

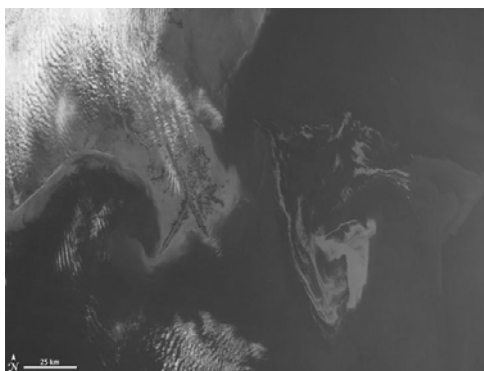
Gulf Oil Spill: The Aftermath

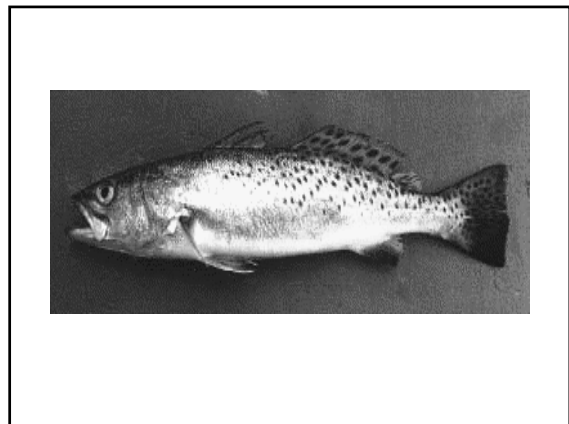
**Satellite Conference and Live Webcast
Thursday, January 27, 2011
12:00 – 1:30 p.m. Central Time**

**Produced by the Alabama Department of Public Health
Video Communications and Distance Learning Division**

Faculty

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Goals and Objectives

- Describe the major post-oil spill issues
- Describe the seafood monitoring program to insure the Gulf seafood safety
- Discuss oil impact on beaches and health issues

Goals and Objectives

- Describe issues of stress and mental health effects
- Discuss conflicting reports on the effects of the oil spill
- Discuss risk perception, influence of news media on beliefs, and the importance of clear and consistent messaging



Major Post-spill Issues

- Seafood safety



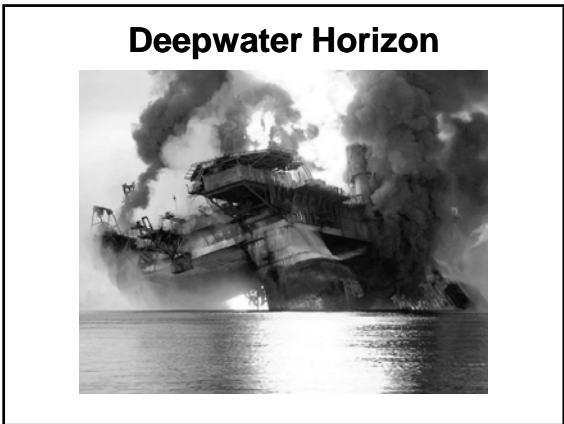
Major Post-spill Issues

- Recreational use of beaches

A black and white photograph of several people playing volleyball on a beach. A net is visible in the foreground, and the ocean is in the background.

Major Post-spill Issues

- Concern about toxicity of oil and dispersants
- Mental health issues

A black and white photograph showing people on a beach. In the foreground, a person's hand is visible, holding a small, dark object. Other people are walking in the background.

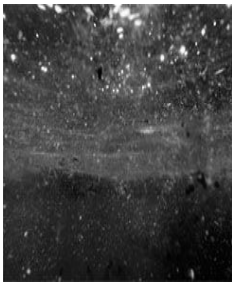
Deepwater Horizon

- Deepwater Horizon site
 - 50 miles off the tip of the Mississippi River
 - 5,000 feet (1 mile) below the surface



Deepwater Horizon

- Spewed ~ 200 million gallons of oil over 4 months
- Oil and tar balls reached the coast

An aerial photograph showing a large, dark, irregularly shaped oil spill on the surface of the water. The spill is surrounded by a lighter-colored ring of oil, and the surrounding water is a dark gray color.

