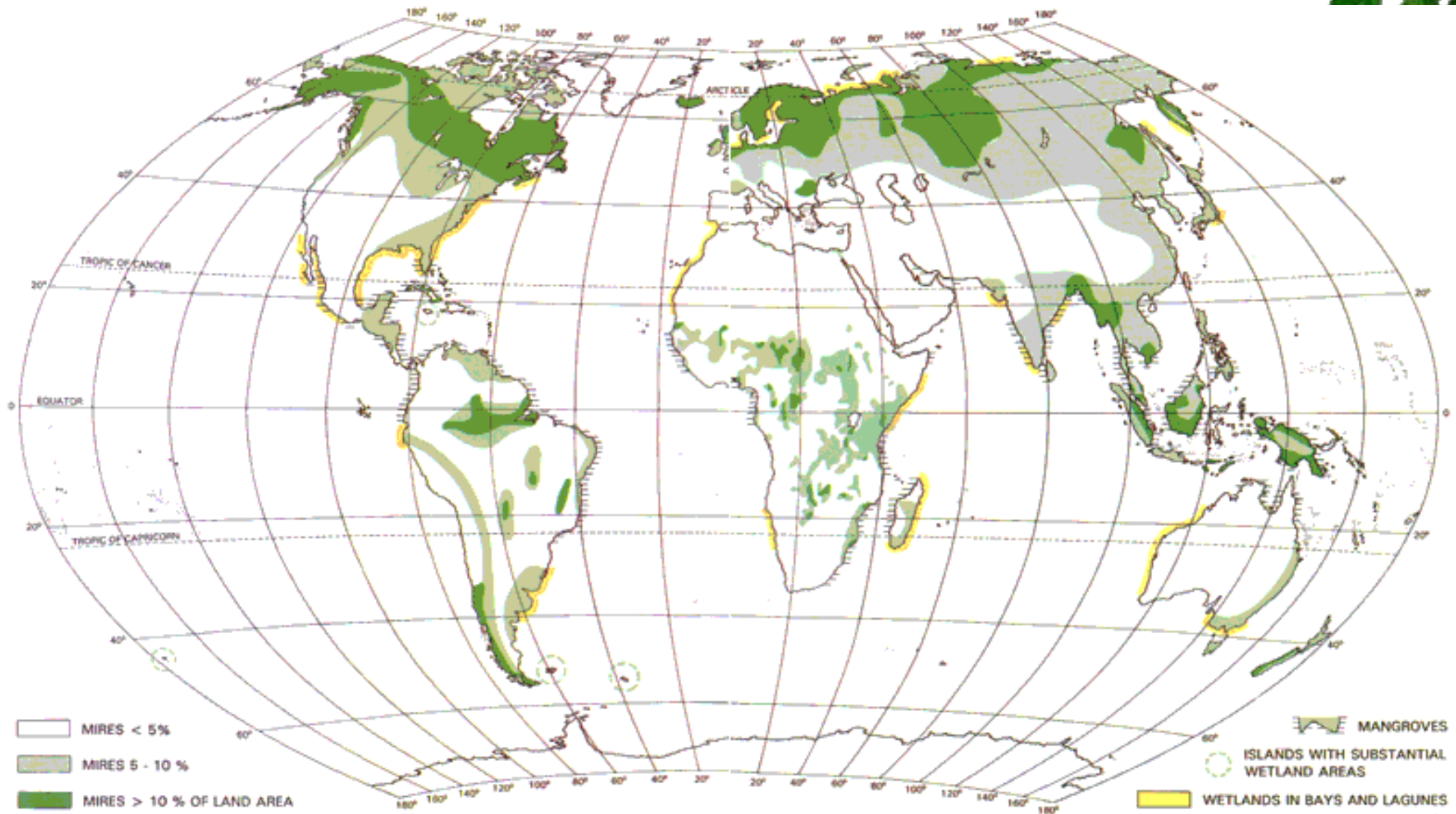


# Plants as fuel





# Worldwide peat distribution





# Horticultural peat

\* US, Canada, South Africa top producers

>100,000 HA

>800 companies



# Coal



## World coal stats

- \* U.S. production : 1.07 billion tons
- \* U.S. consumption : 1.09 billion tons

Source: [http://www.eia.doe.gov/cneaf/coal/quarterly/qcr\\_sum.html](http://www.eia.doe.gov/cneaf/coal/quarterly/qcr_sum.html)





# Plants & emotions



- \* Floriculture - \$77 billion worldwide retail value
- \* U.S. – largest floral producer





# Landscaping





# Musical instruments



Flutes and clarinets.



