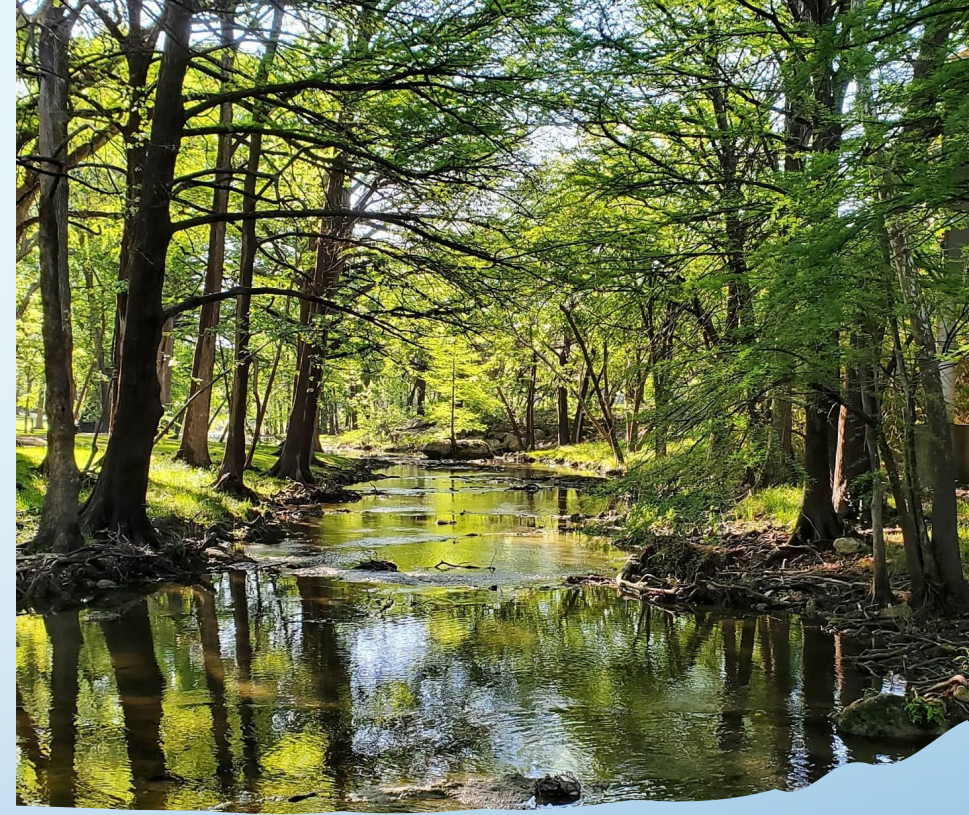




**Do you like
being outside?**

**What if
being
outside
looked like
this?**





WHAT IS ENVIRONMENTAL ENGINEERING?

MADELINE CONGER AND JONATHAN CLAYTON



THE UNIVERSITY OF
ALABAMA

THE HISTORY OF ENVIRONMENTAL ENGINEERING

EVEN THOUGH “ENVIRONMENTAL ENGINEER” MAY BE A FAIRLY NEW TERM, THE JOB HAS BEEN AROUND SINCE **ANCIENT TIMES!**

- ROMAN CLOCAE – 6TH CENTURY – STORMWATER AND WASTEWATER MANAGEMENT!
- ROMAN AQUEDUCTS: LARGER CITIES REQUIRED TRANSPORTATION OF HUGE VOLUMES OF WATER TO MEET THE NEEDS OF CITIZENS FOR WATER AND AGRICULTURE

IMAGES: ROMAN CLOCAE AND AQUEDUCTS (ELEVATED AND UNDERGROUND)

