Chapter 1

Insights Into Our World and how We Influence It

What are some examples of environmental problems?

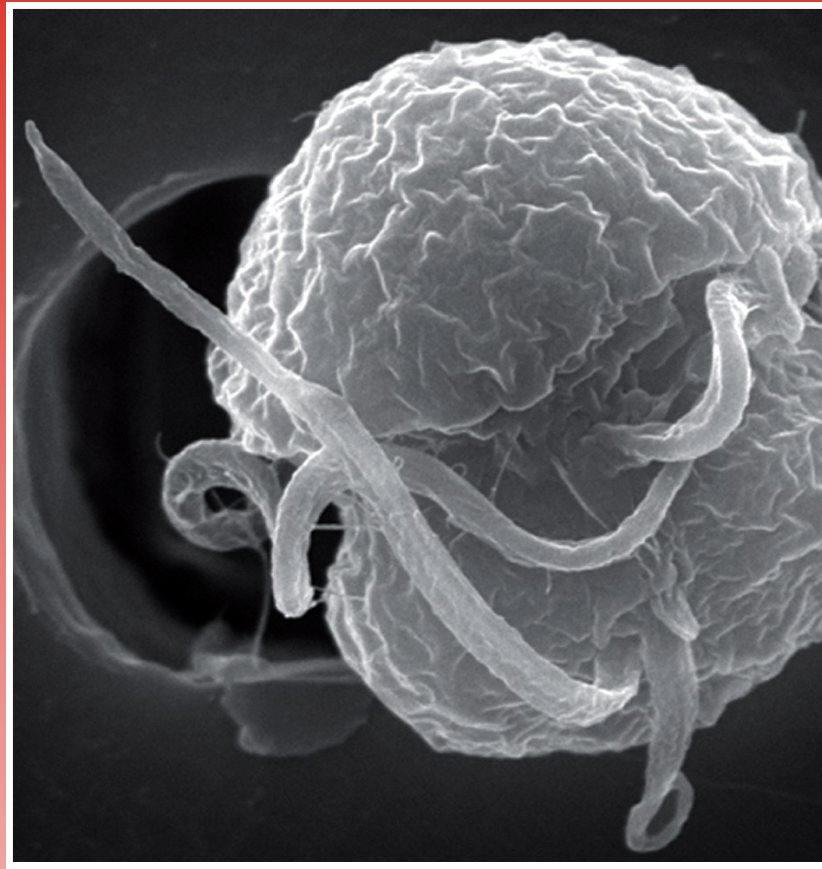
Global:

Regional:

Local:

Studying The State of Our Earth

- Pfiesteria…
- What is it?
- What forms does it take?
- How does it cause damage?
- Other factors at work?



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Environmental Science

Pfiesteria

ions on fish

Raw sewage releases

Pfiesteria…other factors

noff from fields

ltural runoff can carry sediment, nutrients and pesticides to e waters.

USDA Soil Conservation Service

Runoff from feedlots

- Environment- a sum of all the conditions surrounding us that influence life.
- Environmental science- the field that looks at interactions among humans and nature.
- System- a set of interacting components tha influence one another by exchanging energy or materials.
- Ecosystem- the living and non-living components of a particular place on earth.

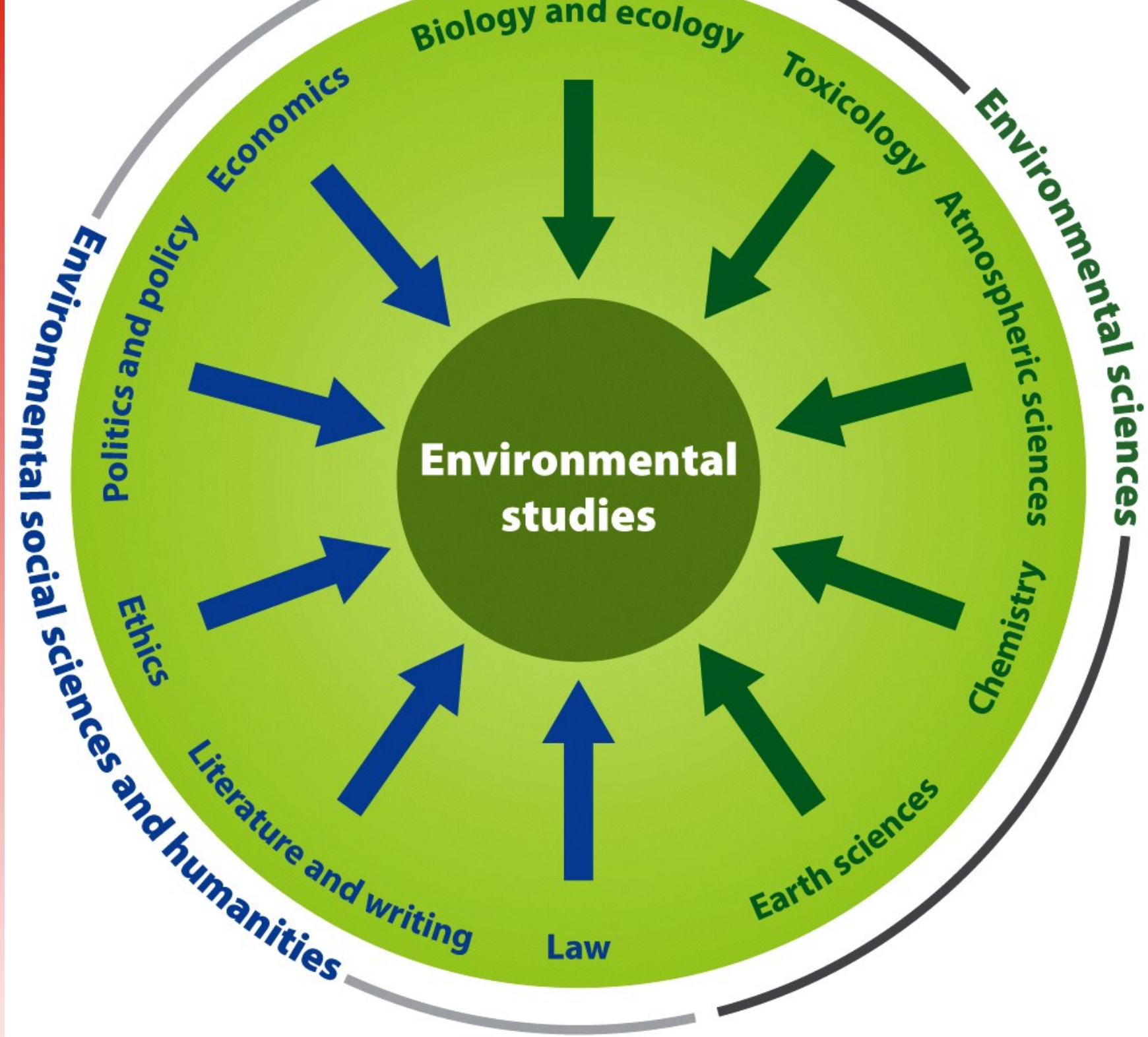
Environmental studies
Biology and ecology
Toxicology
Atmospheric sciences
Chemistry
Earth sciences
Law
Literature and writing
Ethics
Politics and policy
Economics
Environmental sciences
Environmental social sciences and humanities

Figure 1.1

- Biotic- the living part of the Earth (animals, plants)
- Abiotic- the non-living part of the Earth (soil, air, water)
- Environmental studies- includes environmental science, the study of interactions among human systems and those found in nature along with other subjects such as environmental policy, economics, literature and ethics.