# Plants and sports





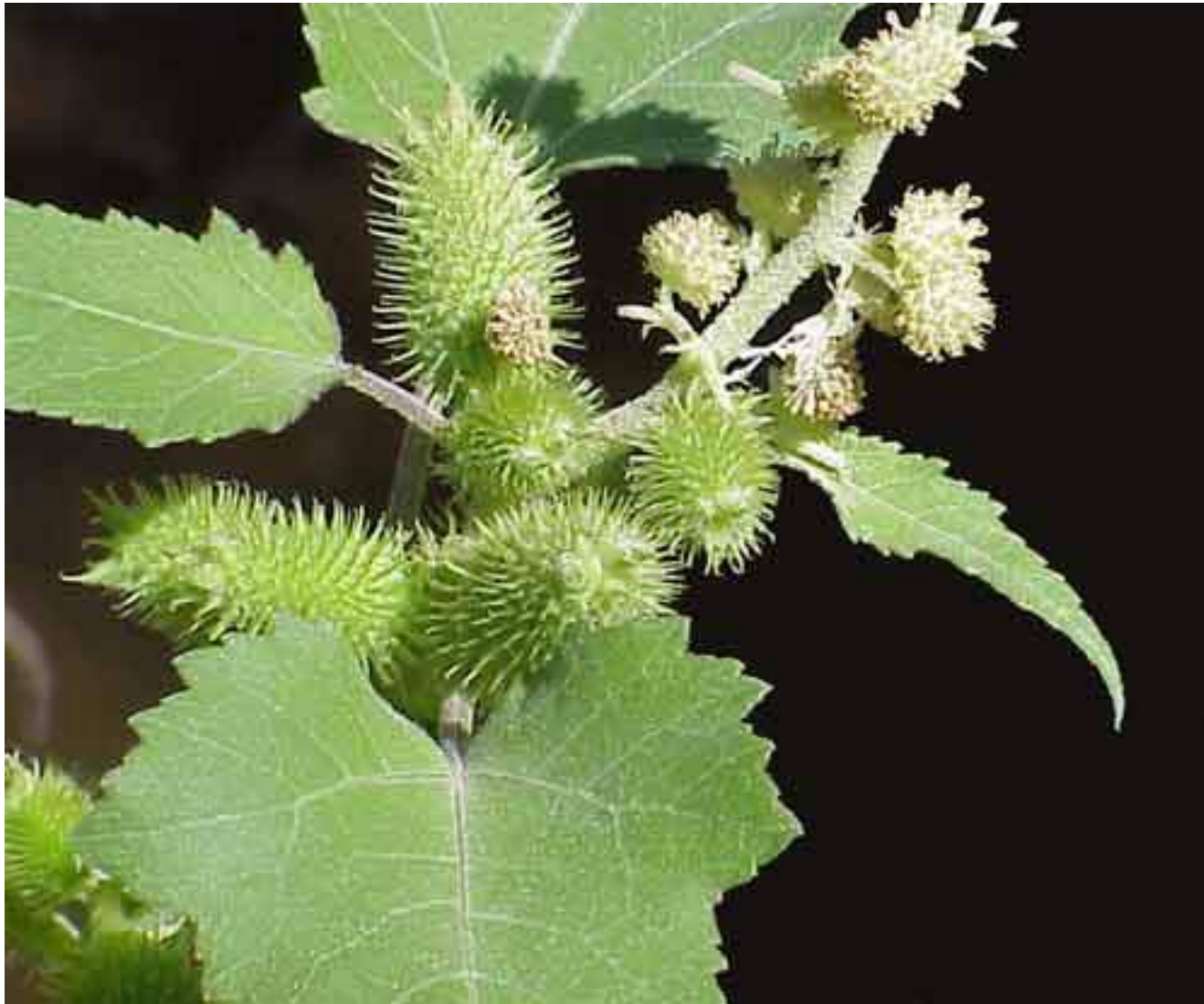
# Personal care products



shampoo



# Plant-related inventions

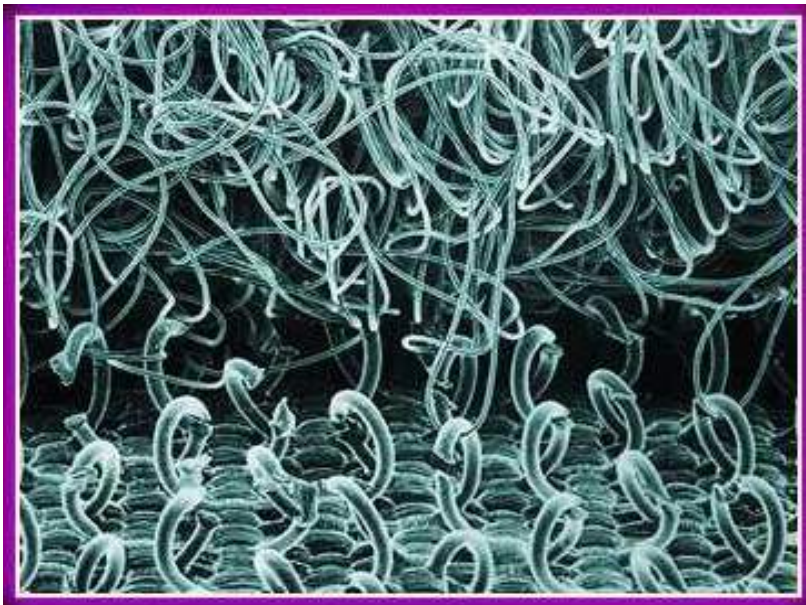


\* Velcro





# Velcro – George de Mestral



1907-1990



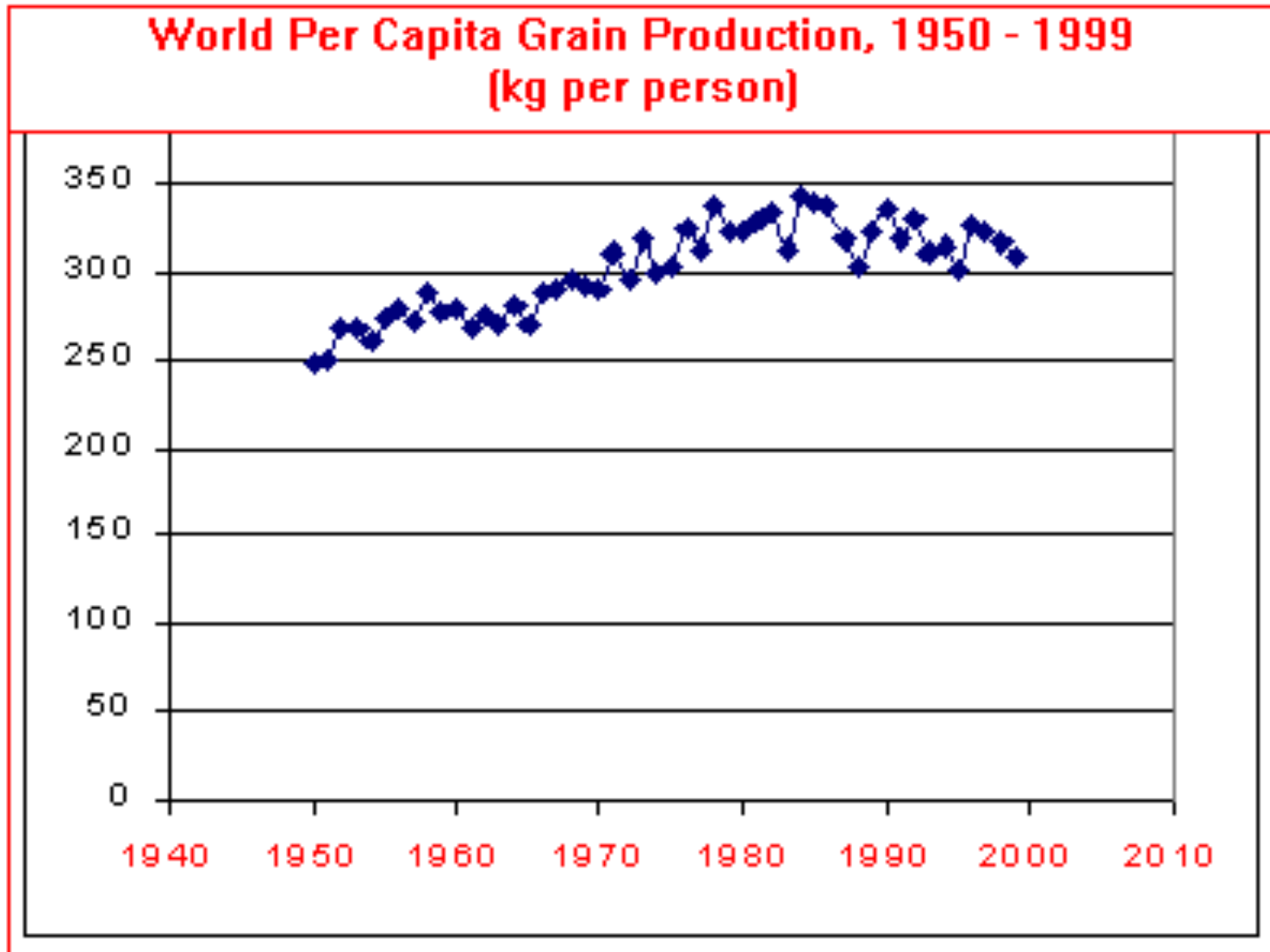
# **Conservation biology & plant resources**

- \* How do we better maintain worldwide natural resources, in the face of increasing global demand and exponential human population growth?

