

# TIDES OF TRASH

A GEOGRAPHY GRAPHIC NOVEL

THE BATTLE FOR OUR OCEANS

The oceans connect  
every coastline on Earth...

Most people  
think the ocean  
is too big to  
damage.

But pollution  
is reaching  
almost  
everywhere.

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OCEAN MARINE  
GUARDIANS

FIELD  
NOTES

## KEY GEOGRAPHY CONCEPTS



OCEAN  
POLLUTION



MARINE  
ECOSYSTEMS



GLOBALIZATION



INTERCONNECTED  
SYSTEMS



ENVIRONMENTAL  
SUSTAINABILITY

...and now pollution  
connects them too.

## FRAME 2 – AN OCEAN UNDER PRESSURE

Radioactive waste, oil pollution, and plastics are among the greatest threats facing the oceans.



### RADIOACTIVE POLLUTION

Nuclear accidents, dumping, and industrial activities release radioactive materials that can remain dangerous for decades or centuries.



### OIL POLLUTION

Oil enters the ocean from tanker spills, offshore drilling, pipelines, shipping, and everyday urban runoff.



### PLASTIC POLLUTION

Plastic waste from land and sea breaks down into microplastics that spread across the entire ocean.

Is most pollution caused at sea?

Actually, around 80% comes from land-based sources.

#### POLLUTION PATHWAYS



#### KEY GEOGRAPHY CONCEPTS



LAND-BASED POLLUTION



MARINE CONTAMINATION



POLLUTION PATHWAYS



COASTAL IMPACTS

# RADIOACTIVE POLLUTION

Radioactive materials can remain dangerous for decades or even centuries.

In March 2011, a powerful earthquake and tsunami struck Japan, damaging the Fukushima Daiichi Nuclear Power Plant and releasing radioactive materials into the environment.



FUKUSHIMA  
DAIICHI  
NUCLEAR  
POWER PLANT

And ocean currents spread it far beyond Japan?

In 2011, the Fukushima disaster released radioactive contamination into the Pacific Ocean.

Exactly.

Ocean currents carry radioactive particles across huge distances.

These particles can enter marine food chains, affecting fish, marine mammals, and eventually humans.

## KEY GEOGRAPHY CONCEPTS



**RADIOACTIVE CONTAMINATION**  
Long-lasting and difficult to remove.



**OCEAN CURRENTS**  
Transport pollutants across great distances.



**BIOACCUMULATION**  
Toxins build up in organisms as they move up the food chain.



**ENVIRONMENTAL HAZARDS**  
Threaten ecosystems, food security, and human health.

# POISON THROUGH THE FOOD CHAIN

Radioactive substances can accumulate through marine food chains.

When pollution enters ecosystems...

...It rarely stays in one place.

Radioactive contamination doesn't disappear. It moves. It builds up. It affects everything.

## CONTAMINATION BUILDS UP THE FOOD CHAIN (BIOACCUMULATION)

- 1. PLANKTON**  
Absorb radioactive particles in the water.
- 2. SMALL FISH**  
Eat contaminated plankton.
- 3. TUNA**  
Eat many small fish.
- 4. MARINE MAMMALS**  
Tuna are eaten by larger predators.
- 5. HUMANS**  
People consume fish and seafood.



### IMPACTS:



- Damages marine ecosystems
- Threatens fisheries and food security
- Can affect human health over time

## KEY GEOGRAPHY CONCEPTS



**FOOD CHAINS**  
Energy moves through living organisms.



**BIOACCUMULATION**  
Toxins build up in organisms as they move up the food chain.



**FISHERIES**  
Healthy oceans support fishing communities and coastal economies.



**FOOD SECURITY**  
Pollution threatens the supply of safe seafood.



**MARINE ECOSYSTEMS**  
Ecosystems are connected and vulnerable to contamination.

# FIGHTING THE RADIATION

Managing radioactive pollution is complex, expensive, and long-term.

FUKUSHIMA  
DAIICHI  
NUCLEAR  
POWER PLANT  
福島第一原発

So even cleaning it up creates more waste?

That's one of the biggest challenges.

## 1. FROZEN SOIL WALL (ICE WALL)

Thousands of pipes freeze the ground, creating a barrier that blocks contaminated groundwater from reaching the ocean.

## 2. ADVANCED FILTRATION SYSTEMS

Contaminated water is cleaned using multi-step filtration to remove radioactive materials.