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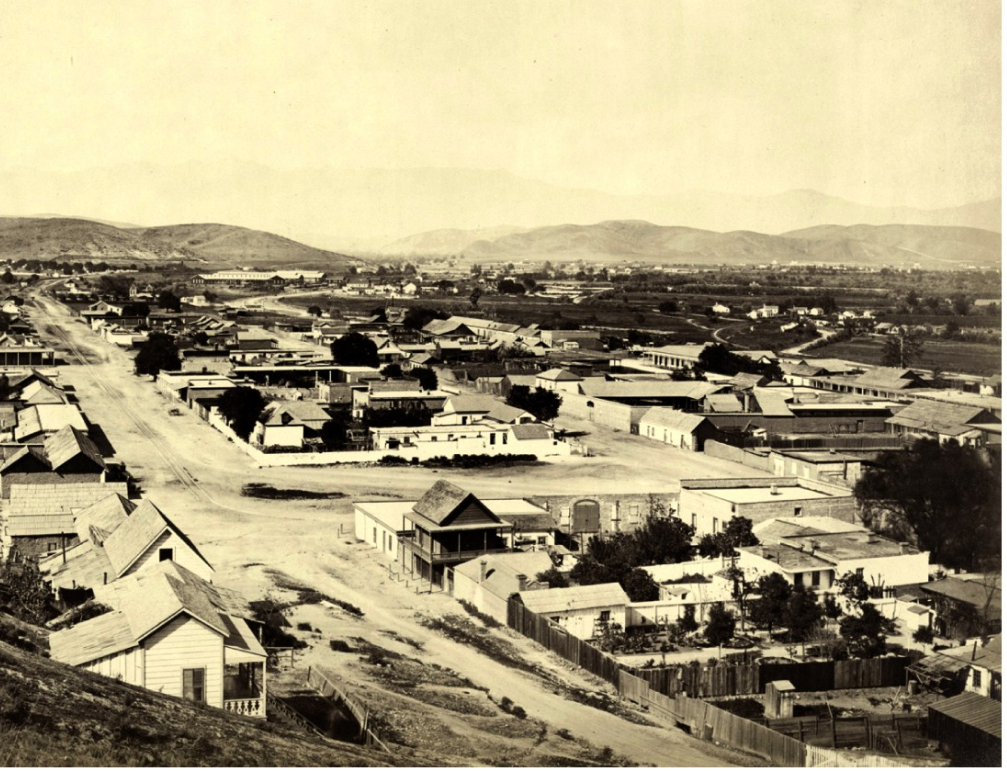
Humans Alter Natural Systems

- Humans manipulate their environment more than any other species.



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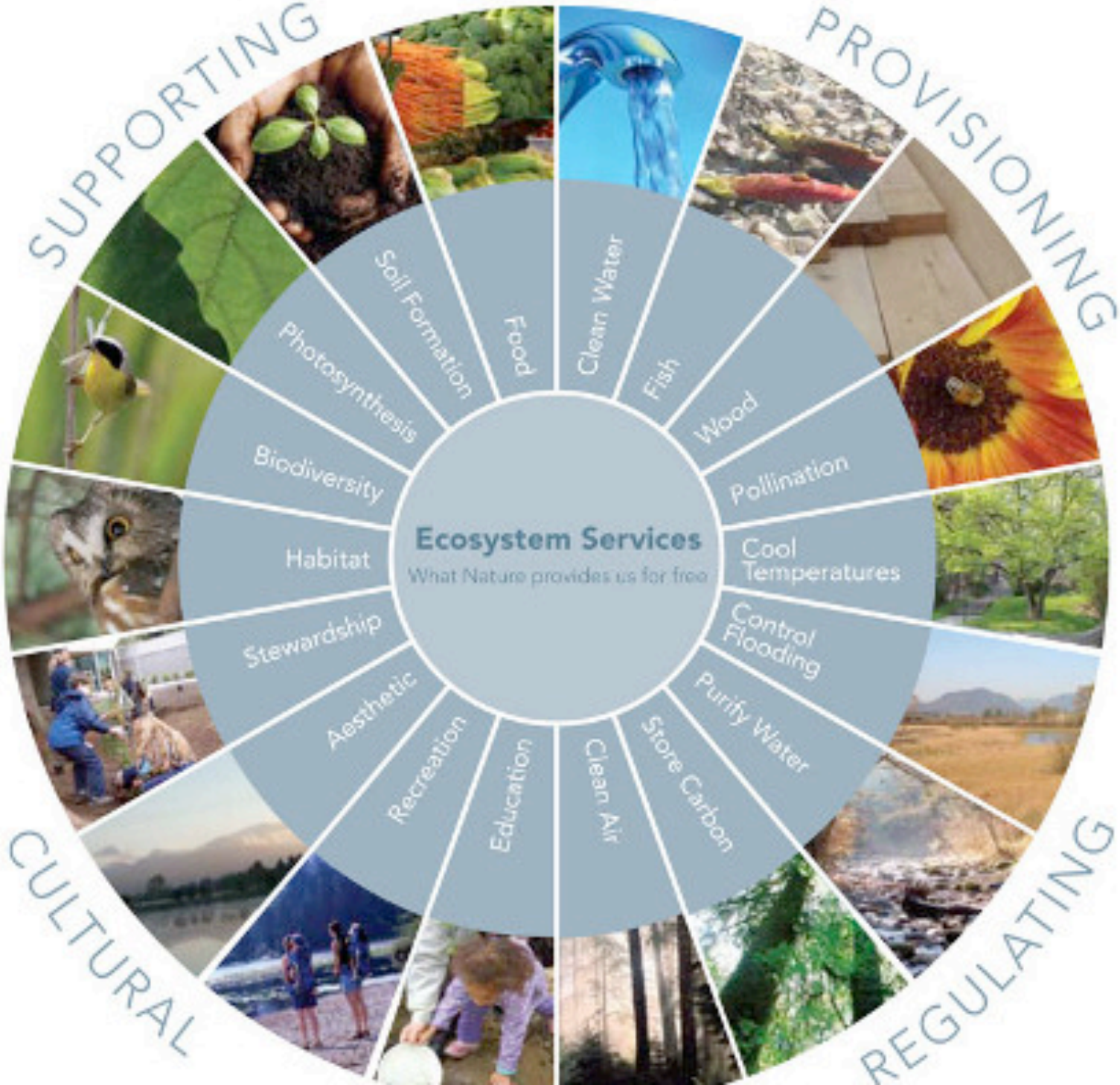
Environmental Scientists Monitor Natural Systems for Signs of Stress

- Ecosystem services- environments provide life supporting services such as clean water, timber, fisheries, crops.
- Environmental indicators- describe the current state of the environment. (See Table 1.1)
- Sustainability- living on the Earth in a way that allows us to use its resources without depriving future generations of those resources.