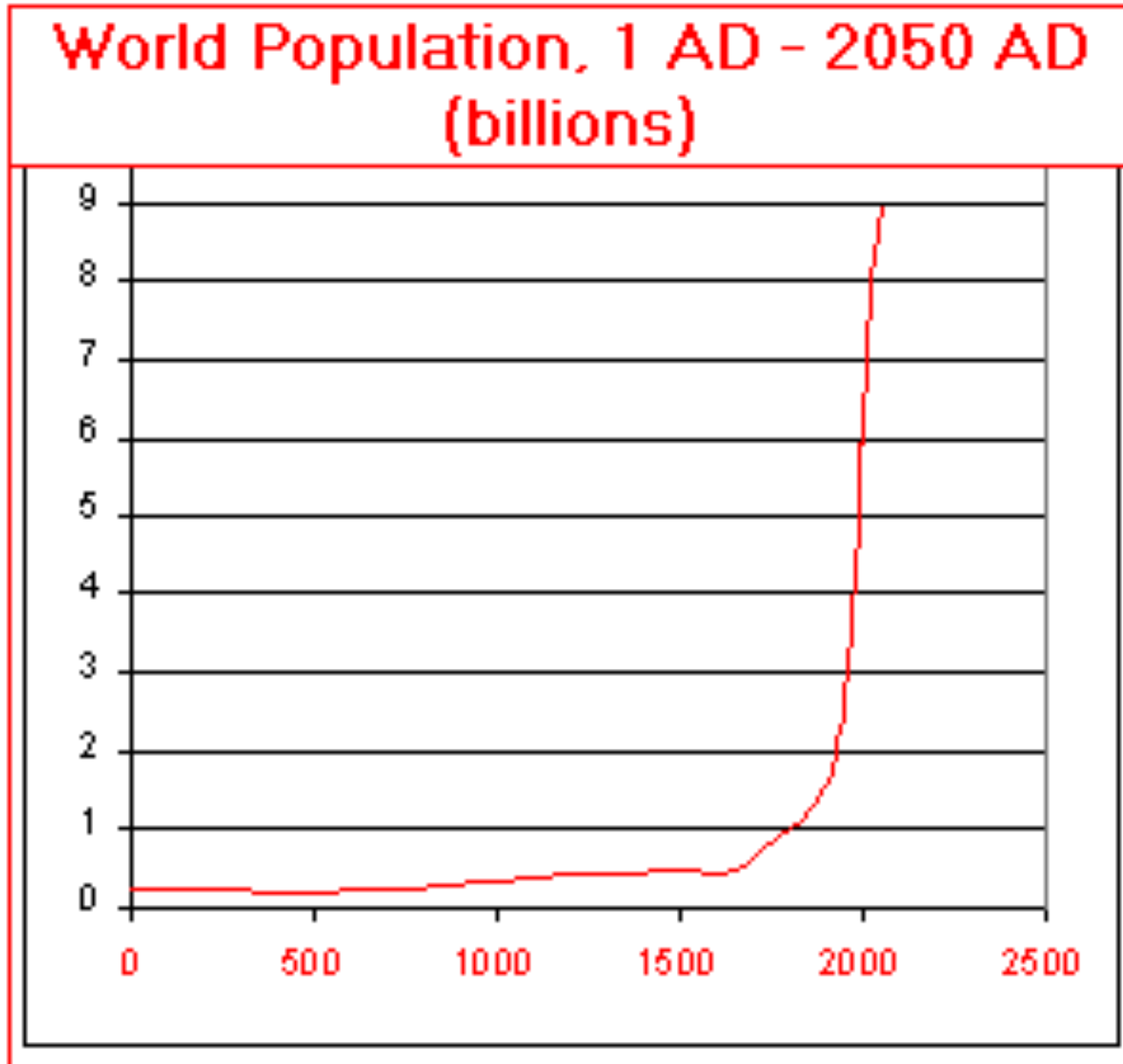




# Plants, food and population growth



# World population growth



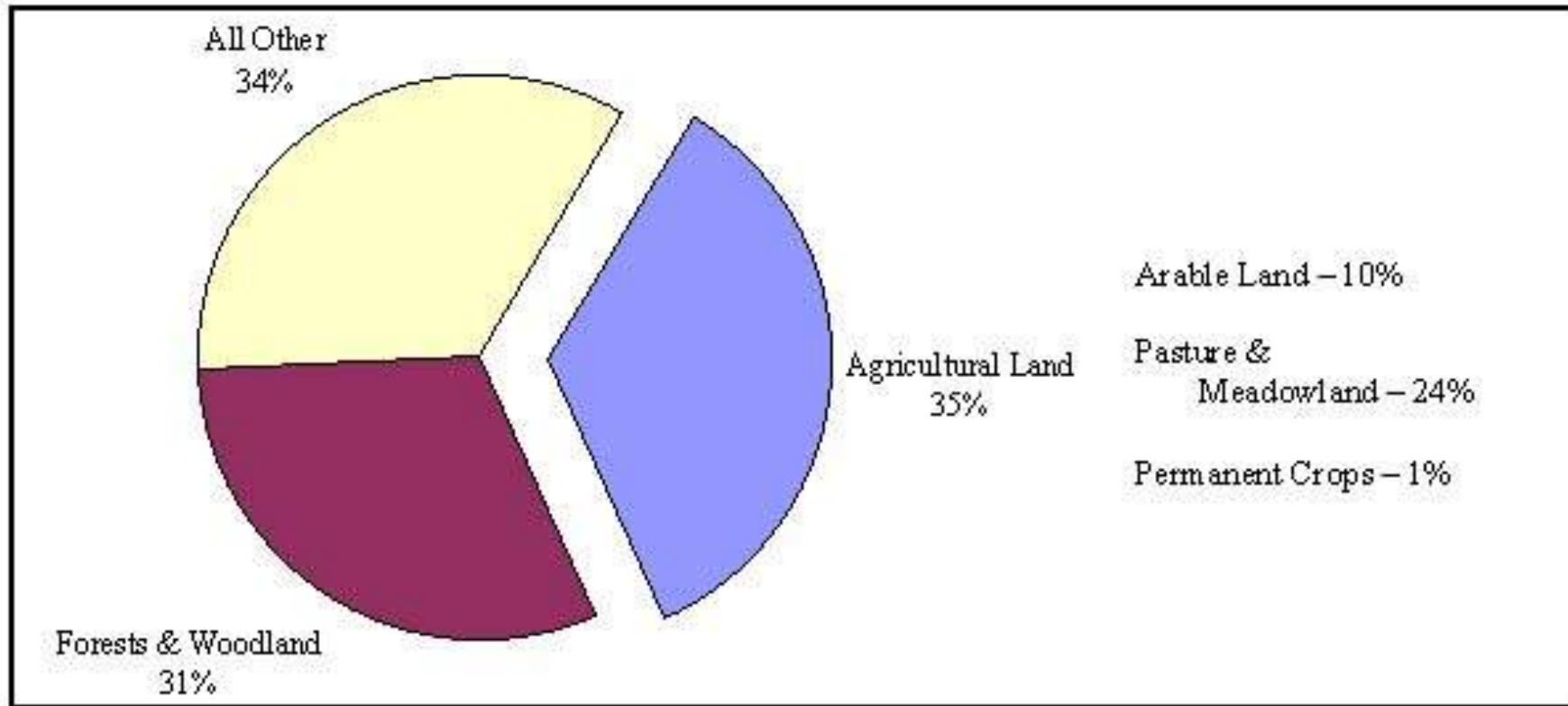


# **In the next 50 years, can we double our food supply?**

- \* Increase land used for agriculture?
- \* Increase crop productivity?
- \* Convert to vegetarian diet?