Deepwater Horizon

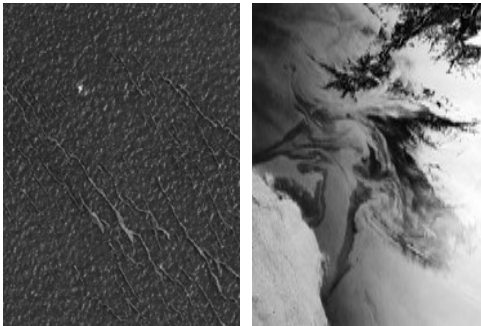
- Continual media coverage for months

An aerial photograph showing a large, dark, irregularly shaped oil spill on the surface of the water. The spill is surrounded by a lighter-colored ring of oil, and the surrounding water is a dark gray color.

Every Oil Spill is Different

- Gulf of Mexico spill differs greatly from tanker spills

Every Oil Spill is Different

Two side-by-side images. The left image is a close-up of a dark, textured oil spill on the water surface, showing a complex, branching pattern. The right image is a close-up of a white, foamy oil spill, showing a thick, bubbly texture.

Misconceptions About the Gulf Oil Spill

- No
 - Large waves of oil lap the shore
 - Oil distributed along coast, most in Louisiana
 - Oil is highly toxic and many people are seriously ill
 - Dispersants are highly toxic and make the oil more toxic

What We See from the Gulf Oil Spill

- Yes
 - Louisiana light sweet crude oil
 - Oil is spread as a sheen in many areas
 - Ribbons of “weathering crude”

What We See from the Gulf Oil Spill

- Not evenly distributed
 - Moves on top of the water with the tides, winds, and currents
- Few exposed to high concentrations of crude oil components

Louisiana Sweet Crude Oil

| # Carbons | Product | Compounds | Health Effects | Physical State | Fate |
|---|--|---|---|---------------------|--|
| C ₁ -C ₂ C ₃ -C ₄ | Natural gas; Propane and Butane | Methane | Few | Gas | Remains in water or evaporates from the surface of the water |
| C ₅ -C ₁₀ C ₉ -C ₁₆ C ₅ -C ₁₆ | Gasoline Kerosene Jet and turbo fuel | Benzene Toluene Alkanes Aromatic | Carcinogen Moderate Few Moderate | Volatile Liquids | |
| C ₁₇ -C ₂₄ | Mineral oil Lubricating oil | Aliphatics PAH | Few Carcinogen | Heavy liquids | Goopy liquid |
| C ₂₄ - higher | Paraffin Asphaltenes | | Few | Solids | Tar Balls |

↑
Crude Oil
↓
↑
Weathered Crude
↓



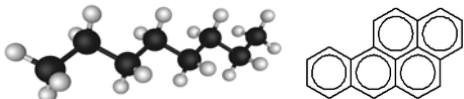
Toxicology of Petroleum Hydrocarbons

- Oil is composed of thousands of hydrocarbons
- Most hydrocarbons have a low degree of toxicity to humans
- Compounds of concern
 - VOCs – Benzene, Toluene, Ethylbenzene, Xylene



Toxicology of Petroleum Hydrocarbons

- Most common effects: irritation, headache, nausea
- PAHs – Carcinogenic potential with prolonged exposure



Toxicology of Petroleum Hydrocarbons

- The aquatic and ecological toxicity of oil is different than human health toxicity
- Ecological effects are most frequently related to the physical coating of marine life and birds

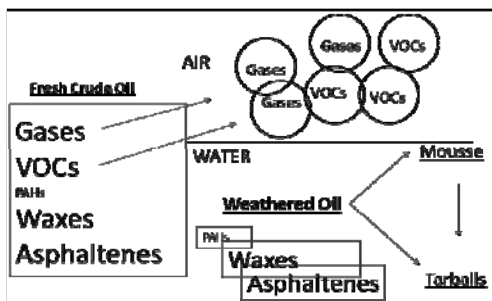
Weathered Crude Oil

- The composition of crude oil changes in the environment
- The oil “weathers” or “ages” as it moves to the coastline
- Volatile compounds evaporate in heat
- The smaller molecular weight compounds breakdown