systems Provide Goods and Services



nental r	Unit of measure	Chapter w indicator
opulation	Individuals	
al footprint	Hectares of land	
d production	Metric tons of grain	1
duction per unit area	Kilograms of grain per hectare of land	1
a food production	Kilograms of grain per person	1
lioxide	Concentration in air (parts per million)	1
global surface temperature	Degrees centigrade	1
change	Millimeters	1
recipitation	Millimeters	
diversity	Number of species	5, 1
sumption advisories	Present or absent; number of fish allowed per week	1
uality (toxic chemicals)	Concentration	1
uality (conventional pollutants)	Concentration; presence or absence of bacteria	1
on rates of atmospheric compounds	Milligrams per square meter per year	1
h or harvest	Kilograms of fish per year or weight of fish per effort expended	1
n rate	Number of species per year	
oss rate	Hectares of land cleared or "lost" per year	1
ortality rate	Number of deaths of infants under age 1 per 1,000 live births	
ectancy	Average number of years a newborn infant can be expected to live under current conditions	

Environmental indicators help us describe the current state of an environmental syste
The five global environmental indicators ar

- Biological diversity
- Food production
- Average global surface temperature an carbon dioxide concentrations in the atmosphere
- Human population
- Resource depletion

E 1.2 Five key global environmental indicators

r	Recent trend	Outlook for future	Overall impact on environmental qua
al diversity	Large number of extinctions, extinction rate increasing	Extinctions will continue	Negative
oduction t	Per capita production possibly	Unclear leveling off	May affect the nun people Earth
global surface ature and ncentrations	CO_2 concentrations and temperatures increasing	Probably will continue to increase, at least in the short term	Effects are uncerta and varied, but probably detrime
opulation	Still increasing, but growth rate slowing	Population leveling off Resource consumption rates are also a factor	Negative
e depletion	Many resources are being depleted at rapid rates. But human ingenuity frequently develops "new" resources, and efficiency of resource use is increasing in many cases	Unknown	Increased use of m resources has neg effects

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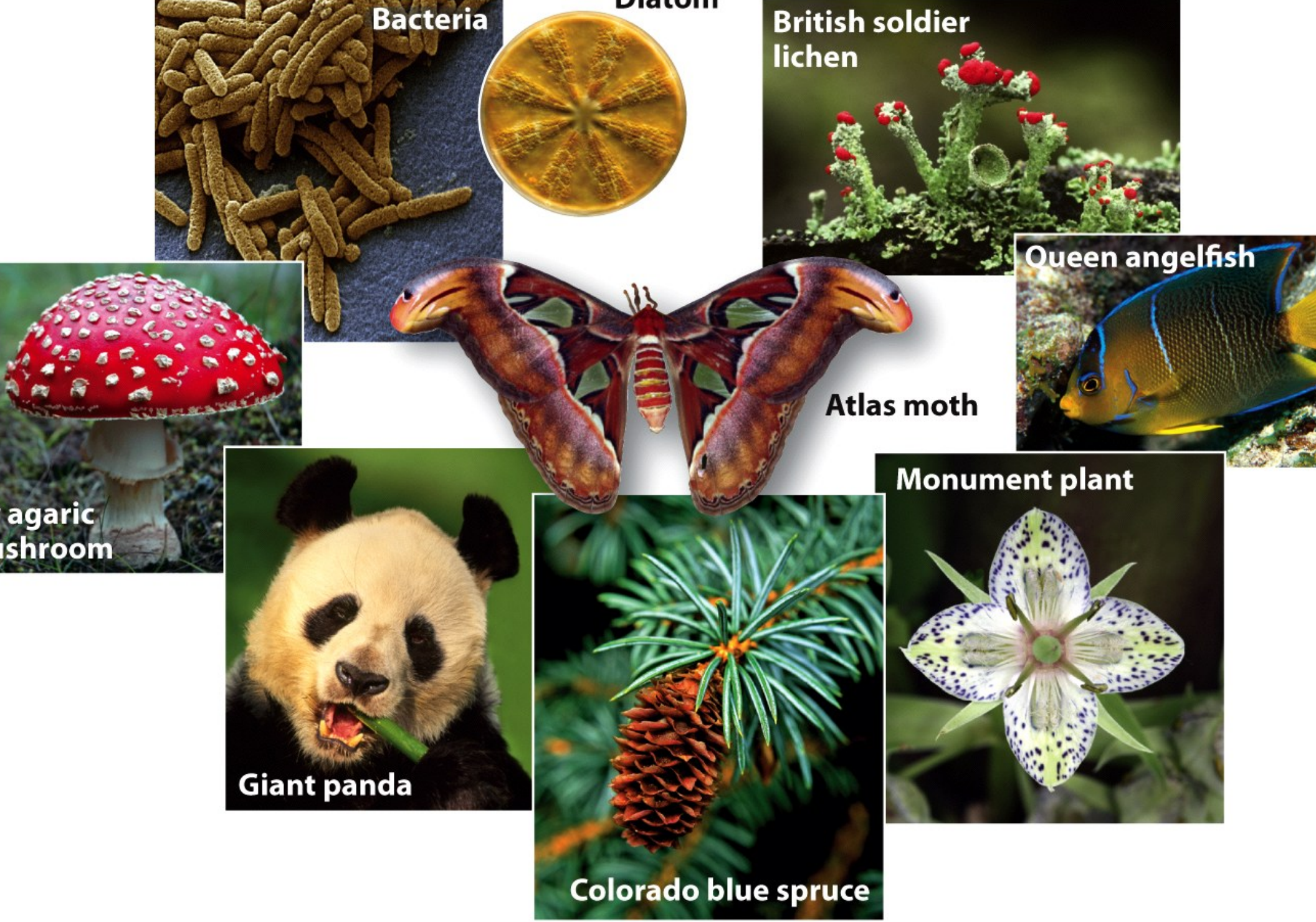
Biological Diversity

- Biodiversity- the diversity of life formed in an environment
- Biological diversity includes genetic, species and ecosystem diversity.



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Genetic Diversity

- A measure of the genetic variation among individuals in a population.
- Populations with high genetic diversity are better able to respond to environmental change than populations with lower genetic diversity.

Genetic Diversity

Species Diversity

- The number of species in a region or in a particular type of habitat.
- Species- a group of organisms that is distinct form other groups in form, behavio or biochemical properties. Individuals in a species can breed and produce fertile offspring.

Species Diversity

Species diversity: threats and extinction

Figure 1.5b

Ecosystem Diversity

- A measure of the diversity of ecosystems or habitats that exist in a particular region.