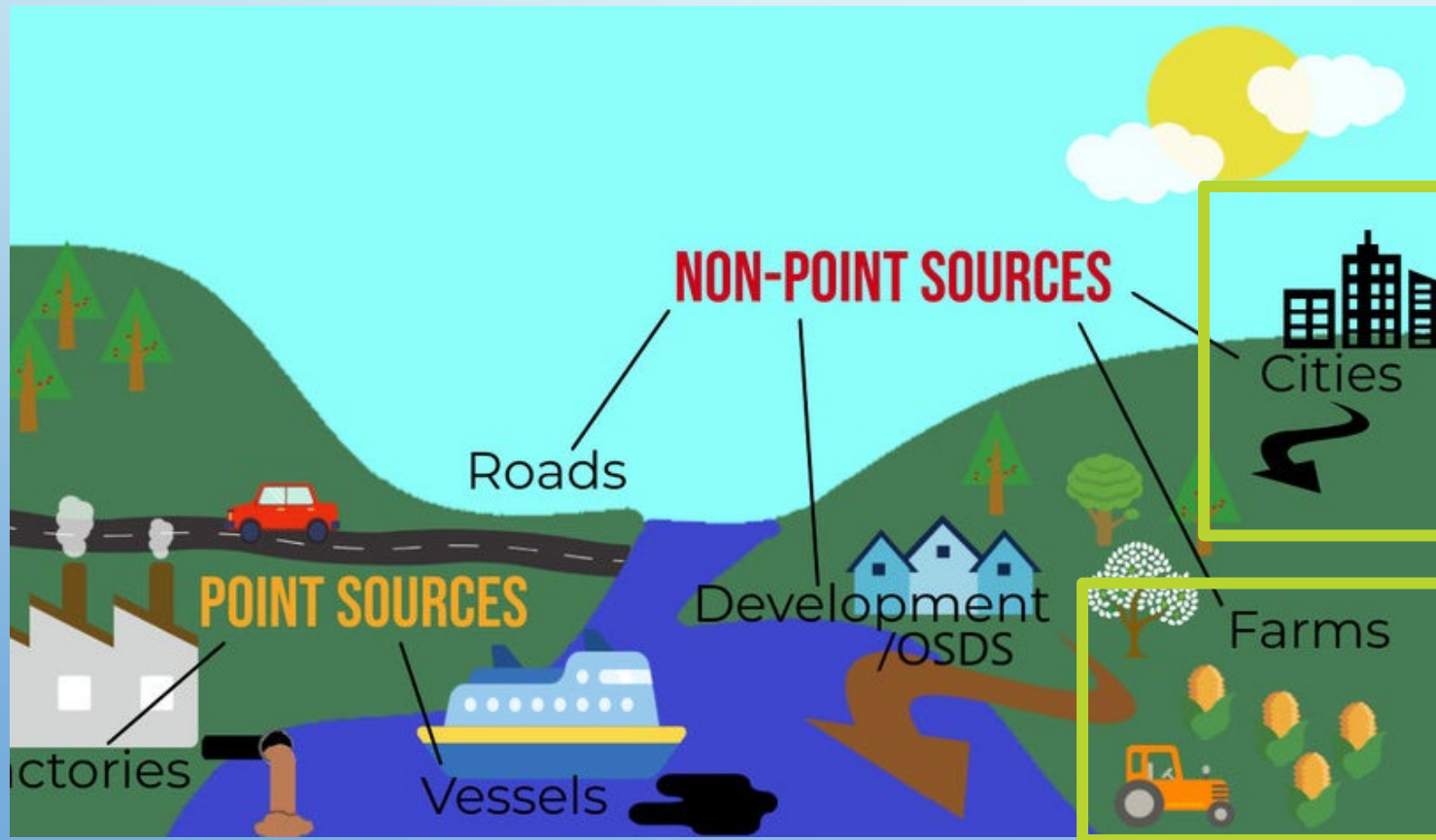




ENVIRONMENTAL ENGINEERS HELP **PROTECT PEOPLE FROM** **THE HARMFUL EFFECTS OF** **POLLUTION.**

- A POLLUTANT IS ANY SUBSTANCE THAT ADVERSELY AFFECTS THE ECOSYSTEM OR HUMAN HEALTH.
- POLLUTANTS CAN BE FROM BOTH HUMAN SOURCES AND NATURAL SOURCES... **CAN YOU NAME SOME?**
- EXAMPLES: CARS, BUILDINGS, SEWER SYSTEMS, ETC. AND NATURAL SOURCES SUCH AS DUST STORMS, EROSION, VOLCANOES,