Weathered Crude Oil

- Primarily long chained hydrocarbons remain
- PAH may be present, but not always
- Weathered oil is thicker or more solid
- Mousse
- Tarballs

Weathered Crude Oil



Analysis of Weathered Oil

- Near Grand Isle and Barataria Bay

| | Weathered Oil | Mousse | Tarball | Water |
|--|---------------|--------|---------|-------|
| Total Petro Hydrocarbons C ⁶ -C ¹⁰ | ND | ND | ND | ND |
| Total Petro Hydrocarbons C ¹⁰ -C ²⁸ | YES | YES | YES | YES |
| Total Petro Hydrocarbons >C ²⁸ -C ³⁵ | YES | YES | YES | YES |
| PAH | YES | ND | ND | ND |
| BTEX | ND | ND | ND | ND |

Analysis of Weathered Oil

- Near Grand Isle and Barataria Bay
 - Most common PAH detected
 - Crysene, Phenanthrene, pyrene
 - Occasionally detected
 - Fluoranthene, Fluorene, benzo(a)anthracene
 - In one sample
 - Benzeo(a)pyrene

If ~ 200 Million Gallons of Oil Spewed into the Gulf...

- Where is it?
 - Rumors abound about pools of oil at the bottom of the gulf
 - People see tarballs washing onto beaches and along the coastline

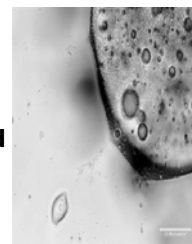


If ~ 200 Million Gallons of Oil Spewed into the Gulf...

- Components of oil separate
 - Gaseous and volatile components evaporate in the air
 - A percentage of methane and VOCs remain in the water
 - Evidence of biodegradation

If ~ 200 Million Gallons of Oil Spewed into the Gulf...

- Solid components move around in the gulf
 - Heavier tarballs can sink
 - More difficult and takes longer, but do break down



If ~ 200 Million Gallons of Oil Spewed into the Gulf...

“Bugs ate up the methane from the gulf spill”

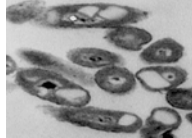
– John Kessler, Texas A&M

Biodegradation Mighty Microbes

- Microbial degradation is the ultimate clean up of oil
- Natural population of oil-degrading bacteria
 - Abundant in every ocean and particularly plentiful in the Gulf of Mexico

Biodegradation Mighty Microbes

- Natural oil and gas seeps support a large natural population
- More than 200 genera of bacteria break down hydrocarbons present in Gulf from natural seeps, marine traffic, oil spills



Biodegradation Mighty Microbes

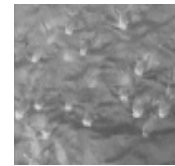
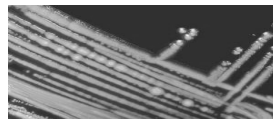
- Aerobic metabolism involves oxygenases, dehydrogenases, and hydrolases
- Aerobic metabolism of oil is an oxidative process requires oxygen and nutrients

Biodegradation Mighty Microbes

- Large amounts of oil spilled during Hurricane Katrina and little remained 1 year following the storm

Biodegradation

- Microbes are responsible for large amount of biodegradation of hydrocarbons
- Biodegradation known to break down oil along the gulf coast



Biodegradation

- Studies by Kessler of Texas A&M tracked methane plumes in the Gulf
- Oil plume found in June was gone when tested in August to October
- Methane levels had returned to normal

Biodegradation

- Study by Terry Hazen of Berkeley National Laboratory
- Found cold water microbe intrinsic to bioremediation of oil plumes in the deep sea
- Microbes consume O₂ but did not create oxygen deficits or dead zones

Biodegradation

- Study by Rich Camilli of Woods Hole had seemingly contradictory study
 - But comparisons found studies complementary when compared
 - Camilli found oil plume in June prior to capping of well similar to Hazen

Can I Eat Gulf Seafood?