## 3. CONTAMINATED WATER STORAGE

Treated water that still contains some radioactive materials is stored in secure, monitored tanks.

## 4. HAZARDOUS WASTE MANAGEMENT

Filters, equipment, and soil contaminated with radioactive materials are carefully sealed and stored as hazardous waste.

## 5. INTERNATIONAL MONITORING & COOPERATION

The IAEA and global experts monitor, review, and support Japan's cleanup efforts.



Science, technology, and global cooperation are our best tools to protect the oceans.

| KEY GEOGRAPHY CONCEPTS                                                                |                                                                                       |                                                                                       |                                                                                       |                                                                                       |
|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|  |  |  |  |  |
| <b>REMEDIATION</b><br>Solutions to reduce and manage pollution                        | <b>FILTRATION SYSTEMS</b><br>Remove contaminants from water.                          | <b>IAEA</b><br>International cooperation ensures safety and transparency.             | <b>INTERNATIONAL COOPERATION</b><br>Countries and experts working together.           | <b>HAZARDOUS WASTE</b><br>Careful handling and long-term storage are essential.       |

# OIL POLLUTION

Oil pollution damages ecosystems, tourism, and coastal livelihoods.

Major oil spills, like the 2010 Deepwater Horizon disaster in the Gulf of Mexico, can release millions of barrels of oil into the ocean.

Some oil spills are dramatic disasters...

...but most oil pollution actually comes from everyday human activity.

## RAYONG OIL SPILL, THAILAND (2013)



Oil spills impact local communities and tourism. Koh Samet's beautiful beaches were heavily affected, hurting businesses and coastal livelihoods.

## KEY GEOGRAPHY CONCEPTS



**OFFSHORE DRILLING**  
Extracting oil and gas from below the seafloor carries risks of leaks and blowouts.



**OIL SPILLS**  
Large spills cause immediate damage; smaller leaks add up over time.



**MARINE POLLUTION**  
Oil harms marine life, destroys habitats, and disrupts food webs.



**COASTAL ECONOMIES**  
Oil pollution damages tourism, fisheries, and local livelihoods.



**ENVIRONMENTAL DISASTERS**  
Cleanup is long, costly, and often incomplete.

## EVERYDAY SOURCES OF OIL POLLUTION



VEHICLE LEAKS AND RUNOFF



URBAN STORMWATER RUNOFF



AGRICULTURAL RUNOFF



INDUSTRIAL DISCHARGES



SHIP BILGE AND DISCHARGES



An estimated **70-80%** of oil pollution in the ocean comes from these smaller, land-based sources.

# WHEN THE SEA TURNS BLACK

Oil coats feathers, fur, beaches and ecosystems.

## A HEALTHY MARINE ECOSYSTEM

The damage spreads everywhere.

And recovery can take years.

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## AN OIL-POLLUTED COASTLINE

### DEAD SEABIRDS

Oil destroys the insulating ability of feathers, causing death from exposure and poisoning.

### POISONED FISH

Toxic oil compounds contaminate marine life and enter the food chain.

### TOURISM DECLINE

Polluted beaches scare away visitors. Local businesses suffer and jobs are lost.

### FISHERIES COLLAPSE

Oil pollution damages habitats and fish populations, leaving fishermen with empty nets.

## IMPACTS OF OIL POLLUTION



**ECOSYSTEM DAMAGE**  
Destroys habitats and kills marine life.



**TOURISM DECLINE**  
Beaches and coastal areas lose visitors and revenue.



**FISHERIES COLLAPSE**  
Fish stocks drop, threatening food security and jobs.



**ENVIRONMENTAL RECOVERY**  
Cleanup and natural recovery can take years or even decades.

### OIL LINGERS

Even after the visible oil is gone, residues can remain in sediments and organisms for a long time.



# CLEANING THE SPILL

Oil spill cleanup can reduce damage, but rarely removes all the oil.



DISPERSANT AIRCRAFT

Booms help contain oil near the surface.

But some pollution still spreads underwater?

## 1. BOOMS

Floating barriers contain and slow the spread of oil, keeping it concentrated for recovery.

## 2. SKIMMERS

Specialized ships remove oil from the water surface before it reaches shore.



## 3. DISPERSANTS

Chemicals break oil into smaller droplets, helping it disperse and dilute in the water.

## 4. SHORELINE CLEANUP

Volunteers and crews remove oil from beaches and coastal habitats as quickly as possible.