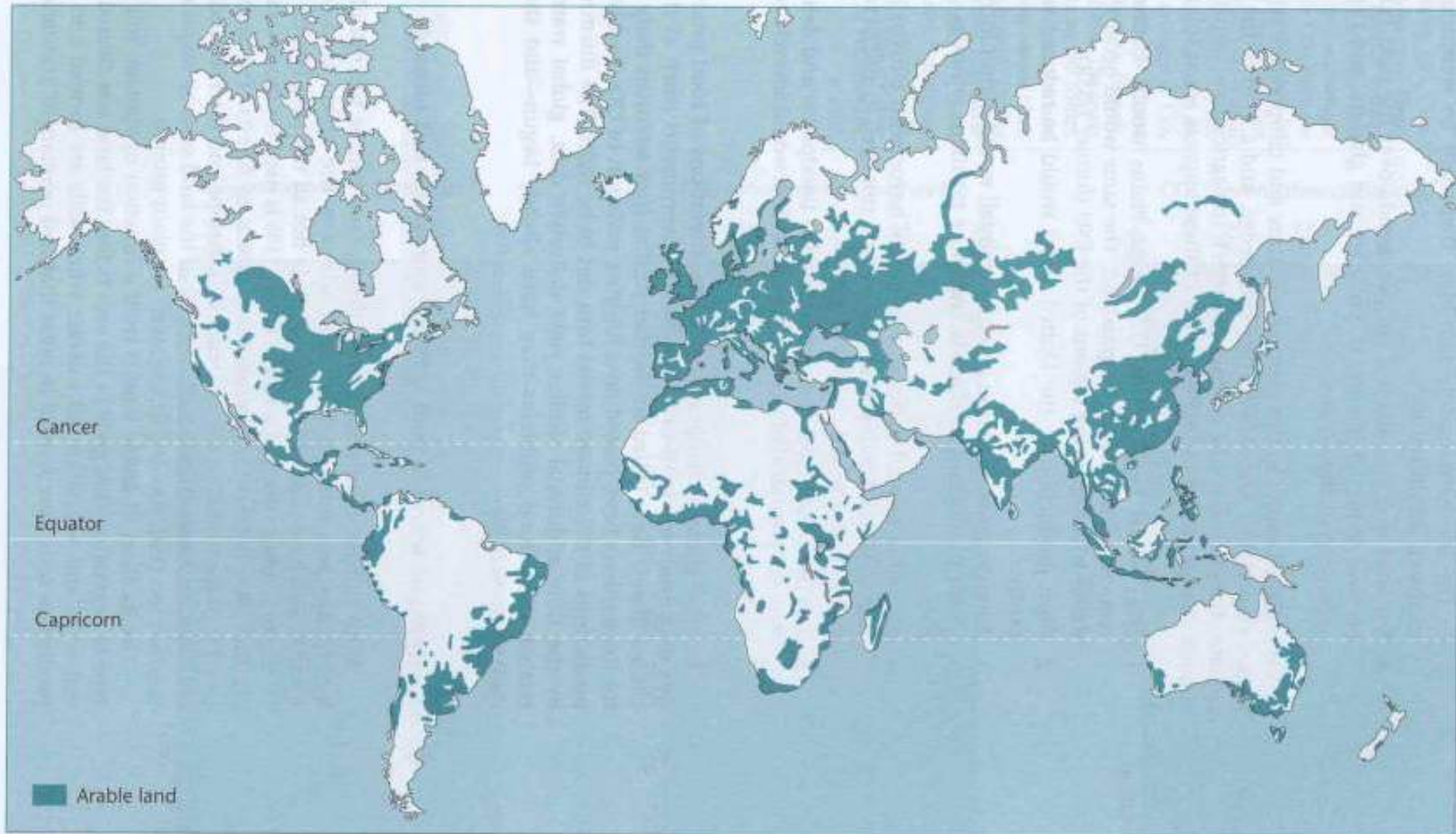


# Worldwide land resources





# Distribution of arable land

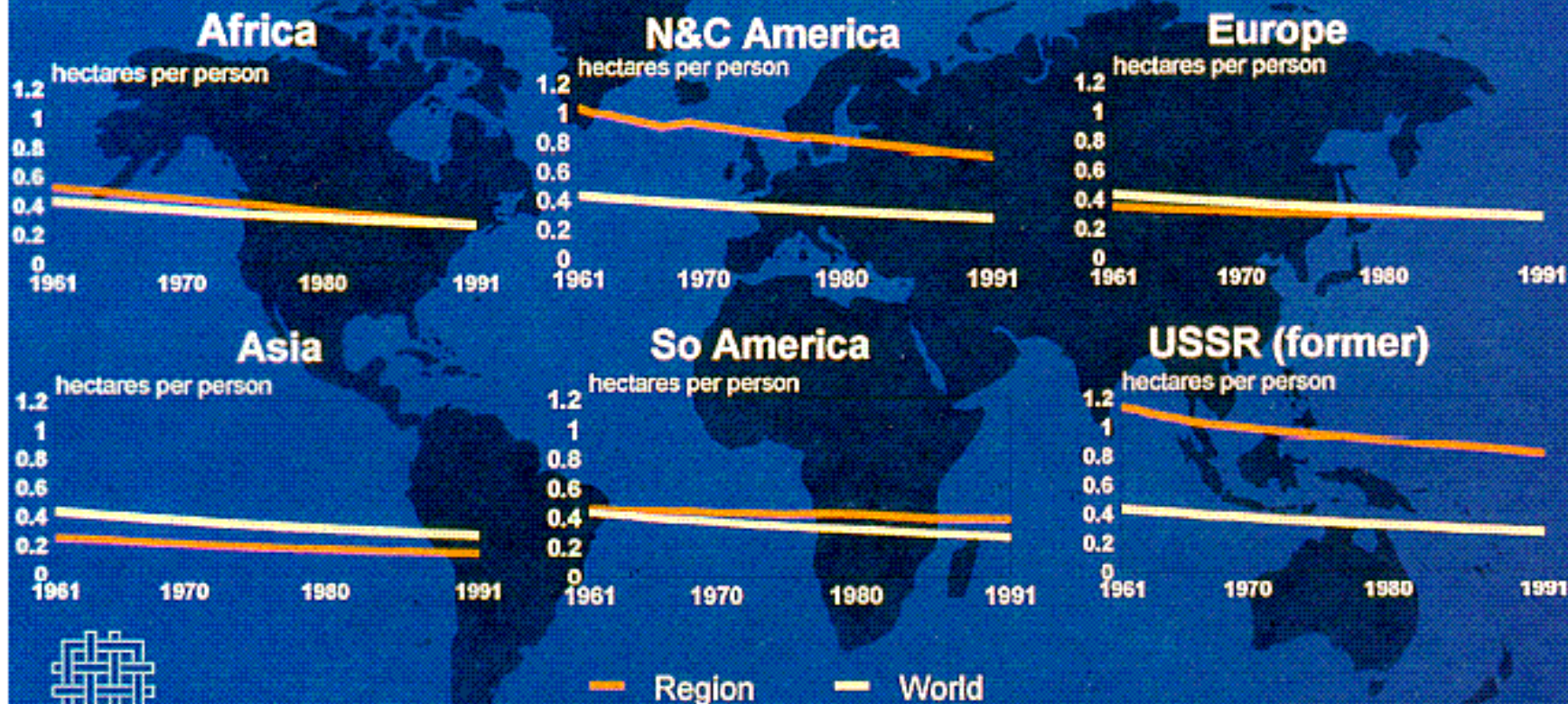


**Figure 2.8**

*The World Distribution of Arable Land. Notice that most of the arable land is in the United