POINT VS. NON-POINT SOURCES



- **POINT SOURCES:** WHERE POLLUTANTS ARE RELEASED INTO THE SURROUNDING ENVIRONMENT FROM ONE SOURCE.
- **NON-POINT SOURCE POLLUTION:** WHERE POLLUTANTS ARE RELEASED BY MANY SMALL SOURCES THAT ARE SPREAD OUT.
- **DO YOU THINK URBAN (CITIES) OR RURAL AREAS (FARMLAND) EXPERIENCE MORE POINT SOURCE SOLUTION?**
 - **WHY?**

SUPERFUND SITES

- LOVE CANAL IN NIAGARA FALLS, NY
- TOXIC WASTE LANDFILL FOR DECADES — PEOPLE STARTED HAVING LONG TERM HEALTH EFFECTS, LIKE CANCER
- **SUPERFUND SITE:** A DESIGNATION RESERVED FOR THE WORST CASES OF ENVIRONMENTAL CONTAMINATION THAT REQUIRE LARGE-SCALE FEDERAL ATTENTION TO CLEAN-UP.



WHERE ARE SUPER FUND SITES?



- THEY ARE EVERYWHERE!
- YOU CAN LOOK UP WHERE YOU LIVE AND SEE WHAT SITES ARE AROUND YOU!
- SEARCH FOR SUPERFUND SITES WHERE YOU LIVE | US EPA

WHY DOES CANADA NOT HAVE ANY SUPER FUND SITES?



- ▶ THEY HAVE ENVIRONMENTAL SITES OF CONCERN TOO!
- ▶ THE EPA IS THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, SO THEIR AREA OF CONCERN IS ONLY IN THE UNITED STATES!

WHEN PEOPLE CARE, THINGS CHANGE!

- IN RESPONSE TO MANY ENVIRONMENTAL DISASTERS, MANY PEOPLE BEGAN LOBBYING FOR CHANGE ON A GOVERNMENTAL LEVEL
- ENVIRONMENTAL REGULATIONS WERE SIGNED INTO LAW IN THE 1960'S, 70'S, AND 80'S:

OCCUPATIONAL SAFETY AND HEALTH
ADMINISTRATION (OSHA)

CLEAN WATER ACT

CLEAN AIR ACT

RESOURCE CONSERVATION AND RECOVERY ACT

**Key: spreading awareness and
environmental consciousness**

What does this mean to you? How can you help your family and community take care of the environment?

NOTABLE IMPROVEMENTS THAT ENVIRONMENTAL ENGINEERS HAVE HELPED BRING ABOUT?

- **HUMAN HEALTH HAS IMPROVED** MARKEDLY IN AREAS SUCH AS INFANT MORTALITY, DEATHS FROM WATER-BORNE ILLNESSES, AND LEAD CONCENTRATIONS IN OUR BLOOD!
- AIR POLLUTION IS DOWN 78% FROM THE 1970'S!



WHAT CURRENT CHALLENGES ARE ENVIRONMENTAL ENGINEERS WORKING ON?

CHALLENGES OCCUR ON BOTH THE NATIONAL AND GLOBAL SCALE:

- WATER SCARCITY AND CONFLICT
- INCREASED VARIABILITY IN CLIMATES
- CHANGING PH OF THE WORLD'S OCEANS
- MANAGEMENT OF HIGH CONCENTRATIONS OF POLLUTANTS IN CITIES
- DEFORESTATION AND ENDANGERED SPECIES
- DRINKING AND WASTEWATER MANAGEMENT
- ALGAE BLOOMS
- MORE!!



What Tools Do We Use?

Physical Models

Field Sampling

Citizen-science

Industry Partnerships

Analytical Tools (GC-MS, HPLC, ESM, etc.)

GIS

Other software (EPAnet, OpenLCA, coding languages, tensorflow, etc.)

Stopwatches, measuring tape, etc.

IS ENVIRONMENTAL ENGINEERING A GOOD PROFESSION?