CLEAN SHORES STRONGER TOGETHER

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Exactly.



## UNDERWATER IMPACT

Oil and chemicals can sink, affecting marine life, habitats, and food webs.

## WORKING TOGETHER FOR CLEANER OCEANS

Scientists, governments, local communities, and environmental organizations must act quickly and coordinate response efforts.



SCIENTISTS



GOVERNMENT AGENCIES



LOCAL COMMUNITIES



NGOS & VOLUNTEERS

## EVERY ACTION HELPS



Report spill's immediately.



Act fast to contain the oil.



Remove as much oil as possible.



Protect wildlife and habitats.



Monitor and learn to improve response.



Cleanup today, healthier oceans tomorrow.

## KEY GEOGRAPHY CONCEPTS



### BOOMS

Floating barriers that contain oil and reduce its spread.



### SKIMMERS

Vessels that collect oil from the water surface.



### DISPERSANTS

Chemicals that break oil into tiny droplets to help it disperse.



### COASTAL MANAGEMENT

Protecting shorelines and habitats through planning and action.



### EMERGENCY RESPONSE

Fast, coordinated action can reduce environmental impacts and save livelihoods.

# THE PLASTIC OCEAN

Plastic pollution has become one of the most visible global environmental problems.

How big?

Some ocean plastic patches are enormous.

The Great Pacific Garbage Patch is estimated to be roughly twice the size of Texas.

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## IMPACTS OF PLASTIC POLLUTION



Harms marine life through ingestion and entanglement.



Microplastics enter the food chain.



Pollutes habitats and damages ecosystems.



Affects coastal economies and tourism.

## OCEAN GYRES: NATURE'S CIRCULAR CURRENT

Gyres are large systems of rotating ocean currents that trap and concentrate floating debris in the center.



Every piece of plastic that enters the ocean has a journey. Every piece we keep out makes a difference.

## THE GREAT PACIFIC GARBAGE PATCH

A massive accumulation of plastic and marine debris floating in a gyre of the North Pacific Ocean.



Estimated to be roughly twice the size of Texas.



## WHAT MAKES UP THE PLASTIC PATCH?



PLASTIC BOTTLES AND CONTAINERS



FISHING NETS AND ROPES



MICROPLASTICS  
TINY PLASTIC FRAGMENTS



FOAM, BAGS AND  
FLOATING DEBRIS

## KEY GEOGRAPHY CONCEPTS



**PLASTIC WASTE**  
Human-produced plastic that persists in the environment for decades.



**GREAT PACIFIC GARBAGE PATCH**  
One of several ocean garbage patches, located in the North Pacific Gyre.



**OCEAN GYRES**  
Large circular currents that concentrate debris in the open ocean.



**MARINE DEBRIS**  
Solid waste in the ocean that harms wildlife, ecosystems, and human communities.

# EATING THE PROBLEM

Marine animals often mistake plastics for food.

Plastic doesn't disappear...

...it just breaks into smaller and smaller pieces.

## 1. INGESTION

Animals mistake plastic bags and debris for food, which can block digestive systems and cause starvation.

## 3. ENTANGLEMENT

Fishing nets and plastic debris can trap and injure marine animals, restricting movement and leading to death.

## 2. FEEDING PLASTIC

Seabirds collect plastic to feed their chicks, causing injury, poisoning, and reduced survival.

## 4. MICROPLASTICS

Plastics break down into microplastics—tiny bits less than 5mm—that spread throughout the ocean and enter the food chain.

## FROM MICROPLASTICS TO HUMANS: BIOMAGNIFICATION



## WHAT WE CAN DO

|                                                                      |                                                         |                                                                            |                                                                  |                                                                                                     |
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| <p><b>REDUCE</b><br/>Use less plastic and choose reusable items.</p> | <p><b>REUSE</b><br/>Find new uses and repair items.</p> | <p><b>RECYCLE</b><br/>Recycle properly and support recycling programs.</p> | <p><b>CLEAN UP</b><br/>Join beach and ocean cleanup efforts.</p> | <p><b>SUPPORT SOLUTIONS</b><br/>Support policies and innovations that reduce plastic pollution.</p> |
|----------------------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|



Our ocean connects us all.  
Protecting it means protecting ourselves and future generations.

## IMPACTS ON MARINE LIFE



### INGESTION

Causes internal injuries, blockages, and starvation.



### ENTANGLEMENT

Restricts movement, causes injuries, and can be fatal.