- Most common question and people are not convinced seafood is safe to eat
 - Commercial sales of seafood are down
 - Some restaurants advertise they do not have Gulf seafood

Can I Eat Gulf Seafood?

- Yet, public health and other agencies pronounce the seafood is safe to eat
- Why the disconnect?
 - Distrust of government
 - Media coverage focusing on worst case scenario
 - Conflicting scientific reports
 - Legal advocates building case against BP

Keeping Seafood Safe

- State health agencies closed waters to harvesting of seafood to protect public health during the oil spill
 - Fishing areas closed when visible oil reached an area
 - Finfishing, shrimping, crabbing and harvesting of oysters



Ways Seafood may be Contaminated During Oil Spill

- External coating of fish or shell fish
 - Too high concentration of oil will kill fish and shellfish
 - Oil on fish can be smelled and tasted
 - Oil can be detected at levels far below those which may cause health effects

Ways Seafood may be Contaminated During Oil Spill

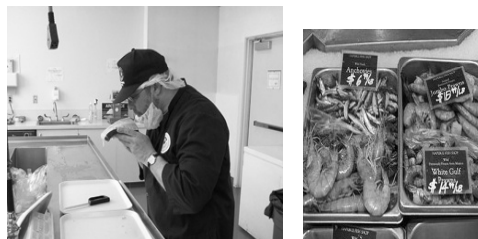
- Uptake of PAHs – primary contaminant of concern
 - PAHs metabolized by CYP 450 enzymes – does not bioaccumulate
 - Rate of uptake and elimination varies among species

Ways Seafood may be Contaminated During Oil Spill

- Fish – readily metabolize and excrete PAHs
 - Half life in days
- Shrimp and crabs – metabolize less rapidly
- Oysters – more slowly
 - Half life days to weeks

Seafood Monitoring Programs

- Closing an area is easy – reopening is more difficult



Seafood Monitoring Programs

- FDA, NOAA, and state agencies have implemented a seafood monitoring program
 1. Visible oil in fishing areas
 2. Sensory analysis for aliphatic compounds
 3. Chemical testing for PAHs, particularly in oysters

Seafood Monitoring Programs

- Approach for monitoring: protect public health
 - Designed to show an area is free of contaminants to prevent harvesting and consumption of contaminated seafood
 - Designed for reopening fishing areas for human consumption of seafood

Seafood Monitoring Programs

- Limited laboratory capacity
- Is not designed to find contaminated areas
- Differs from research approach
 - Does not characterize behavior of oil in seafood species

Confusion About Testing

- Seafood monitoring program
 - Objective: Identify areas that may be safely reopened to harvest seafood
 - Samples collected from areas free of oil using sampling plan
 - Treated the same as seafood harvested for consumption
 - Testing of edible portions of fish

Confusion About Testing

- **Sampling for Research or Litigation**
 - **Objective: Detect contaminants or characterize oil in aquatic organisms**
 - **Selection of samples with oil or from highly oiled areas**
 - **Handled to reflect area caught**
 - **Analysis of whole fish or shell fish, including visible oil**

Confusion About Testing



Seafood Sampling Results (La)


| | Total # | # with no detected level | # with any detected level | Above level of concern | Range (mg/kg) |
|-------------|---------|--------------------------|---------------------------|------------------------|---------------|
| Oysters | 319 | 166 | 153 | 0 | ND-0.042 |
| Shrimp | 141 | 107 | 34 | 0 | ND-0.062 |
| Crab | 70 | 55 | 15 | 0 | ND-0.014 |
| Finfish | 175 | 144 | 31 | 0 | ND-0.014 |
| All Seafood | 705 | 472 | 233 | 0 | ND-0.062 |

Seafood Sampling Results (La)

- **PAH detected**
 - **Anthracene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(a)pyrene, Chrysene, Fluorene, Fluoranthene, Indeno(1, 2, 3-cd)pyrene, Naphthalene, Phenanthrene, and Pyrene**
 - **Sample dates: 4/30/2010 to 10/22/2010**

Controversy

- **People are naturally concerned about seafood safety**
 - **Amount of oil in the Gulf**
 - **Media coverage for months**
 - **Conflicting reports from scientists**
 - **Distrust of government and industry**



Controversy

- **Issues raised about risk assessment assumptions in determining 'safe' levels**
 - **Amount of seafood consumption**
 - **Weight of a person/children**
 - **Number of samples collected**
 - **Substances tested**

Controversy

- Bottom line
 - Concentrations detected in seafood sampling is far below levels of concern



Is the Seafood that Gets to Market Safe?