- **HELP IMPROVE THE ENVIRONMENT FOR THE PEOPLE, PLANTS, AND ANIMALS YOU LOVE!**
- ENVIRONMENTAL ENGINEERS CLEARLY HAVE MANY AREAS IN WHICH THEY CAN CONTRIBUTE; IT IS A GROWING FIELD!
- ON TOP OF THAT, ENVIRONMENTAL ENGINEERING IS RANKED BY **FORBES AS #5 OF THE "15 MOST VALUABLE COLLEGE MAJORS"**. ACCORDING TO FORBES, THE MEDIAN STARTING SALARY FOR ENVIRONMENTAL ENGINEERS IS \$51,700 AND THE MEDIAN MID-CAREER SALARY IS \$88,600.

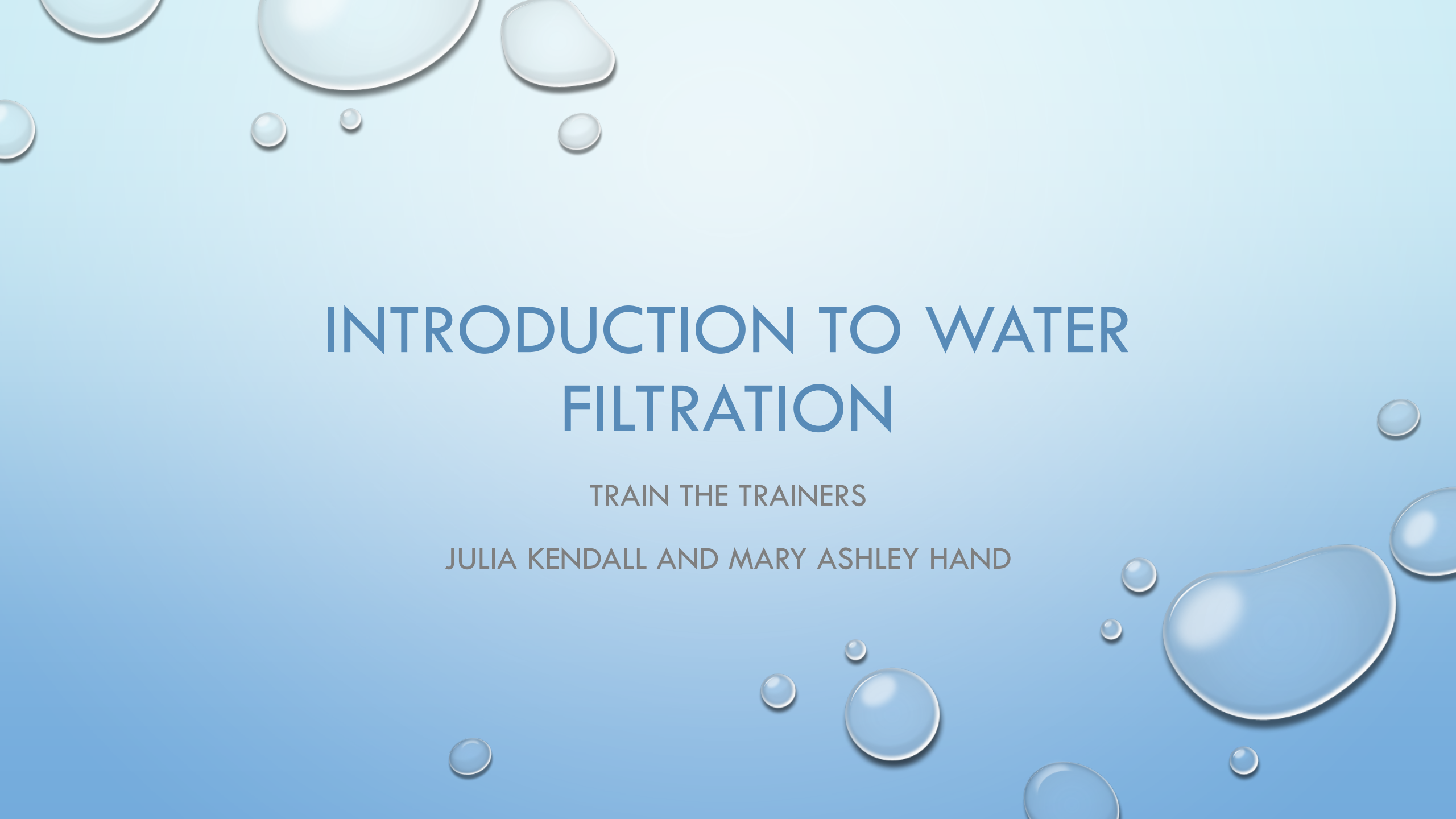




**Where Could
Environmental Engineering
Take You?**



QUESTIONS?