States, Europe, Russia, Western Asia, India, and China.*



# Cropland Per Capita

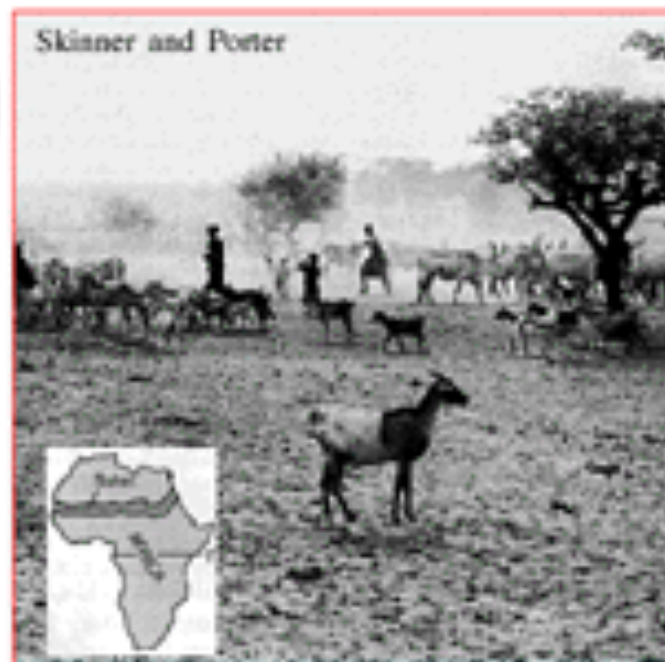
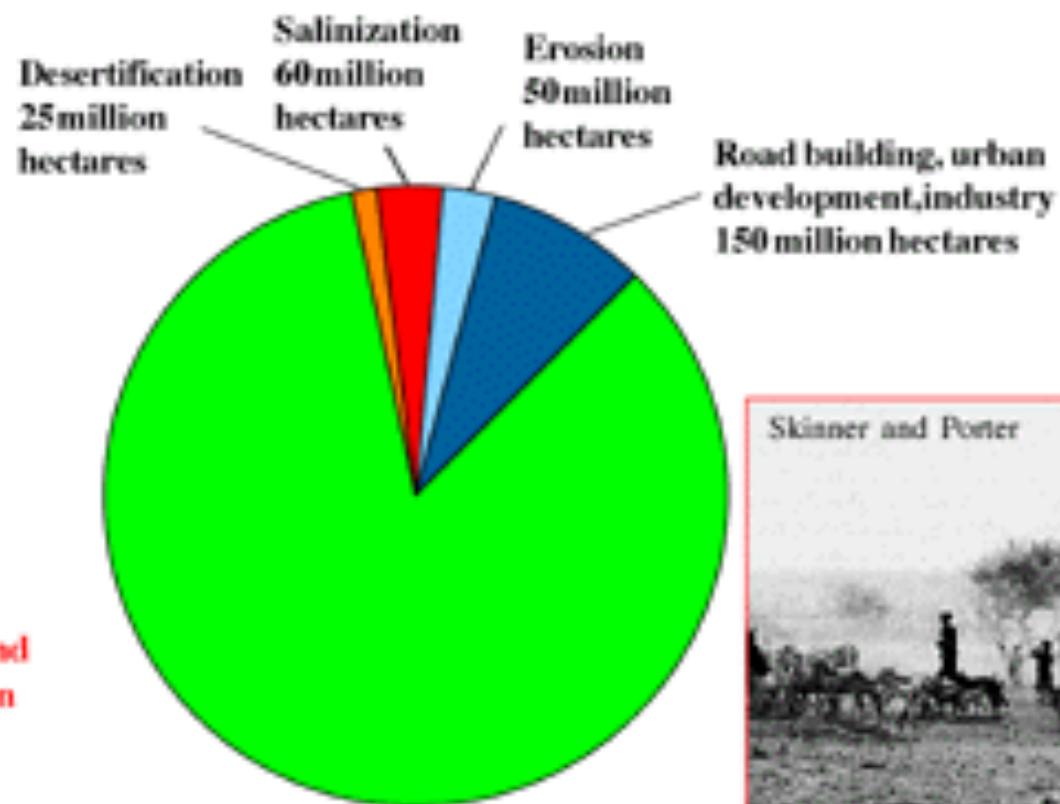


World  
Resources  
Institute

Source: Food and Agriculture Organization of the United Nations, 1993.

