

OIL POLLUTION

...AND SOME SOLUTIONS



WHAT IS OIL POLLUTION?

- Pollution: the introduction or release of substances or energy by humans that decrease the quality of the marine environment
- Oil is one of the most widespread pollutants in the ocean
- **206 million gallons** of oil enter the world's oceans each year as a result of pollution! (NRC Report 2003)



312
Olympic
swimming
pools

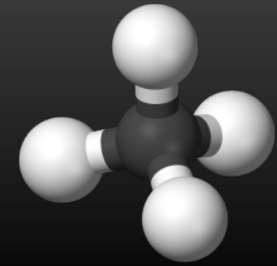
WHY SO MUCH OIL POLLUTION?

- Oil is a valuable commodity!
- Used in:
 - Fuel
 - Paint
 - Synthetic fibers
 - Plastics
 - Rubber
 - Fertilizers
 - And much, much more!

3 billion gallons
consumed each day!



CHEMISTRY OF OIL

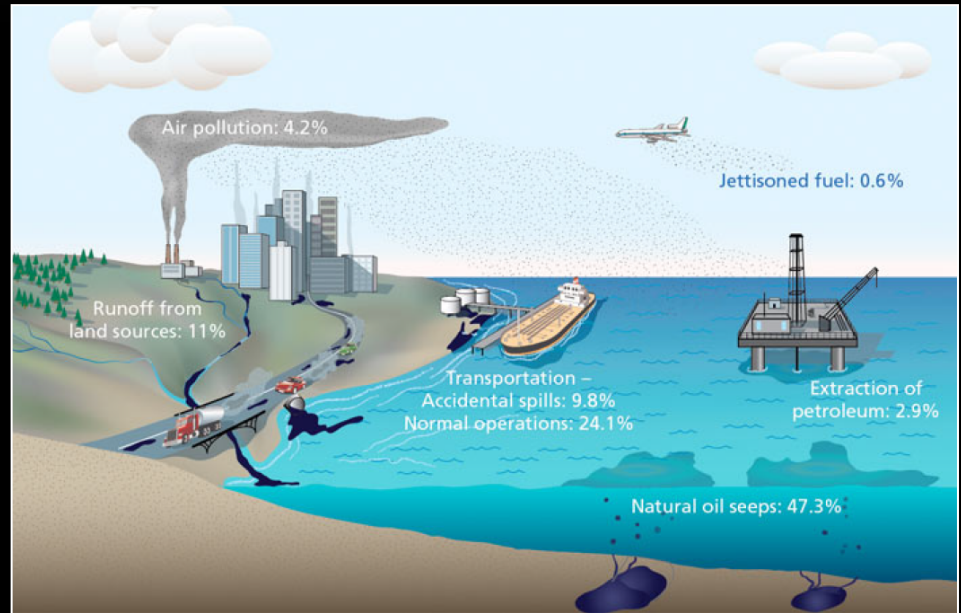


- Complex mixture of hydrocarbons
- Non-polar
- Hydrophobic (water-fearing)
- Lipophilic (“lipid loving”)
- Flammable!



OIL IN THE MARINE ENVIRONMENT

- Natural seeps (47%)
- Runoff from land (11%)
- Air pollution (5%)
- Transportation of oil (spills 10%, operation 24%)
- Extraction/drilling (3%)



(Illustration by Jack Cook, Woods Hole Oceanographic Institution)

IMPACT OF OIL SPILLS

MARINE LIFE

- Birds, marine mammals, fish die of exposure or suffocation when coated with oil
- Birds are unable to fly
- Toxic compounds interfere with reproduction, development, growth, and behavior
- Studies show fish can become more susceptible to diseases
- Inhibits growth of phytoplankton



source: Wikimedia Commons



Source: U.S. Fish and Wildlife Service [Public domain], via Wikimedia Commons

IMPACT OF OIL SPILLS

ROCKY INTERTIDAL

- Mortality of attached inhabitants
- Toxic compounds contaminate filter-feeders
- Wave action and tides help to remove oil but can be trapped in isolated pockets for > 15 yrs
- Clean-up methods, like power-washing, are often more damaging than the oil