Ecosystem Diversity

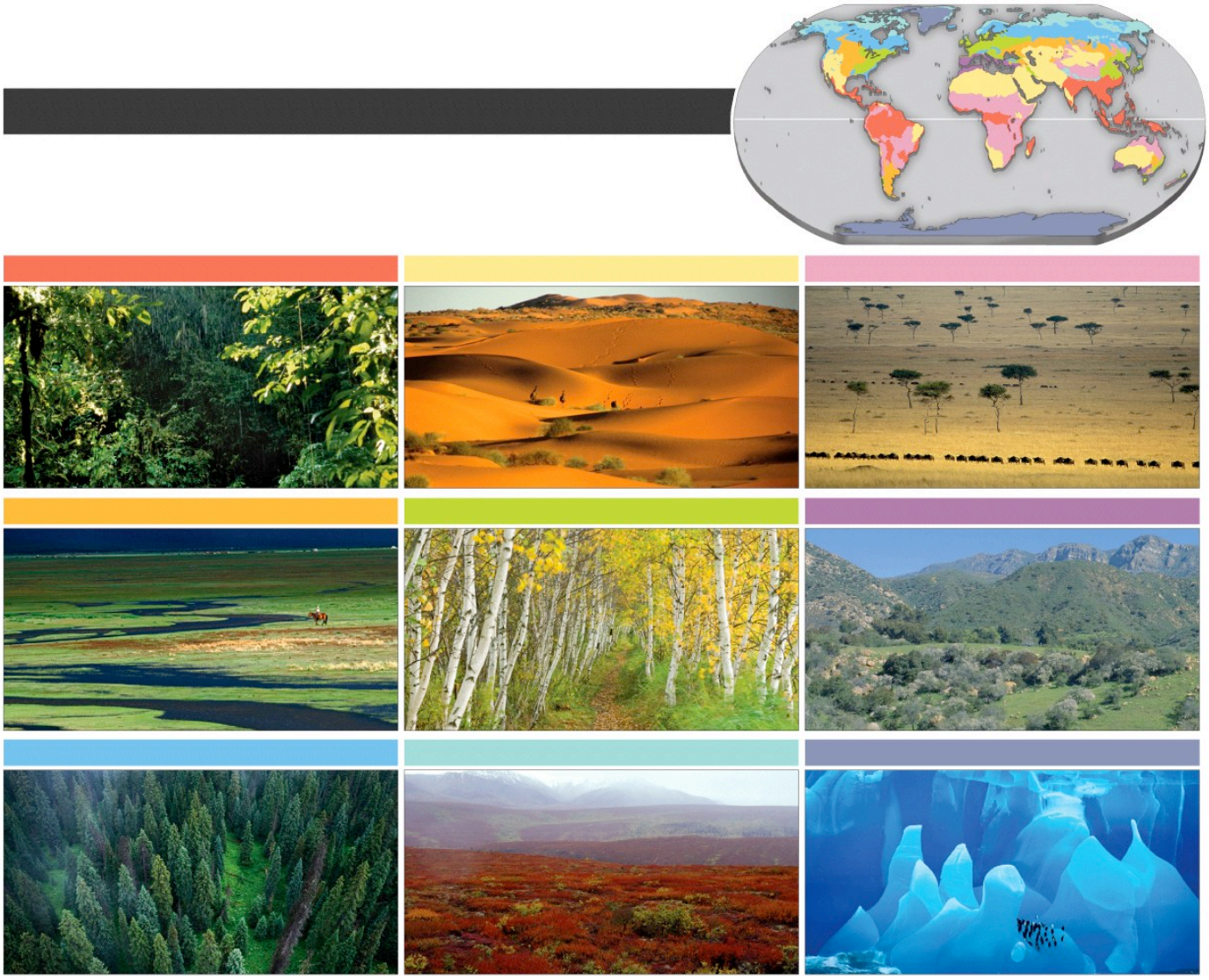
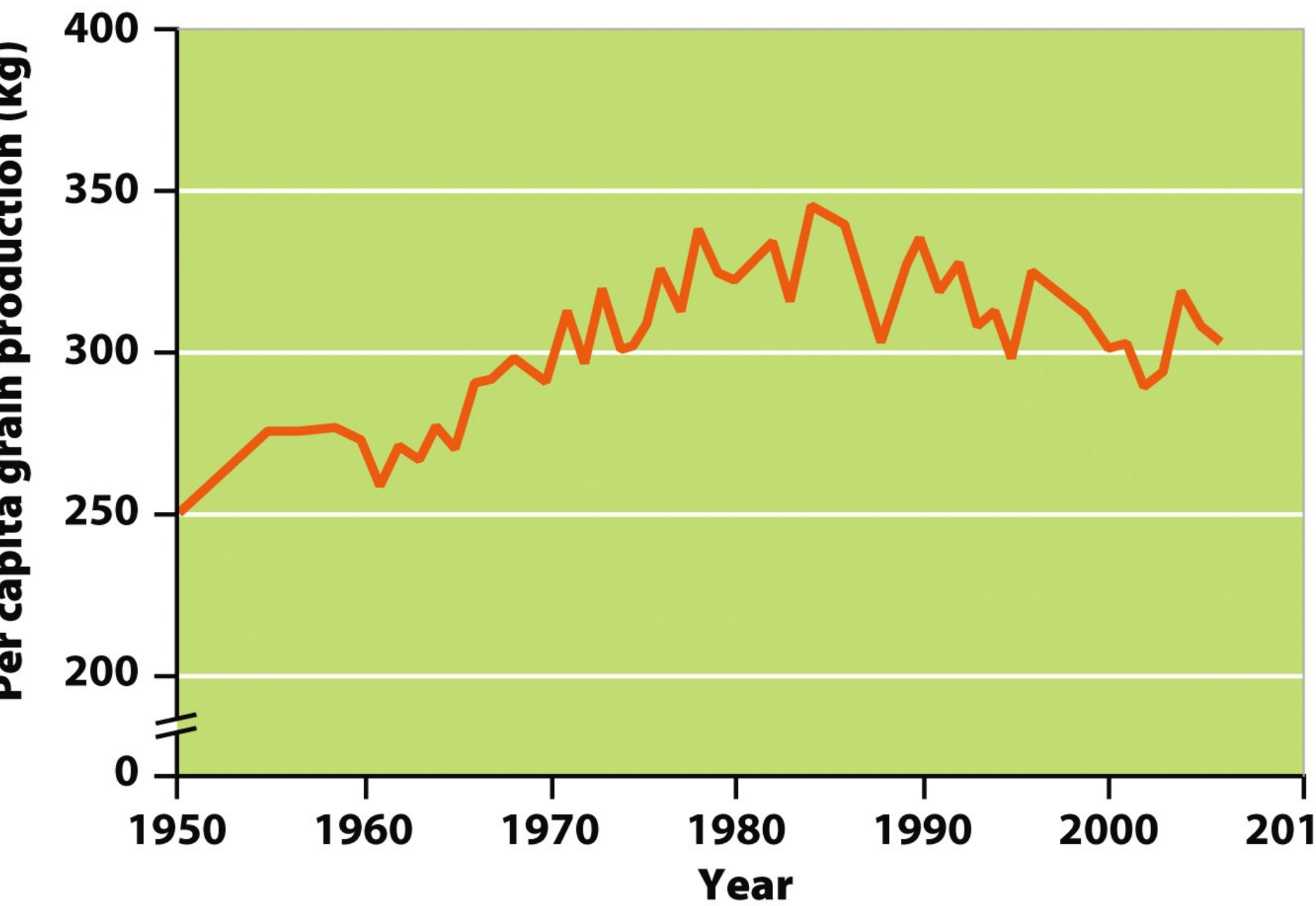


Figure 15-3
What Is Life? A Guide To Biology

Food Production

- Our ability to grow food to nourish the human population.
- We use science and technology to increase the amount of food we can produce on a given area of land.