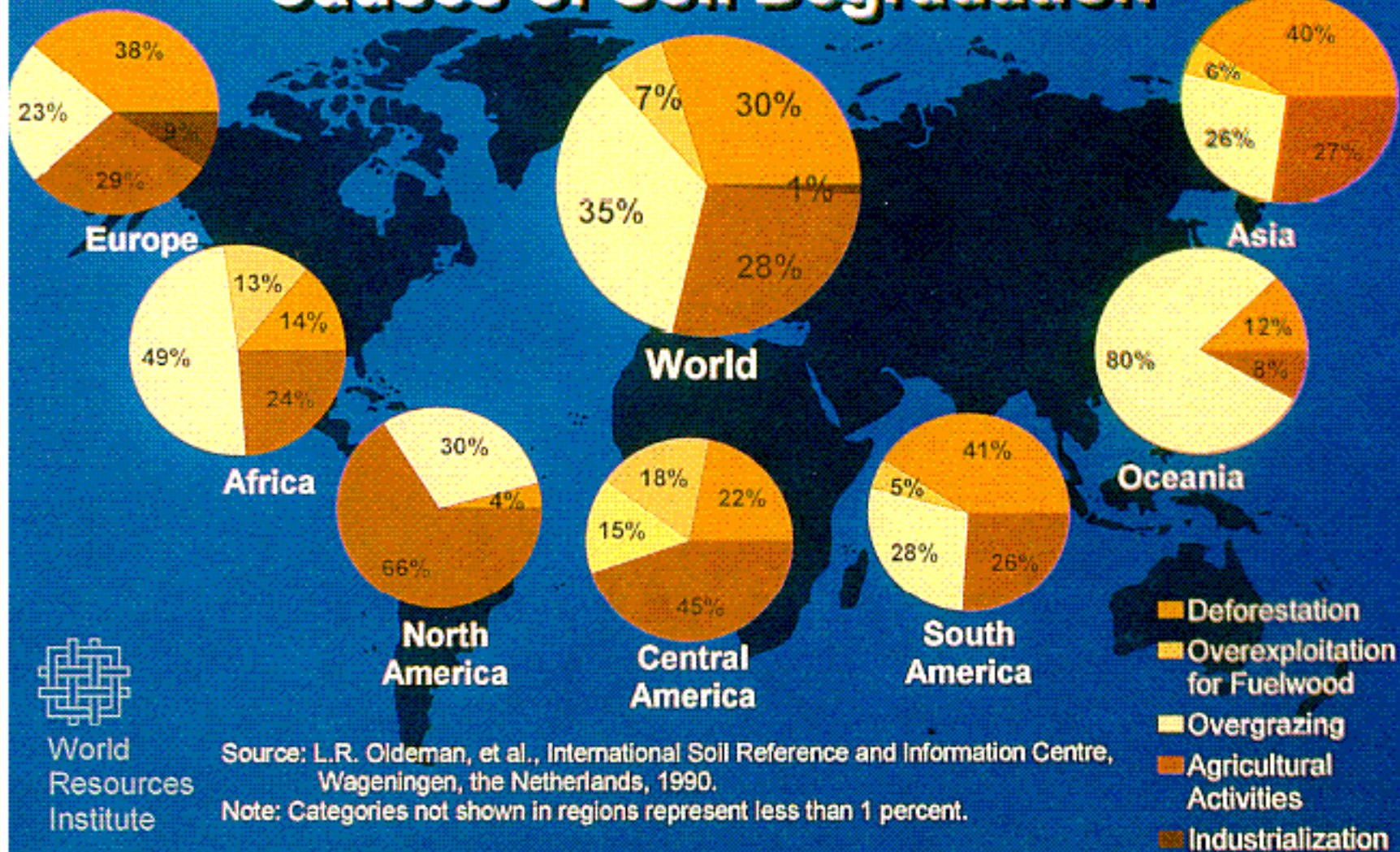


# Loss of Arable Land 1985-2000





# Causes of Soil Degradation





# The Dust Bowl



# Drought





# Drought increases stress

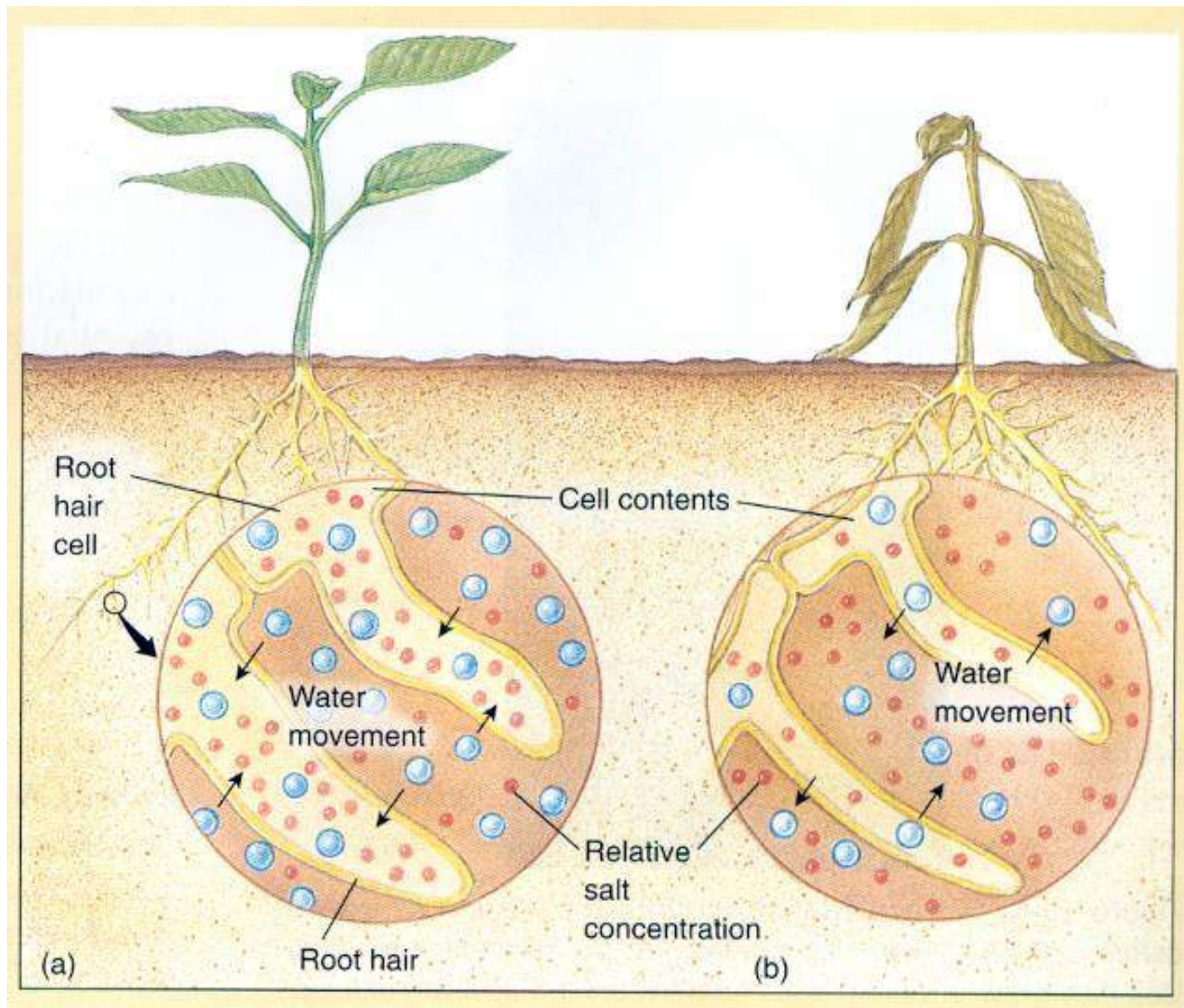


- \* Black shank disease in tobacco



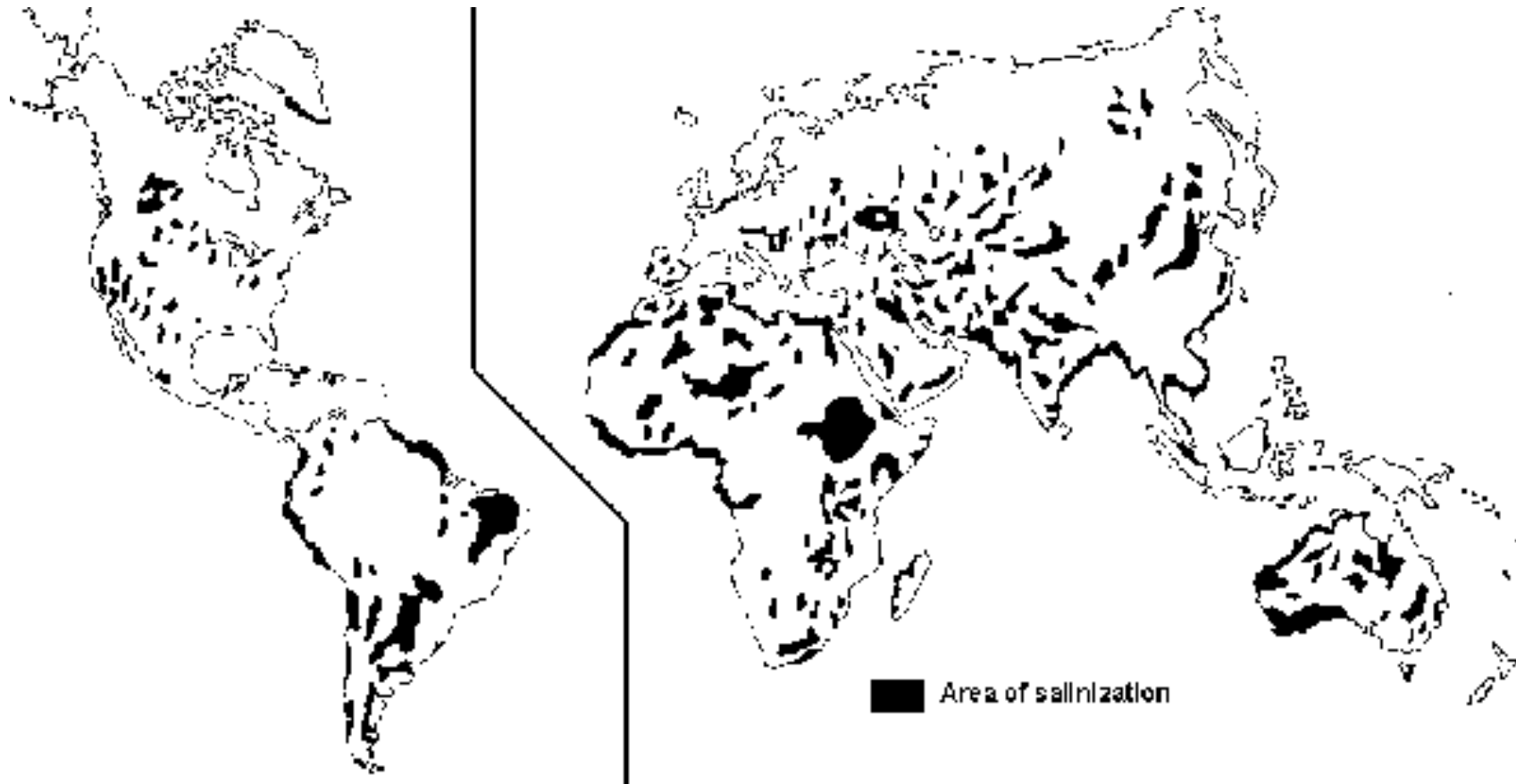


# Soil salinization





# Areas of Salinization



- \* Caused by overwatering and poor irrigation practices.



# Human activities



**SCIENCE NEWS** of the week

## Sooty Air Cuts China's Crop Yields

China leads the world in grain production, harvesting more than 360 million tons each year. The growing affluence of its 1.2 billion inhabitants, however, has fostered a craving for more than China now grows. As a result, this nation imports grain. As China's population continues to swell, so will its demand for imports—leaving less for poorer grain-starved nations.

A new study finds that by cleaning its air, China might eliminate—at least in the near term—its need for imported grain.

Dust-size particles of soot and other pollutants have created a haze over much of China's grain belt. This pollution can significantly depress photosynthesis, reducing crop yields, the new study finds. In fact, its calculations suggest that the haze could be robbing farmers of more grain than China now imports.

Pollution analysts have viewed haze-causing particulates as a visibility-limiting nuisance and potential health threat. "This new paper looks at an impact that's never been considered," says

*Chameides*



*Georgia Tech scientist measures haze in rural Zhejiang Province last month. The 5-mile visibility, typical there, represents almost three times the worst haziness in Tennessee's Smoky Mountains.*

sooty air.

However, Chameides notes, because haze is a problem worldwide, it probably is diminishing crop yields in developing and industrial nations alike.