- Absolutely!!
- Seafood monitoring program is testing seafood prior to opening areas to fishing
 - Split samples with FDA



Is the Seafood that Gets to Market Safe?

- Use of approved standard methods for analysis
- Low limits of detection for PAHs to insure not at levels for health concern

Is the Seafood that Gets to Market Safe?

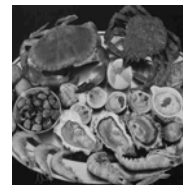
- Oil components break down and degrade in the environment
 - PAHs breakdown with sunlight and by microorganisms
 - Few detected in weathered oil or tarballs

Is the Seafood that Gets to Market Safe?

- PAHs not water soluble and not detected in water
- PAHs are common agents generated by many sources
- If taken up by fish and shell fish, will be metabolized and excreted

Seafood Monitoring

- Chemical analysis has not detected contamination in seafood samples
- Personnel have been trained in sensory analysis
- In Louisiana, baseline testing for aliphatic and PAHs did not detect these contaminants



Seafood Monitoring

- Many fishing areas have been reopened
 - Testing has shown the seafood in this area does not have any contamination



Seafood Monitoring

- Laboratory
 - Split samples with FDA
 - Use of approved standard methods for analysis
 - Low limits of detection for PAHs to insure not at levels for health concern

Let's Think About the Evidence

- The oil components including the PAHs are breaking down in the environment
 - The levels are decreasing over time
 - PAHs may be present from other sources

Let's Think About the Evidence

- PAHs have low water solubility, and the availability for uptake to mobile marine organisms is limited
 - PAHs in the sediments could persist longer

Let's Think About the Evidence

- Fish and shell fish metabolize PAHs
 - If PAHs are taken up by fish or shell fish, they will be metabolized and excreted over time
- Once the oil well was capped, the risk for uptake has steadily decreased

Let's Think About the Evidence

- These facts are consistent with the limited detection of any contaminants in fish and shell fish

**Dispersants:
Fears and Controversy**

- Controversy
 - Amount of dispersant and deep undersea use
 - Distrust of government and BP



**Dispersants:
Fears and Controversy**

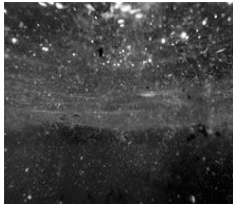
- Points of confusion – gives rise to myths
 - Aquatic toxicity vs. human health effects
 - Little understanding of biodegradation and dilution

**Dispersants:
Fears and Controversy**

- Trade-offs
 - Benefit
 - Reduces damage to estuaries and seabirds
 - Increases biodegradation because oil is in small droplets

**Dispersants:
Fears and Controversy**

- Risk
 - Adds more chemicals to the environment
 - Shifts risk to aquatic organisms in the water column



**Dispersants:
Fears and Controversy**

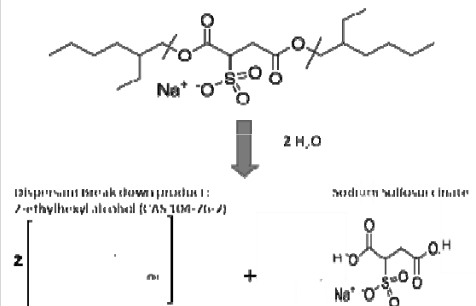
- Monitored in seafood
 - Components tested in seafood samples

Dispersants: Corexit 9500

- Components
 - Surfactants
 - Petroleum distillates
 - Propylene glycol

Dispersants: Corexit 9500

Major Surfactant: Diethylsulfosuccinate CAS 577-11-7



Dispersants: Corexit 9500

- Corexit breaks down in the environment
 - Half-life: 2 days to 2 weeks
 - Does not bioaccumulate in the food chain
 - Water soluble

