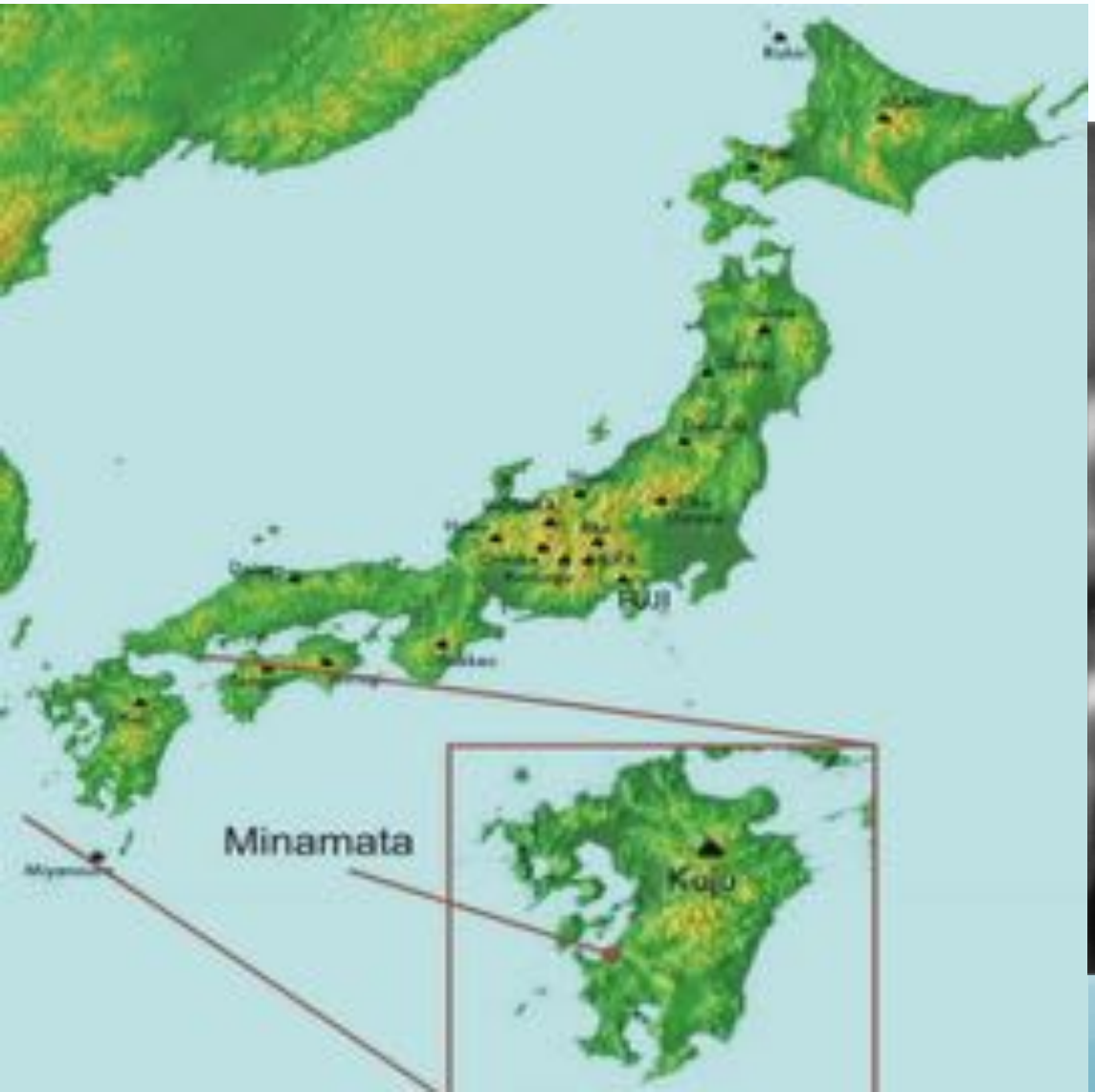
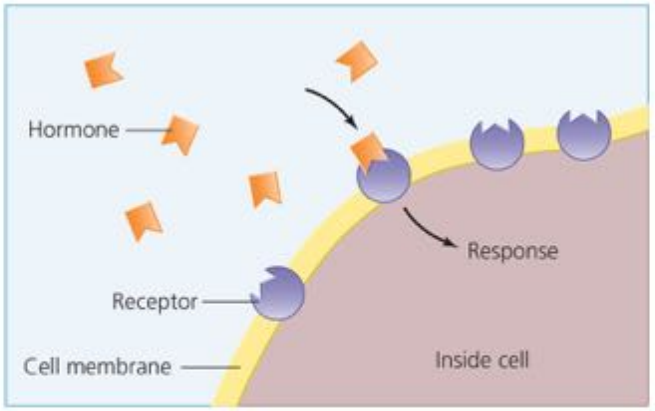
# PCBs Concentrations in Polar Bears