Food Production



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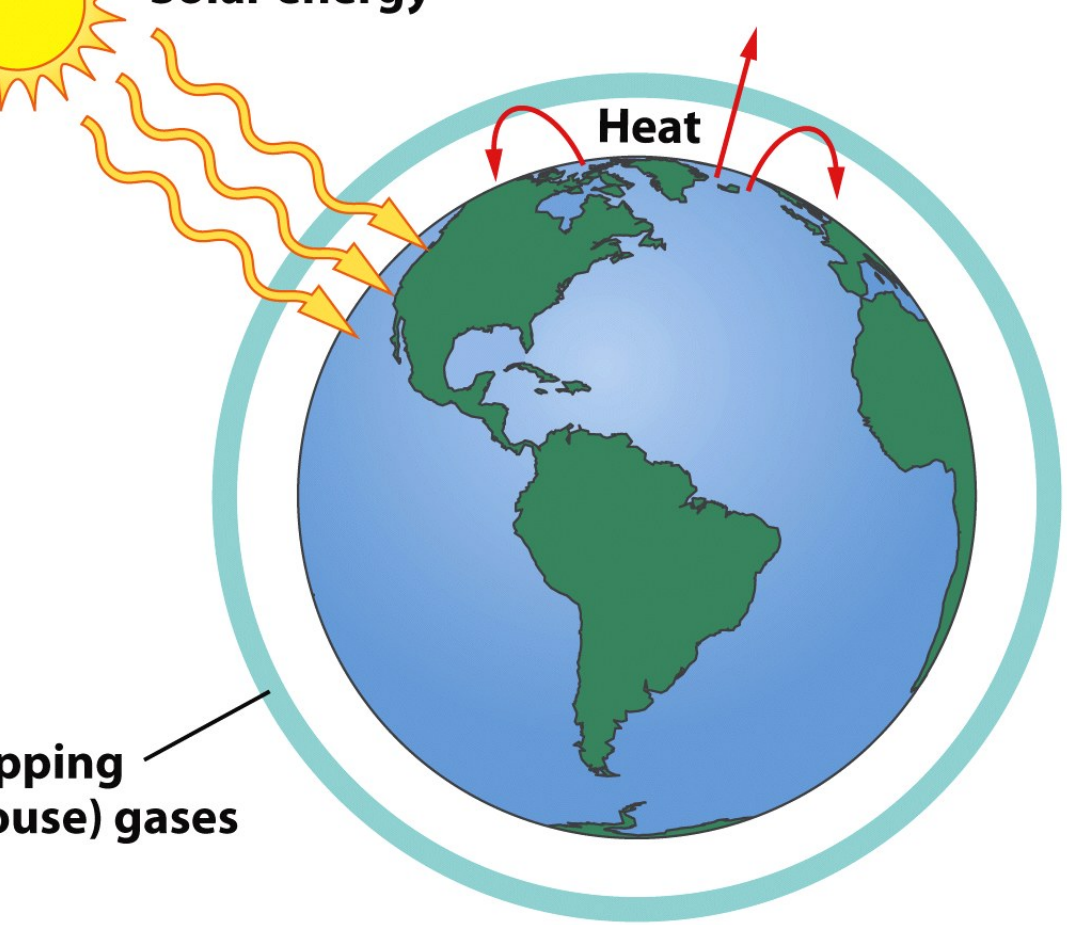
Average Global Surface Temperature and Carbon Dioxide Concentrations

- Greenhouse gases- gases in our planets atmosphere that act like a blanket, trapping heat near Earth's surface.
- The most important greenhouse gas is carbon dioxide.
- Anthropogenic- caused by human activities


Heat
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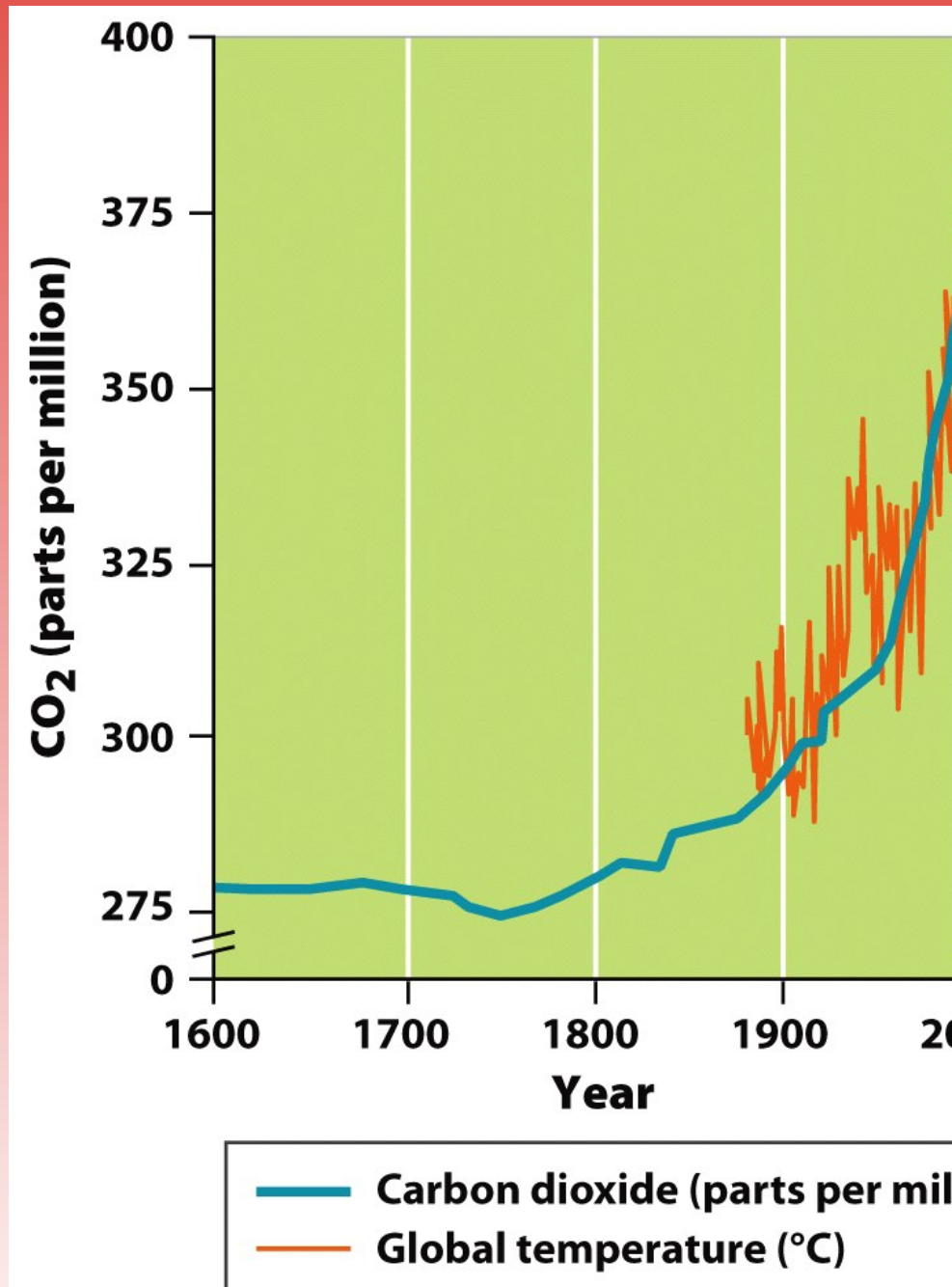
ouse) gases


400
375
350
325
300
275
0
CO_2 (parts per million)
1600
1700
1800
1900
Year
Carbon dioxide (parts per mil
Global temperature (°C)

Human Population

- The current human population is 6.8 billion.
- Over a million additional people is added to the Earth every 5 days.