Dispersants: Corexit 9500

- Dispersants do not change the amount of oil
 - Tool to manage the oil spill
 - Keeps oil from reaching the coast by moving into the water column
 - The small droplets are more easily biodegraded by microorganisms in water

EPA Dispersant Toxicity Tests

- EPA tested the aquatic toxicity of 8 dispersants
 - The dispersants tested had similar toxicity to standard test organisms, mysid shrimp, and silversides fish
- Dispersant toxicity

EPA Dispersant Toxicity Tests

- The dispersants alone were less toxic than oil
- Biodegrade in weeks or months
- Toxicity of dispersants + oil
 - Toxicity of combination is the same as oil alone

EPA Dispersant Toxicity Tests

- Contrary to media reports, Corexit 9500 was not found to be highly toxic

Oil and Beaches

- Weathered oil reached the beaches in various forms and amounts
 - Heavy mousse-like oil to minimal sheen
 - Tarballs may be present without other forms of oil



Oil and Beaches

- Beaches were closed when oil reached the shore
 - Swimming warnings were posted for sheens or tarballs
 - Guidelines for closing beaches or issuing warnings vary from state to state and even county to county

Public Health Recommendations

- Avoid direct contact with oil on a beach
- Do not swim in areas with visible oil
- Pregnant women and small children should stay away from oil on beach
- Wash off any oil on the skin
 - Use soapy water or baby oil

Public Health Recommendations

- Will direct contact with the oil make me sick?
 - It is not likely, but avoiding contact with the oil is highly recommended



Cleaning the Beaches

- Oil on the beaches is ugly, it may have an odor and it decreases desirability for recreational activities



Cleaning the Beaches

- But, beaches can be effectively cleaned...
 - Weathered oil and tarballs have low degree of toxicity
 - Tarballs may be picked up and cleaned from the beaches



Cleaning the Beaches

- Human health benchmark levels determined
 - Florida conducting some testing of beach sediments
- Tarballs may continue to wash up on the beaches and coast for years

Health Surveillance in Louisiana

- Goal is to monitor reports of human health effects to oil contaminants and heat stress
 - Syndromic reporting: defined symptoms used as indicators
 - Reports from 7 hospitals in LA Regions 1,3 and 9; EDs, poison control center, acute care facilities

Health Surveillance in Louisiana

- Does not include injuries or acute conditions not related to oil exposure



Health Surveillance in Louisiana

- Limitations
 - Self reported and cause of symptoms not confirmed
 - Captures only those who seek medical care
 - May not be complete reporting

Health Surveillance

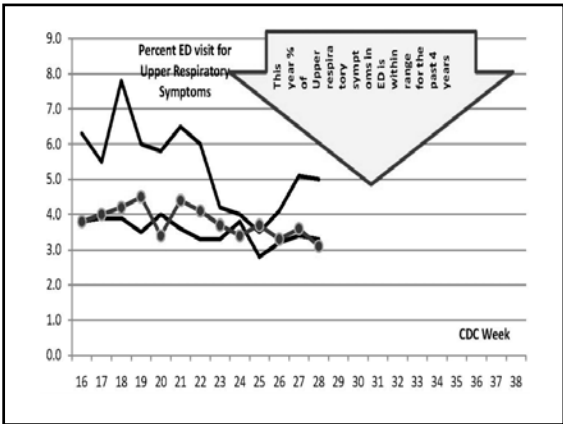
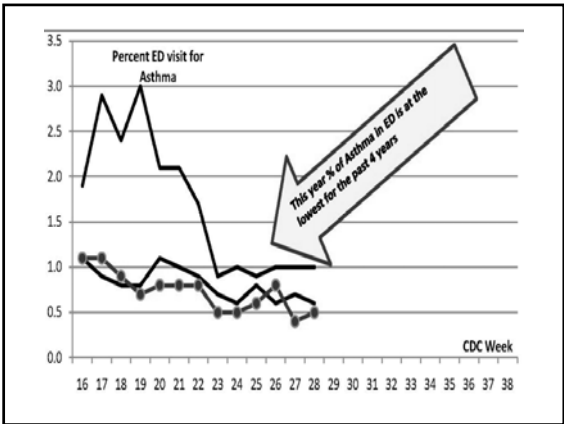
- Reports from hospitals, critical care units, emergency departments and poison control center
 - Workers 277
 - General population 84
 - Total complaints 361
- * As of August 12, 2010