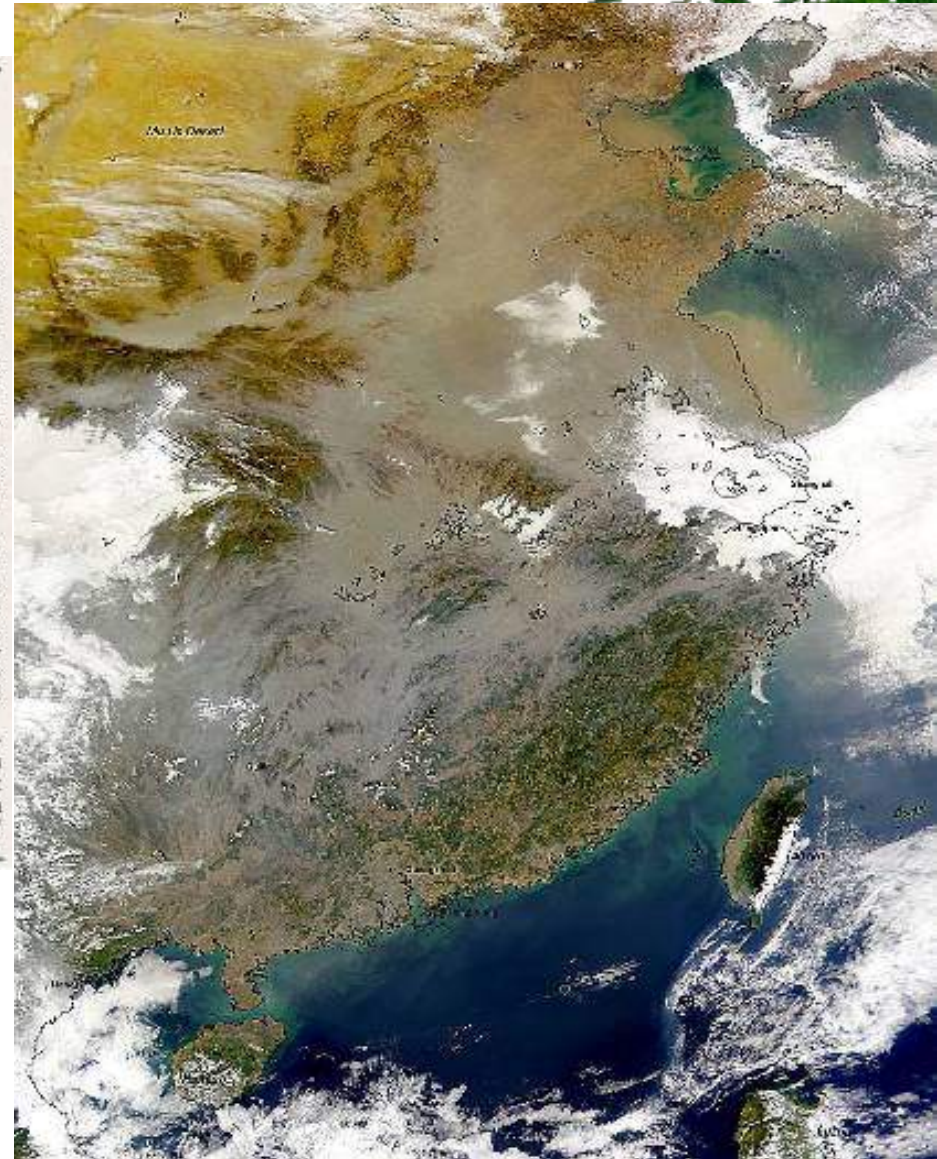
Though the new projections represent

"a good effort," they remain by necessity "a bit rudimentary," says Cynthia E. Rosenzweig of NASA's Goddard Institute for Space Studies in New York. The harvest models, for instance, employ overly simplified relationships between crop growth and sunlight. The new study also estimated yield losses from haze in the absence of any other problems. In fact, Rosenzweig notes, yields can be limited at least as much by pests, water shortages, or insufficient nutrients as by haze.

The good news is that China may have begun a transition away from the coal burning that contributes to its serious haze problems, notes agricultural economist Lester Brown of the Worldwatch Institute in Washington, D.C. Cutting coal subsidies has raised the price of this fuel and limited its use, he says.

Moreover, the nation recently activated its first wind farm. "China has enough usable wind to easily double its current national electricity generation," Brown notes.

—J. Raloff





# Air pollution affects photosynthesis



*Photo courtesy of R.L. Anderson*



*Photo courtesy of R.L. Anderson*



# Human impact on pollination



The loss of bee populations greatly affects pollination of crops.

Causes may be due to climate change, disease, overuse of pesticides, genetics?





# Disease

- \* Reduce crop yields 10-20% despite control efforts



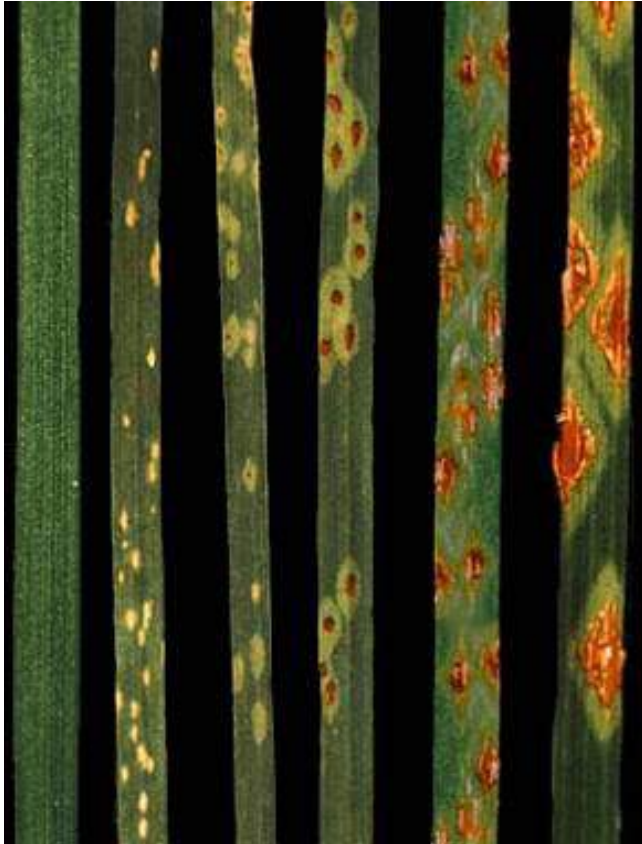
Wheat yellow mosaic on wheat.



Bacterial leaf blight on soybean.



# Wheat rust reduces grain yield





# Insects



# **Insect pests reduce crop productivity**

- \* Reduce crop yields 15% despite control efforts



**Common armyworm damage  
to whorl of corn plant.**





# Mite damage - eggplant





# Mite damage in a bean field





# Weeds

- \* Reduce crop yields 12% despite control efforts.





# Foxtail in corn





# Plant biology is essential

- \* Crop research needed
  - Resistance to insects, disease
  - Tolerance to environmental variables
    - \* Drought, salt tolerance
  - Improved productivity
  - Improved nutritional qualities



# Modern Plant Study

- \*Agronomy
- \*Bryology
- \*Economic Botany
- \*Ethnobotany
- \*Forestry
- \*Horticulture
- \*Paleobotany
- \*Palynology
- \*Phycology
- \*Plant anatomy

- \*Plant breeding
- \*Plant ecology
- \*Plant genetics
- \*Plant geography
- \*Plant molecular biology
- \*Plant morphology
- \*Plant pathology
- \*Plant physiology
- \*Plant systematics
- \*Plant taxonomy