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nmental Science
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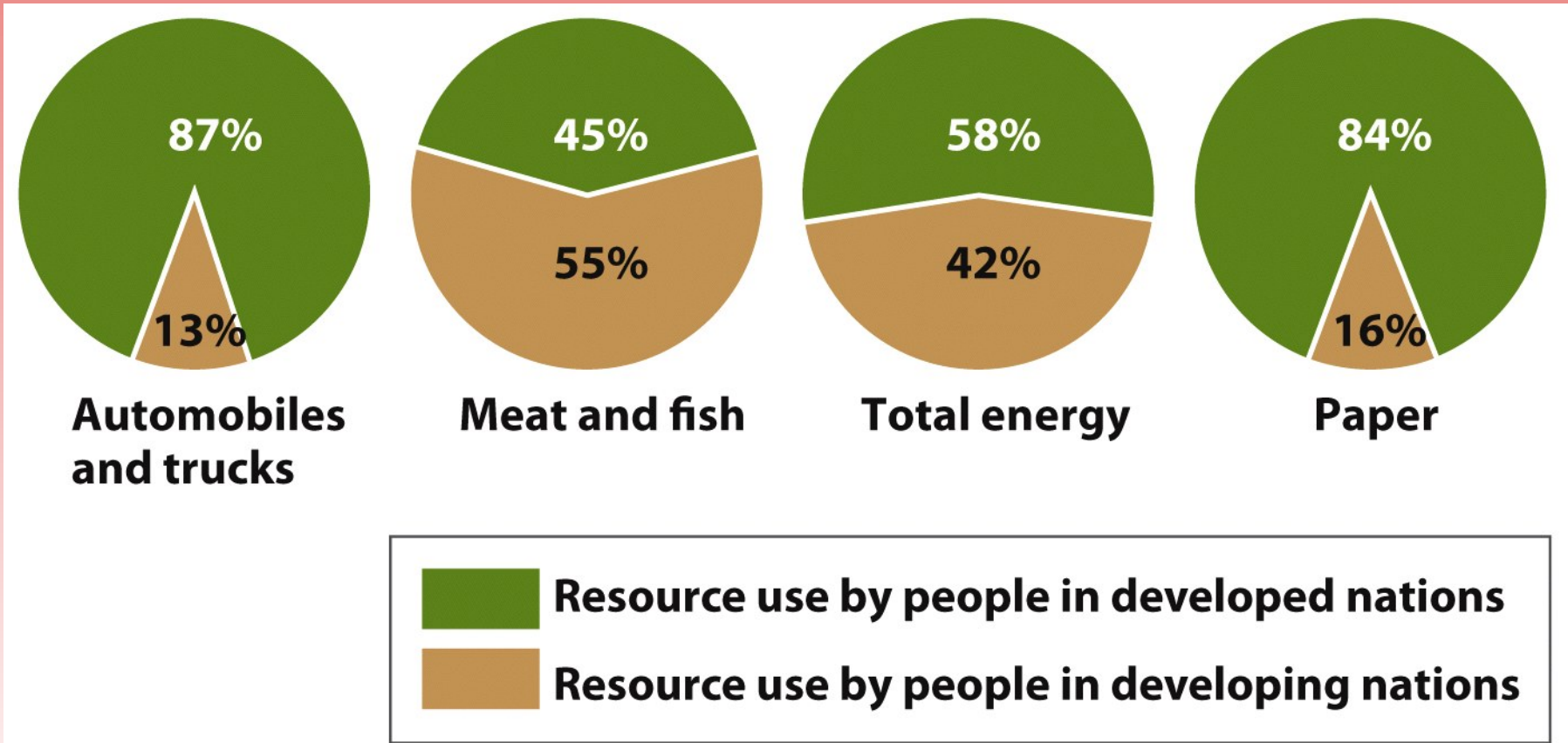
Resource Depletion

- As the human population grows, the resources necessary for our survival becom increasingly depleted.
- Some natural resources such as coal, oil an uranium are finite and cannot be renewed or reused.
- Other natural resources like aluminum or copper, also exist in finite amounts but can be recycled.

Resource Depletion

- Development- improvement in human well being through economic advancement. As economies develop, resource consumption also increases.



Human Well-Being Depends on Sustainable Practices

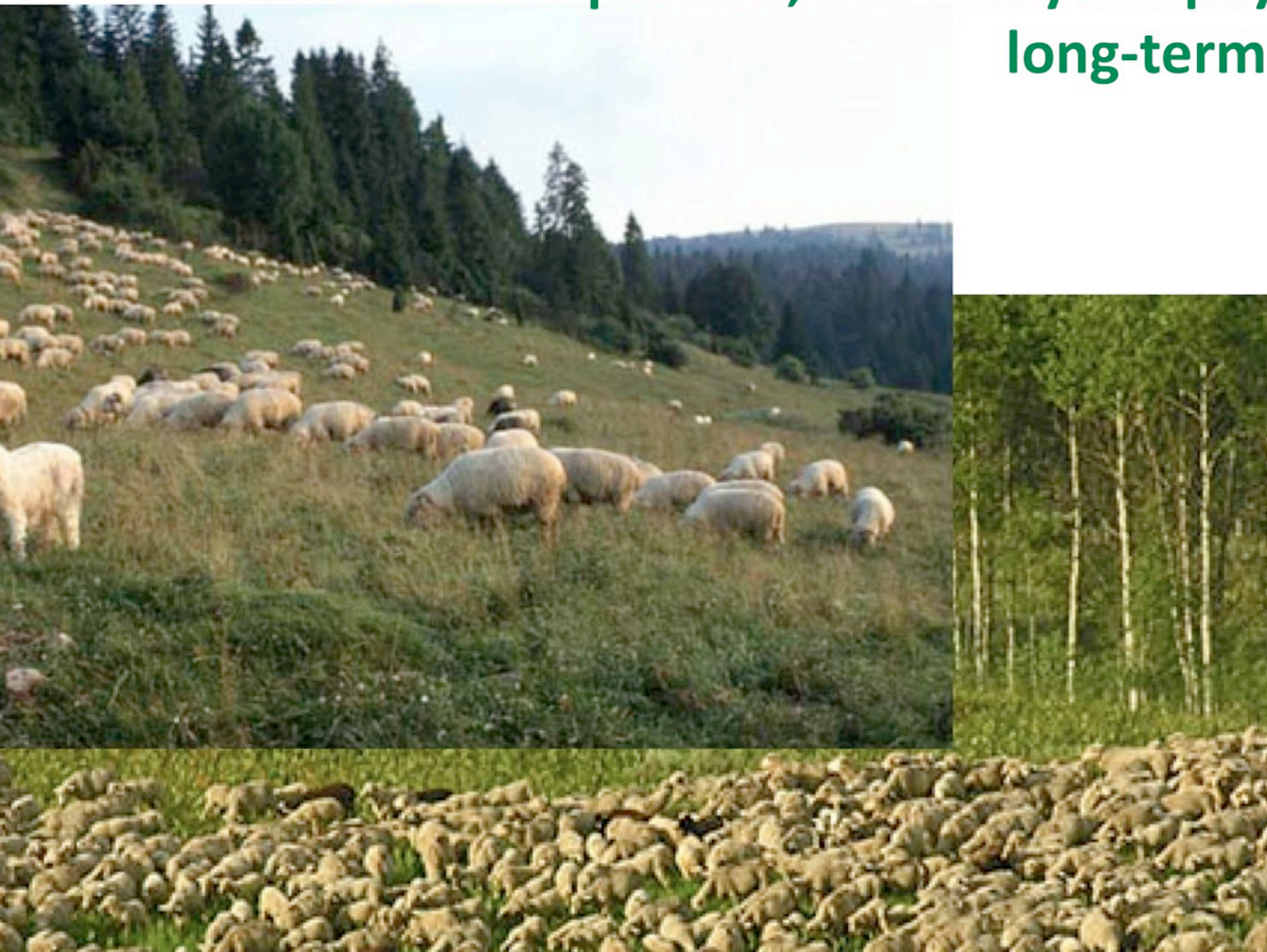
- Sustainable Development- development that balances current human well-being and economic advancement with resource management for the benefit of future generations.