# Minamata Japan:
# The Unfolding Mercury Disaster

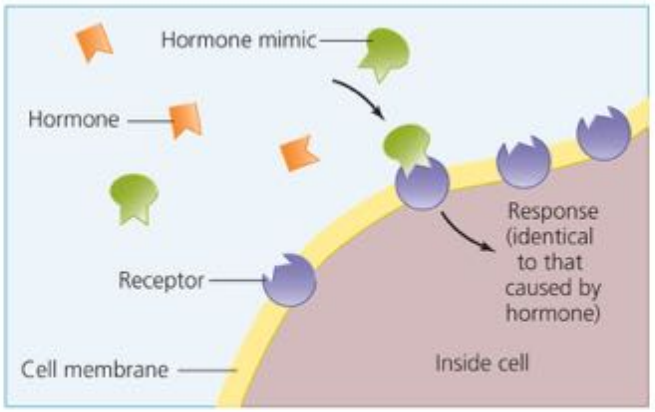



# Endocrine Disruption May Be Widespread

- Theo Colburn wrote *Our Stolen Future* in 1996
  - Synthetic chemicals may be altering the hormones of animals
  - This book integrated scientific work from various fields
  - Shocked many readers and brought criticism from the chemical industry




(a) Normal hormone binding



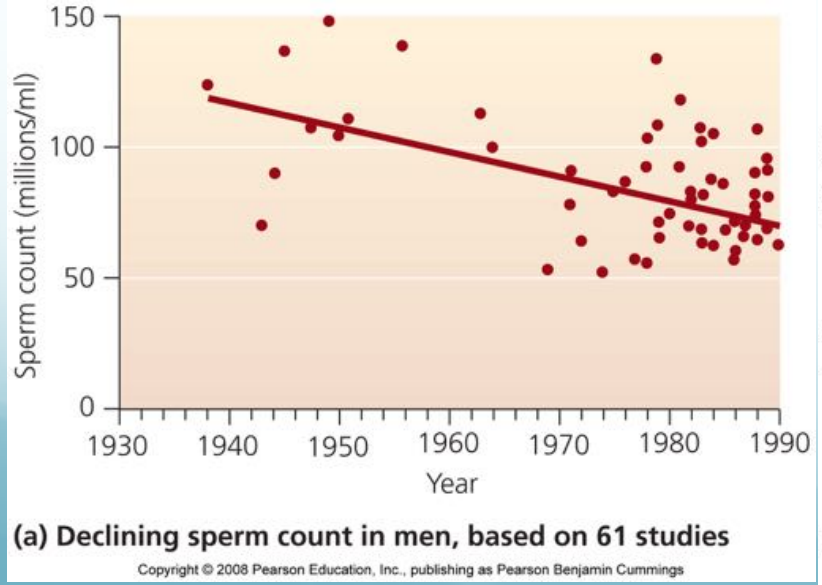

(b) Hormone mimicry

# Evidence For Hormone Disruption

- Frogs also have gonadal abnormalities
  - Male frogs became feminized from atropine concentrations well below EPA guidelines for drinking water
- PCB-contaminated human babies were born weighing less, with smaller heads