### HABITAT DAMAGE

Plastic debris damages reefs and smothers marine habitats.



### LOSS OF BIODIVERSITY

Plastic pollution threatens species survival and reduces marine diversity.

## MICROPLASTICS: EVERYWHERE

Microplastics have been found in drinking water, table salt, honey, air, and even human blood.



## KEY GEOGRAPHY CONCEPTS



### ENTANGLEMENT

Animals become trapped in plastic debris and nets.



### INGESTION

Animals eat plastic, mistaking it for food.



### MICROPLASTICS

Tiny plastic particles spread throughout water systems.



### BIOMAGNIFICATION

Toxins and plastic build up in the food chain.



### MARINE BIODIVERSITY

The variety of life in the ocean is essential and at risk.

# THE FIGHT BACK

Managing ocean pollution requires both local action and global cooperation.

So cleaning beaches isn't enough?

We also need to stop pollution at its source.



## SOLUTIONS: LOCAL AND GLOBAL ACTIONS

### 1. BEACH CLEANUPS



Communities remove litter before it reaches the ocean.

### 2. THE OCEAN CLEANUP



Innovative technologies collect plastic from ocean gyres.

### 3. RECYCLING SYSTEMS



Reduce waste by recycling and improving waste management infrastructure.

### 4. PLASTIC BANS



Bans and restrictions on single-use plastics reduce plastic at the source.

### 5. SEABINS



Seabins catch floating debris in marinas and harbors before it spreads.

### 6. YOUTH ACTIVISM



Young people raise awareness, lead campaigns, and inspire change.

### 7. SCIENTISTS & MONITORING



Scientists monitor oceans, track pollution, and develop better solutions.

### KEY GEOGRAPHY CONCEPTS



**SUSTAINABILITY**  
Meeting our needs today without harming the ability of future generations.



**INTERNATIONAL AGREEMENTS**  
Global cooperation through agreements and partnerships helps protect the oceans.



**PLASTIC BANS**  
Policies that reduce plastic production and use help prevent pollution.



**COMMUNITY ACTION**  
Local actions by individuals and groups create a powerful collective impact.



**PREVENTION STRATEGIES**  
Stopping pollution at the source is more effective than trying to clean it up later.

### GLOBAL COOPERATION



International agreements, organizations, and global goals help protect our oceans.

### WHAT YOU CAN DO



Use less plastic.



Dispose of waste properly.



Choose reusable items.



Join local cleanups and campaigns.



Speak up and inspire others.



Small actions, when multiplied by millions of people, can transform the world.

**TOGETHER, WE CAN TURN THE TIDE ON POLLUTION AND PROTECT OUR OCEAN FOR FUTURE GENERATIONS.**



# ONE OCEAN, ONE FUTURE

The future of the oceans depends on the choices humanity makes today.

The oceans connect us all.

And protecting them is everyone's responsibility.

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THE OCEAN CLEANUP

PROTECTED MARINE AREA

ONE OCEAN. ONE PLANET. ONE FUTURE.



The oceans sustain life.



They connect us all.



Together, we can protect them.



For today. For tomorrow.



For generations to come.



The ocean gives us life, climate regulation, food, jobs, and beauty. Let's return the favor—by protecting it today and every day.

## A HEALTHY OCEAN IS POSSIBLE



CLEANUP EFFORTS REMOVE POLLUTION AND RESTORE HABITATS.



PROTECTED AREAS GIVE MARINE LIFE A CHANCE TO THRIVE.



CLEAN ENERGY REDUCES POLLUTION AND CLIMATE IMPACTS.



HEALTHY ECOSYSTEMS SUPPORT BIODIVERSITY AND FUTURE GENERATIONS.

## THINK IN SYSTEMS



HUMAN ACTIVITIES



POLLUTION ENTERS OCEANS



IMPACTS WILDLIFE, ECOSYSTEMS & PEOPLE



SOLUTIONS REQUIRE EVERYONE TO ACT

Everything is connected. Small actions create big changes.

## EVERYONE CAN MAKE A DIFFERENCE



REDUCE what you use.



REUSE & RECYCLE whenever possible.



JOIN CLEANUPS in your community.



SPEAK UP and inspire others.



SUPPORT POLICIES for a healthy ocean.

**"WE CANNOT PROTECT THE FUTURE WITHOUT PROTECTING THE SEA."**

OUR OCEAN. OUR FUTURE. OUR CHOICE.