The background is a light blue gradient with several realistic water droplets of various sizes scattered across it. Some droplets are at the top, some at the bottom, and some on the right side. They have highlights and shadows, giving them a 3D appearance.

INTRODUCTION TO WATER FILTRATION

TRAIN THE TRAINERS

JULIA KENDALL AND MARY ASHLEY HAND



DAY 1: INTRODUCTION TO WATER FILTERS

BY THE END OF THE LESSON STUDENTS WILL BE ABLE TO:

- UNDERSTAND WHY WATER FILTRATION IS IMPORTANT.
 - LEARN ABOUT DIFFERENT TYPES OF CONTAMINANTS IN WATER.
 - DISCUSS HOW NATURAL AND MAN-MADE FILTRATION SYSTEMS WORK.
- 

WHY IS IT IMPORTANT FOR US TO FILTER WATER? HOW DO WE GET CLEAN DRINKING WATER?

- [HTTPS://WWW.YOUTUBE.COM/WATCH?V=H1AE2DIVSIW](https://www.youtube.com/watch?v=H1AE2DIVSIW)
- [HTTPS://WWW.YOUTUBE.COM/WATCH?V=PEKXB3N6G3I](https://www.youtube.com/watch?v=PEKXB3N6G3I) ← HOW WE GET CLEAN DRINKING WATER