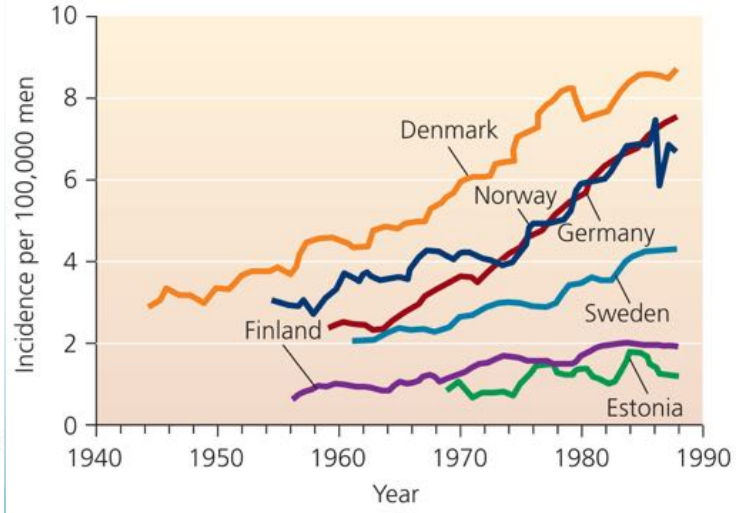
# Male Sperm Counts Are Dropping

- Scientists attribute the shocking drop in men's sperm counts to endocrine disruptors
  - The number and motility of sperm has dropped 50% since 1938
- Testicular cancer, undescended testicles, and genital birth defects are also increasing



(a) Declining sperm count in men, based on 61 studies





(b) Increasing incidence of testicular cancer

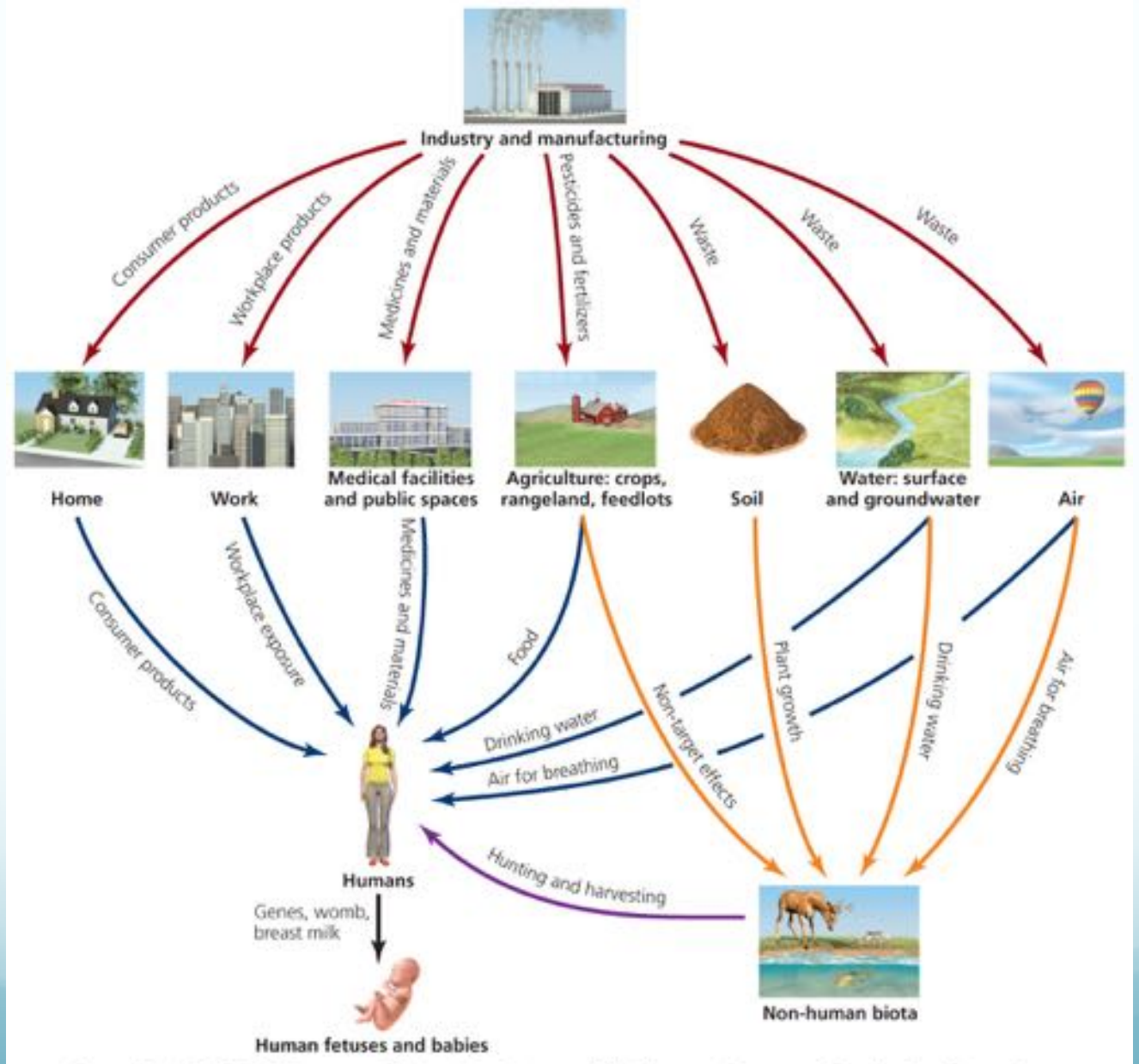
# Endocrine Disruptive Research is Controversial