Figure 1.12

Human Well-Being Depends on Sustainable Practices

- In order to live sustainably:
  - Environmental systems must not be damaged beyond their ability to recov
  - Renewable resources must not be depleted faster than they can regenerate
  - Nonrenewable resources must be used sparingly.

the common pasture, but everyone pay
long-term



Defining Human Needs

- People in developed nations might say that they "need" electricity.
- People in the developing world have never heard of this modern convenience.
- Basic human needs- air, water, food and shelter.

The Ecological Footprint

- A measure of how much a person consumes, expressed in area of land

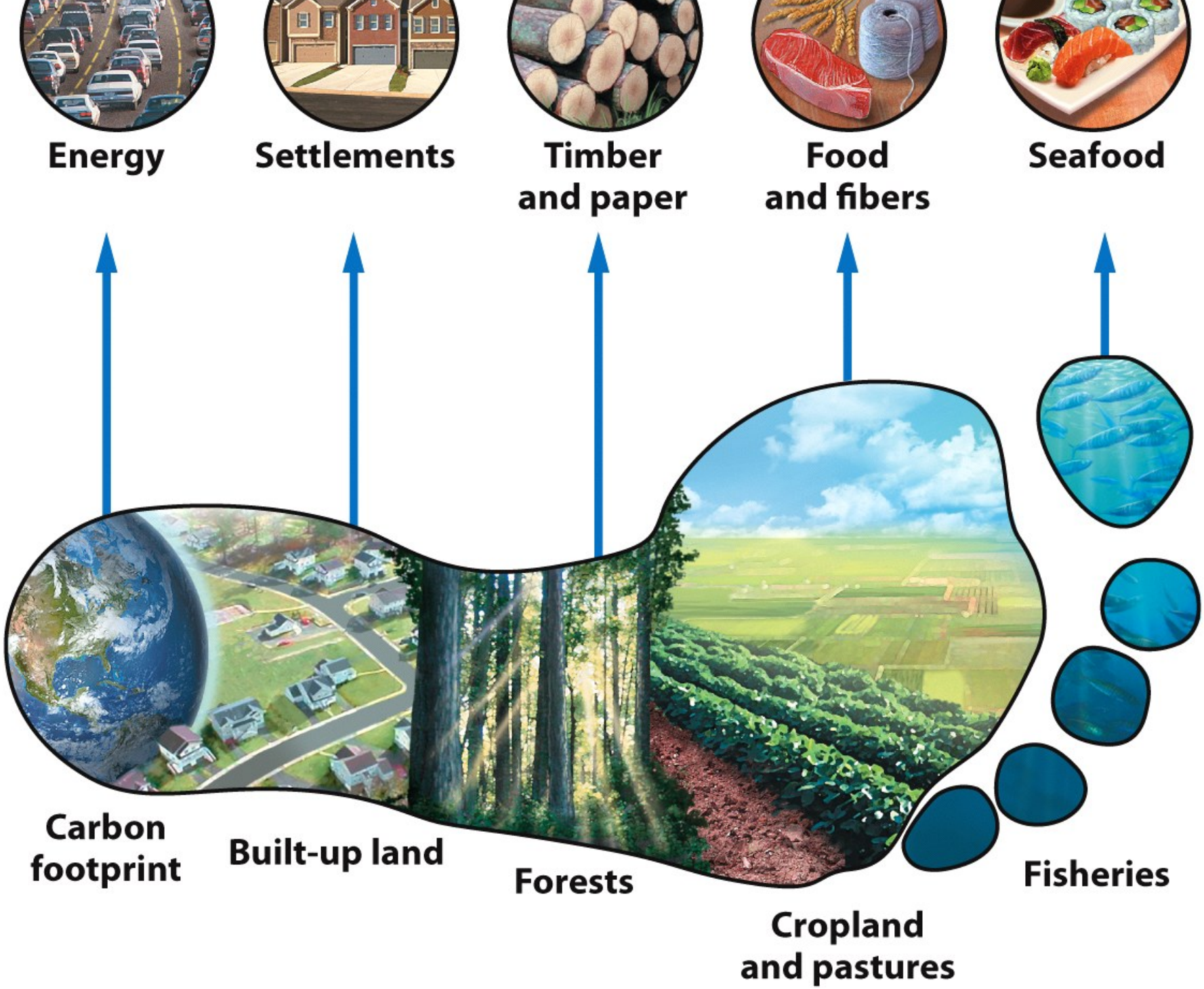


Figure 1.14
Environmental Science


Present-day footprint of global human population
Footprint of global population if all had average U.S. lifestyle