Health Surveillance

- Most frequently reported symptoms
 - Headache, dizziness, nausea, vomiting, weakness/fatigue and upper respiratory irritation
 - Heat related complaints: 133
 - Workers with short hospitalizations: 17

Health Surveillance
 – General population complaints were primarily related to odors with mostly mild symptoms being reported

Comparison of 2010 Weekly Asthma and Respiratory Illness ED Reports to Last 3 Years



More than Physical Health

- Psychological impact of technical disasters
 - Not fair, comes in stages
- Study: Stressors associated with incident
 - 33% reported money problems
 - 15% reported work problems

More than Physical Health

- Stressors
 - Magnitude of the oil spill
 - Stress, fear, anxiety, uncertainty
 - Social disruption
 - Economic impact and bankruptcies
 - Fear of the unknown

More than Physical Health

- Months of 24 hour news coverage of worst case scenarios
- Conflicting views and opinions
 - Politicians and legal advocates 'making a case' for compensation
- Not always recognized



Mental Health Effects

- Adverse behaviors
 - Increased alcohol use
 - Illicit drug use
 - Domestic violence
 - Suicide
 - Anger and personality change
 - Depression
 - Fear of disease and illness



Mental Health Effects

- Signs of trouble
 - Difficulty sleeping
 - Difficulty concentrating
 - Easily frustrated
 - Poor work performance
 - Depression
 - Sadness



Mental Health Effects

- Feeling of hopelessness
- Mood swings
- Crying easily
- Fear of crowds, strangers, being alone



Mental Health

- Increased use of mental health facilities near the coast
 - Limited availability and cost are factors
 - More funding is requested to fill needs

Mental Health

- Examples
 - In 2 months, over 12,000 people sought counseling at the Catholic Charities clinic set up on the LA coast
 - 10% required further treatment, but % expected to rise

Mental Health

- Increase in suicides in area with low rates
- Orange Beach boat captain

Communication

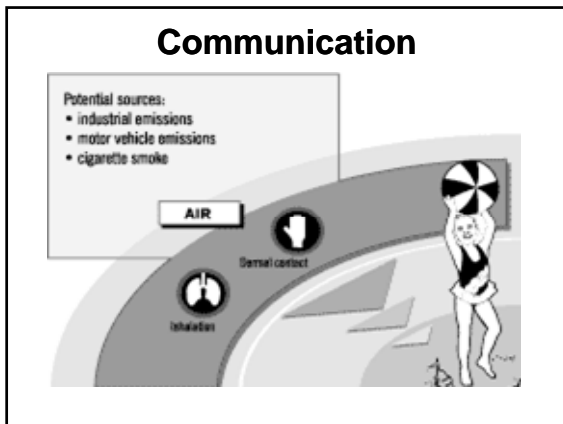
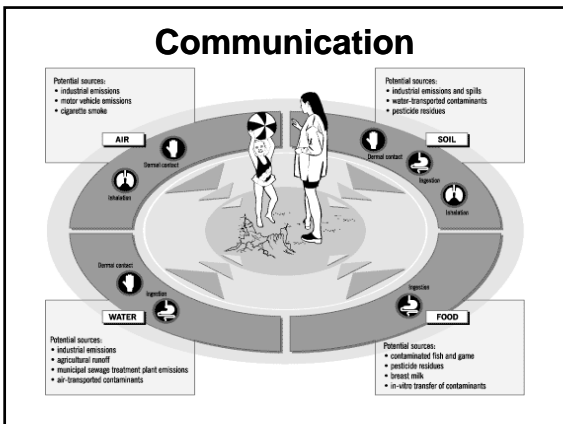
- Reasonable coordination among Gulf States
- Methods to communicate information from environmental monitoring and health is needed
 - Timely and reliable data
 - Interpretation of data