- Research results are uncertain, which is inherent in any young field
- Negative findings pose economic threats to chemical manufacturers
  - Banning a top-selling chemical could cost a company millions of dollars
  - Bisphenol-A, found in plastics, can cause birth defects, but the plastics industry protests that the chemical is safe
- Studies reporting harm are publicly funded, but those reporting no harm are industry funded

# Toxins May Concentrate in Water

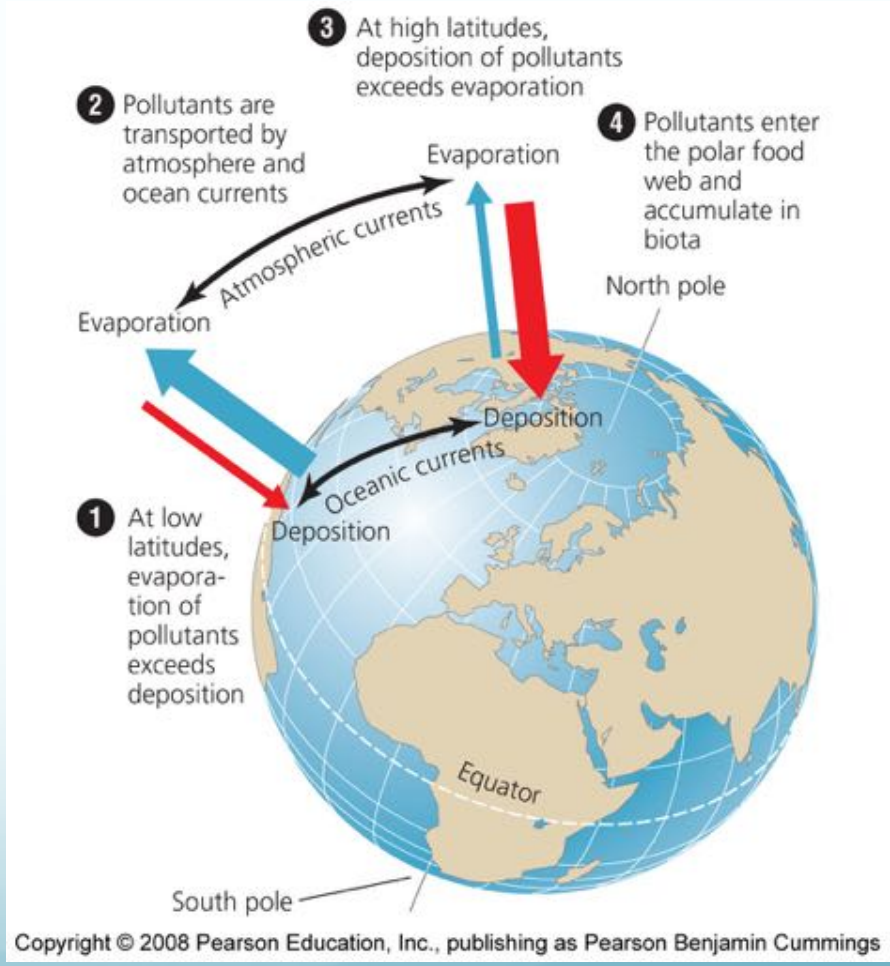
- Runoff carries toxins from large land areas to small volumes of surface water
- Chemicals can leach into the soil
- Chemicals enter organisms through drinking or absorption
  - Aquatic organisms are effective pollution indicators

# Route of Chemical Transport



# Airborne Toxicants Can Travel Widely

- Because chemicals can travel by air, their effects can occur far from the site of chemical use
- **Pesticide Drift:** Airborne transport of pesticides
- Synthetic chemical contaminants are found globally
  - They appear in arctic polar bears, Antarctic penguins, and people living in Greenland



# Global Distillation

- Pollutants that evaporate and rise high into the atmosphere at lower latitudes, or are deposited in the ocean, are carried toward the poles by atmospheric currents of air and oceanic currents
- Even though there is virtually no chemical manufacturing at the poles, polar organisms ingest many chemicals