IMPACT OF OIL SPILLS

HUMAN HEALTH EFFECTS

Acute symptoms from exposure:

- Headache
- Respiratory distress
- Skin and eye irritation

Lingering effects:

- Exposure to cancer causing agents
- Possible nervous and endocrine disruption
- Food contamination



IMPACT OF OIL SPILLS

ECONOMIC

Spills cost billions in lost revenue:

- Commercial fisheries
- Tourism

And billions more for response and clean-up!

- Equipment
- Personnel to contain and clean spill, rehabilitate wildlife



FACTORS THAT INFLUENCE OIL SPILL IMPACT

Type of oil spilled:

- Light oils (jet fuel, gasoline, diesel)
- Medium oils (crude oil)
- Heavy oils (heavy crude oil, bunker fuel)

Weather/Oceanography

- Wind
 - Ocean currents
 - Temperature
-

CASE STUDY: SANTA BARBARA SPILL

- January-February 1969- oil well blow-out
- 4.2 million gallons spilled
- Birds, sea lions, elephant seals, and fish all killed
- Responsible party paid \$9.5 million
- Sparked modern environmental movement
 - In years after the spill, important environmental legislation passed:
 - California Coastal Commission
 - Environmental Protection Agency (EPA) is established
 - First Earth Day November 1969



CASE STUDY: *COSCO-BUSAN* SPILL

- November 7, 2007 tanker collides with Bay Bridge
- 53,000 gallons of heavy fuel oil spilled
- Killed 6,849 birds
- Major damage to herring fishery
- Oiled 384 acres of rocky intertidal

Cost:

- \$1.5 million to repair bridge
- \$70 million for clean-up

Responsible party ordered to pay \$32.3 million!

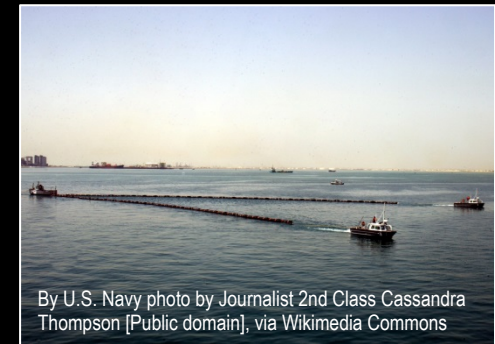


OTHER MAJOR U.S. SPILLS

Source	Date	Spill Volume
1. Deepwater Horizon	April 2010	210 million gallons
2. <i>Exxon Valdez</i> tanker	March 24, 1989	10+ million gallons
3. <i>Argo Merchant</i> tanker	Dec. 15, 1976	7.7 million gallons
4. Hurricane Katrina	Aug.–Sept. 2005	7 million gallons
5. <i>Mega Borg</i> explosion	June 8, 1990	5.1 million gallons

CLEAN-UP METHODS

- Between 2002-2004: ~263 spills/year (>100 gallons) in US coastal waters
- Clean-up strategies have changed very little:
 - Sorbents
 - Skimmers
 - Controlled burns
 - Biodegradation
 - Dispersants



WHAT CAN YOU DO?

- Reduce your use of oil fuels!
 - Bike, walk, take the bus or carpool
- Reuse and repurpose materials
- Properly dispose of oil waste



LAB ACTIVITY

- Part 1- Video experiment testing sorbent materials
 - Take notes and data
- Part 2- Evaluate two oil spill clean-up methods
- Part 3- Challenge questions on rocky shore oil clean- up

Vocabulary

- Sorbent: Material used to absorb large volumes of liquid
- Absorptivity: Amount of liquid that can be absorbed by a sorbent