The Scientific Method

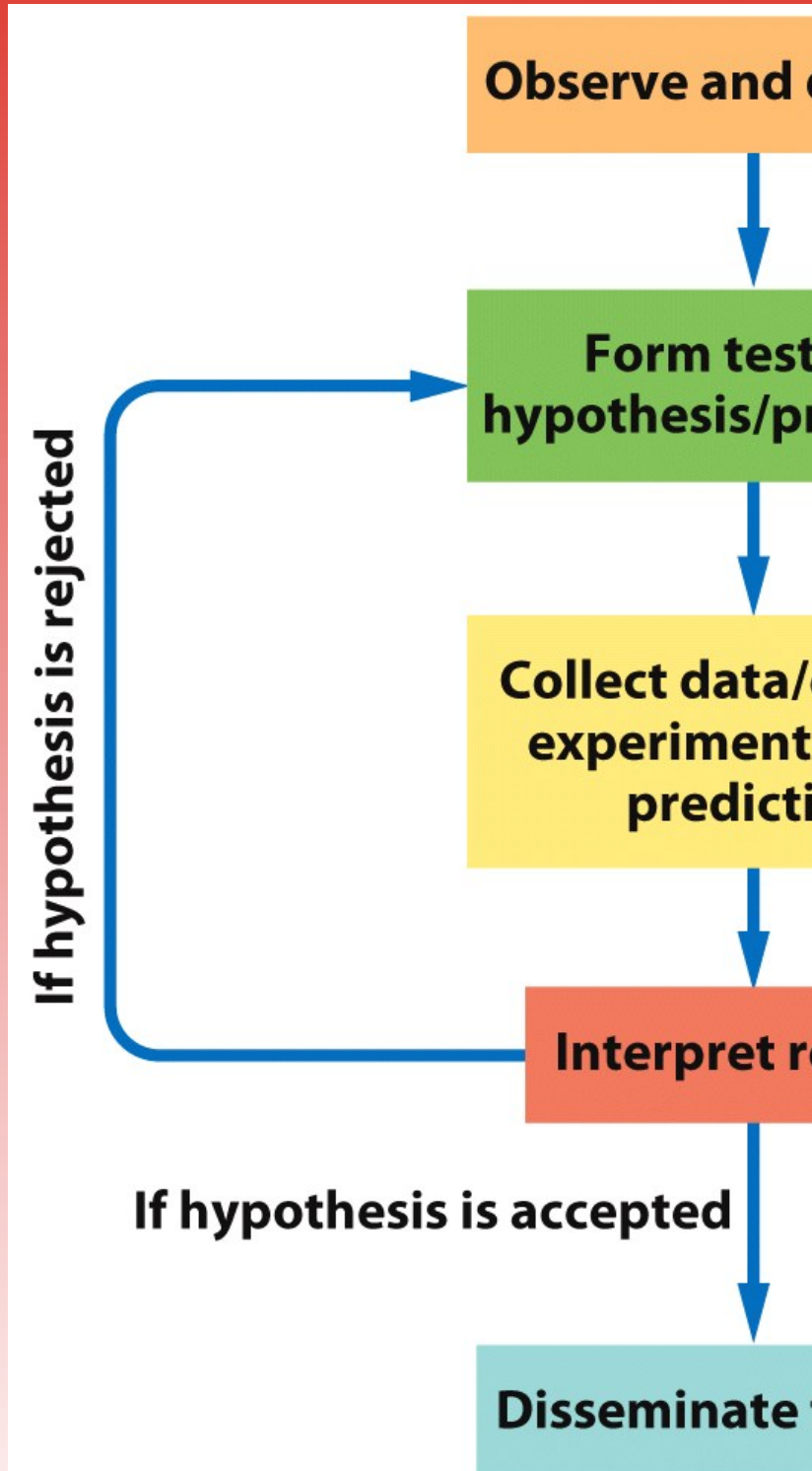
bservations and questions

ypothesis

ollecting data

terpreting results

isseminating findings



Observations and Questions

- Observing and questioning is the first step of the scientific process.

Hypothesis

- An educated guess that can be proved or disproved through controlled experimentation.
- A null hypothesis is a statement that can be proved wrong.

Collecting Data

- Replication- repeating the measurement many times
- Sample size- the number of times the measurement is repeated.
- Accuracy- how close a measured value is to the actual or true value.
- Precision- how close to one another the repeated measurements are.
- Uncertainty- how much the measure differs from the true value

Interpreting Results

- Once results have been obtained, analysis of the data begins. This process involves two types of reasoning, inductive and deductive.
- Inductive reasoning- the process of making general statements from specific facts or examples.
- Deductive reasoning- the process of applying a general statement to specific facts or situations.

Disseminating Findings

- Scientists present papers at conferences and publish the results of their investigations. This allows other scientists to repeat the original experiment and verify or challenge the results.

ow accuracy
gh precision

High accuracy
Low precision

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High precisio

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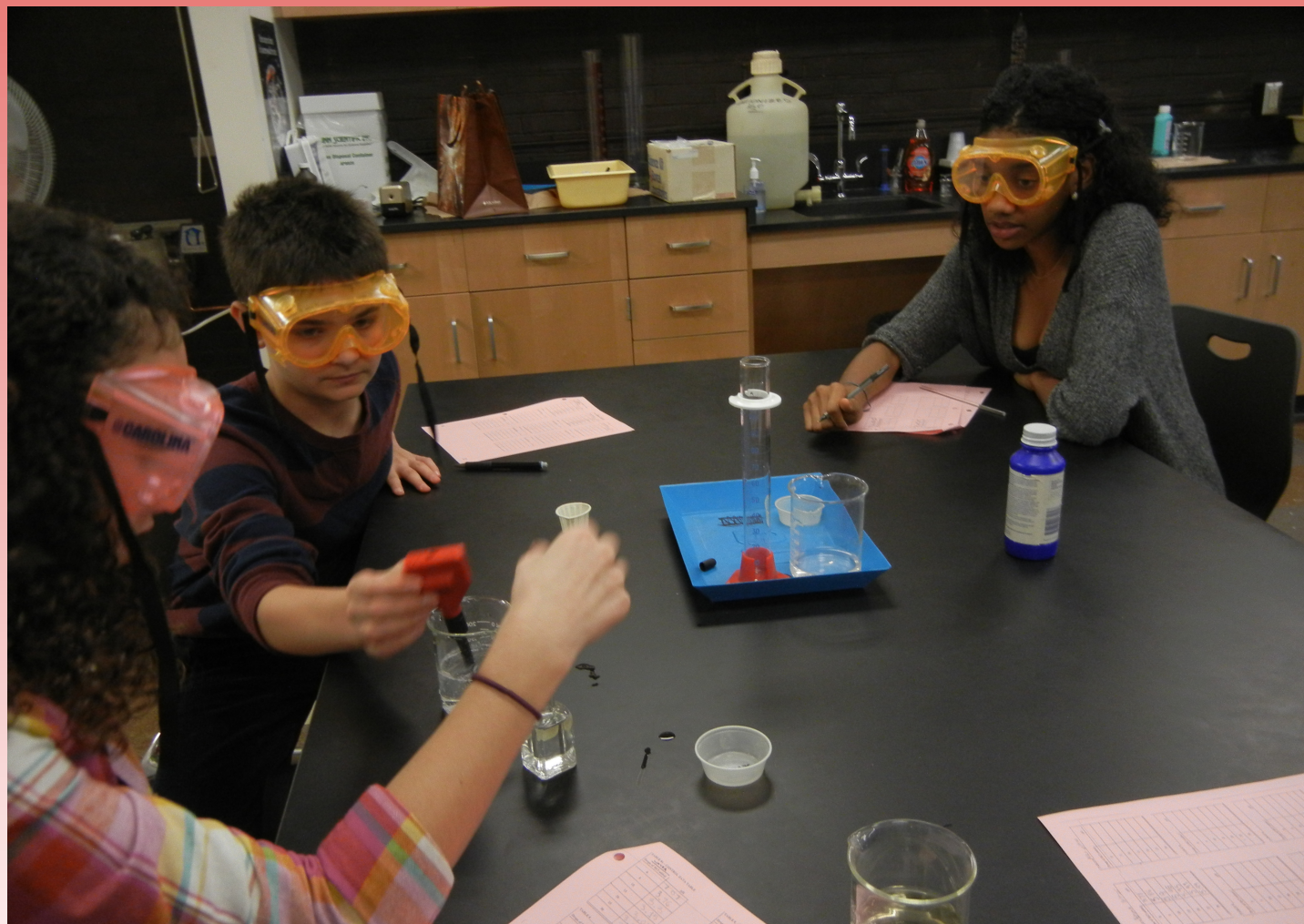
- Theory- a hypothesis that has been repeatedly tested and confirmed by multiple groups of researchers and is wide accepted.

- Natural law- When a theory has been teste multiple times and there are no known exceptions. Ex. Law of gravity and laws of thermodynamics.

Controlled Experiments and Natural Experiments

- Controlled experiment- an experiment conducted in the controlled conditions of a laboratory.



Null hypothesis: Chlorpyrifos has no observable negative effects on the central nervous system.

Conduct experiment:

1 mg/kg chlorpyrifos

Experimental group

Control group (normal food)

Measure enzyme activity in order to test for the effect of chlorpyrifos on the brain.

Results (enzyme activity):

Reduced

Normal

Interpret results: Under these conditions, feeding chlorpyrifos to young rats reduces the activity of a

Controlled Experiments and Natural Experiments

- Natural experiments- when a natural event, such as a volcano, acts as an experimental treatment in an ecosystem.

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Figure 1.19b
Environmental Science

Experimental Science Presents Unique Challenges

- There is no "control" planet to compare the Earth with.
- It is difficult to decide what is better or worse for the environment than something else.
- Environmental science has so many interacting parts, it is not easy to apply one system to another.
- Human well-being is a concern because people that are unable to meet their basic needs are less

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ironmental Science

Cleaner, greener and more sustainable…

San Francisco

Beachwood