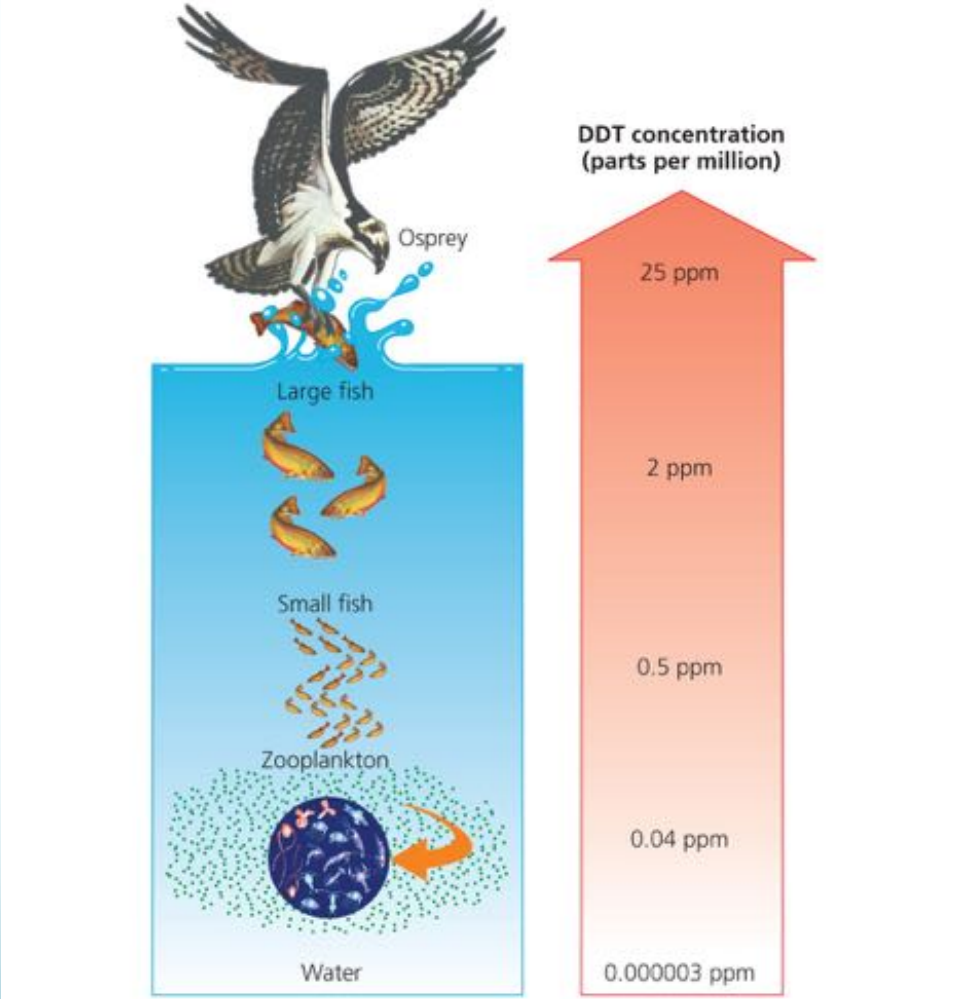

WHY THERE ARE NO PESTICIDE-SNIFFING DOGS

# Some Toxicants Persist For A Long Time

- Toxins can degrade quickly and become harmless
  - Or, they may remain unaltered and persist for decades
  - Rates of degradation depends on temperature, moisture, and sun exposure
- Persistent chemicals have the greatest potential for harm
- **Breakdown Products:** Toxicants degrade into simpler products
  - May be more or less harmful than the original substance
  - DDT degrades into DDE, which is also highly persistent

# Toxicants Can Accumulate and Biomagnify

- Some toxicants can be excreted or metabolized
  - Fat-soluble toxicants are stored in fatty tissues
- **Bioaccumulation:** Toxicants build up in animal tissues
- **Biomagnification:** Toxicants concentrate in top predators
  - Near extinction of peregrine falcons and brown pelicans