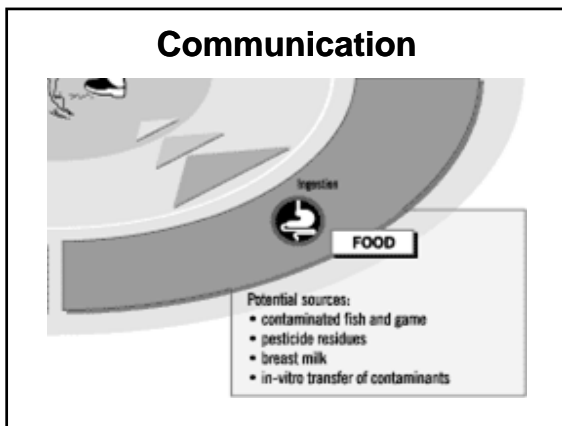
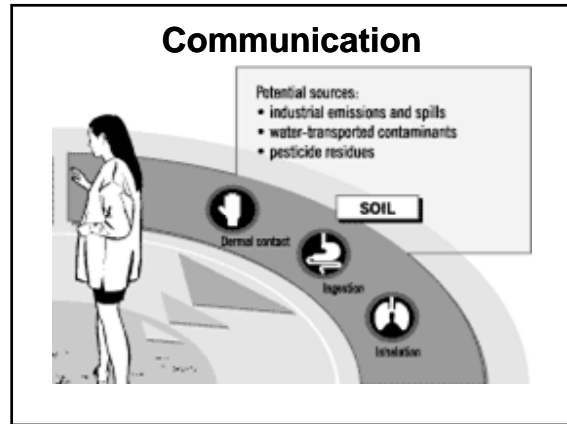
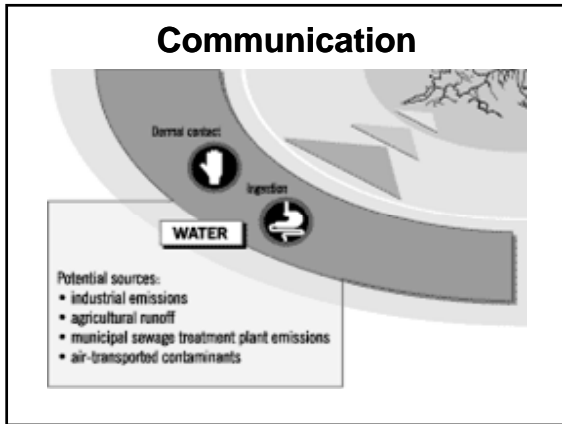
Communication

- News media provides a constant stream of stories that raise concern
- Conflicting reports and lack of interpretation of data causes confusion
- Distrust of government and academics

Communication

- Question
 - How to clearly and accurately communicate health issues and results better?





Perceptions

- Perceptions are reality
 - Many people do not believe that seafood is safe to eat
- Commercial sales of seafood are down

Perceptions

- Many fear the oil at the coast and will not visit for recreation or vacation
- People not vacationing at the Gulf Coast beaches

Perceptions

- The oil spill is making people sick
- Many believe their illnesses are the result of the oil spill, even if they did not come into contact with oil

Data Does Not Influence Perceptions

- I don't care what you tell me....
 - Magnitude of the oil spill
 - *“There must be health effects if so much oil spilled.”*

Data Does Not Influence Perceptions

- Media coverage and speculation of worse case scenarios
 - *“I saw it on TV. I know how bad it is.”*
- Distrust of scientists and government
 - *“You are just trying to cover it up.”*

Data Does Not Influence Perceptions

- Conflicting reports
 - *“Which should I believe?”*

And Now What??

- The well is capped, but the issues will linger for years
- Public Health response will change throughout the incident and its aftermath
- Need for continued coordination of communication and messaging among Gulf State agencies

And Now What??

- Must continue to monitor seafood safety and produce data
- Dissatisfaction with the BP reimbursement process will fuel anger and continue to raise health issues
- Litigation will keep the details of the spill in the news

And Now What??