Peregrine Falcon

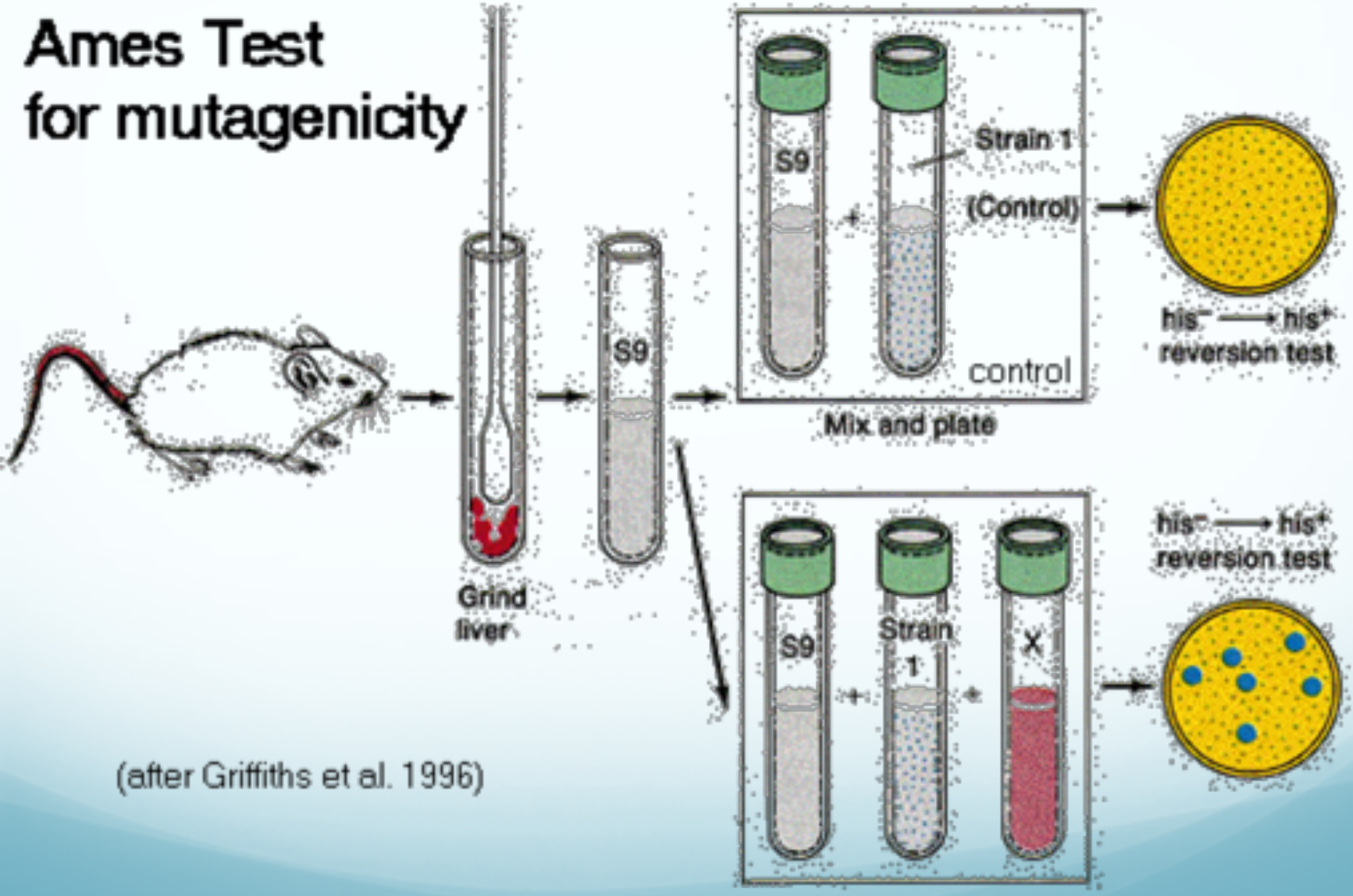
Osprey


ARCTIC
OCEAN
North pole
Russia
Greenland (Denm.)
SVALBARD
(Norway)
Russia
Norway
Iceland
Arctic Circle
Sweden
Finland

# Not All Toxicants Are Synthetic

- Chemical toxicants also exist naturally and in our food
  - Don’t assume natural chemicals are all healthy and synthetic ones are all harmful
- Some scientists feel that natural toxicants dwarf our intake of synthetic chemicals
  - Natural defenses against toxins are effective against synthetic ones, too
  - Critics say natural toxins are more readily metabolized and excreted, and synthetic chemicals persist and accumulate

# Ames Test for mutagenicity




(after Griffiths et al. 1996)

# Essay Question:
# Turn & Talk

- How do toxicants travel through the environment, and where are they most likely to be found?
- What are the life spans of toxic agents?
- Describe the process of bioaccumulation and biomagnification.