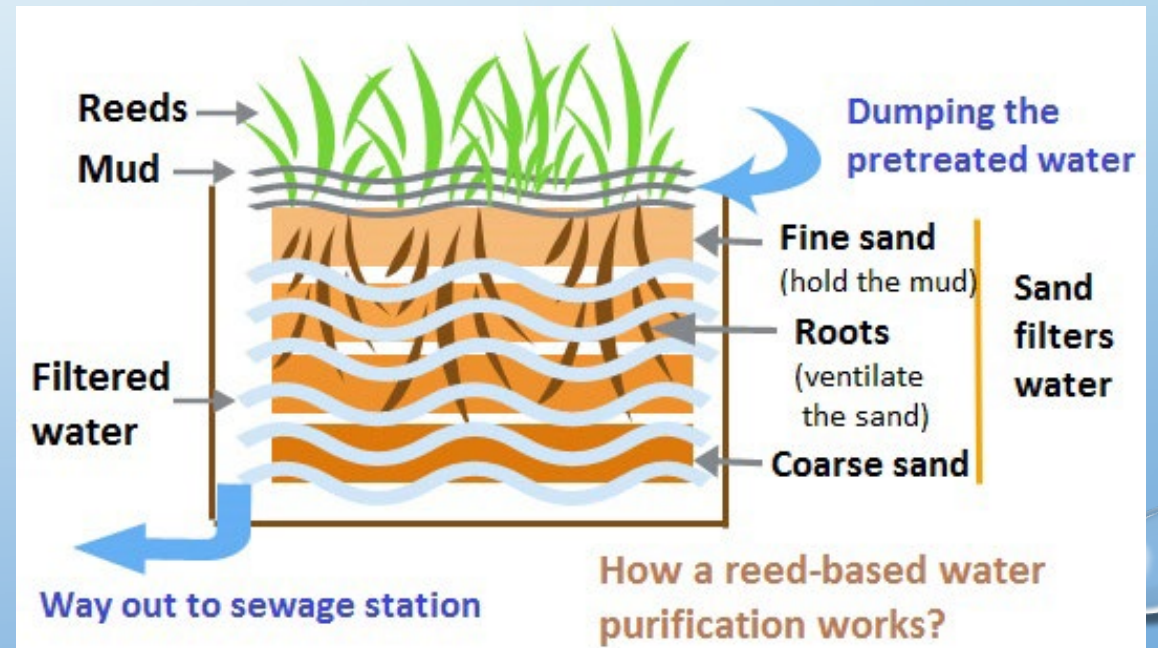
MAIN TYPES OF WATER CONTAMINANTS

- PHYSICAL – IMPACT THE PHYSICAL APPEARANCE OF WATER. (EXAMPLES: DIRT, SAND, OTHER PARTICLES SUSPENDED IN WATER FROM SOIL EROSION)
- CHEMICAL- ELEMENTS OR COMPOUNDS. CAN BE NATURALLY OCCURRING OR MAN-MADE. (EXAMPLES: NITROGEN, PESTICIDES, METALS, BLEACH)
- BIOLOGICAL- ORGANISMS IN WATER. ALSO CALLED MICROBES. (EXAMPLES: PARASITES, BACTERIA, & VIRUSES)



FILTRATION IN NATURE

- IN NATURE WATER IS FILTERED THROUGH LAYERS OF SOILS, SAND, ROCK, AND OTHER ORGANIC MATERIALS LIKE LEAVES.



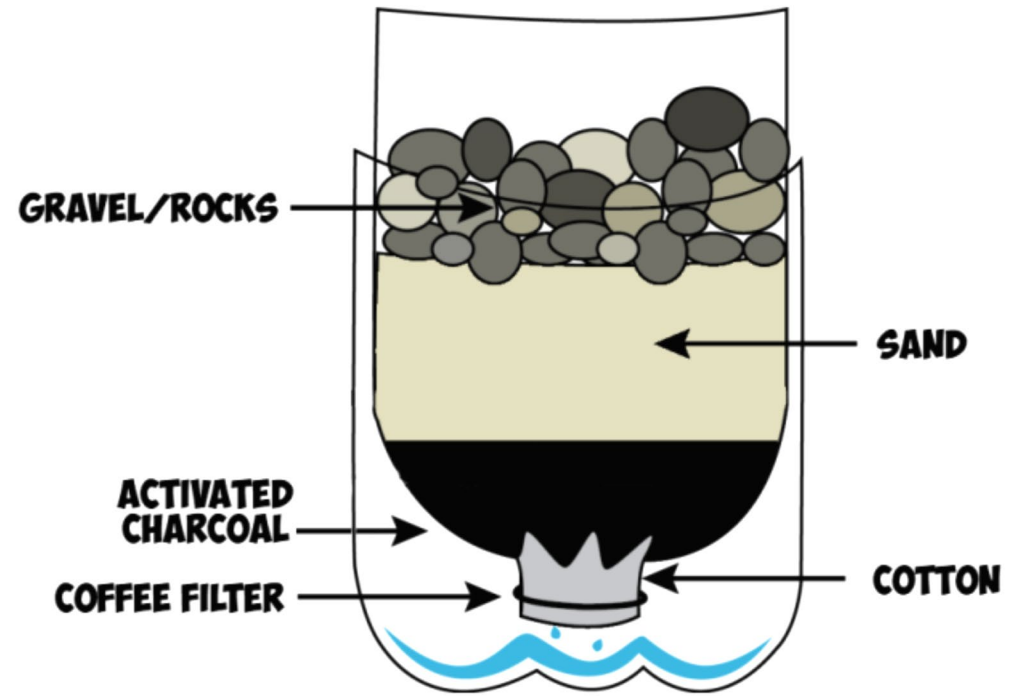
GROUP WORK

- WORK IN GROUPS TO TRY TO FILTER DIRTY WATER USING PAPER TOWELS AND TURBIDIMETER.
- NOTE WATER CLARITY BEFORE AND AFTER FILTRATION. WHAT WORKED AND WHAT DIDN'T? BRAINSTORM FILTRATION METHODS AND CONSIDER OTHER MATERIALS THAT WOULD BE HELPFUL IN FILTRATION.

DAY 2

ENGINEERING

A WATER FILTER





REVIEW!

- WHAT ARE THE DIFFERENT TYPES OF CONTAMINANTS IN WATER?
 - HOW DOES WATER FILTRATION HAPPEN IN NATURE?
- 



PURPOSE OF PROVIDED MATERIALS

- COTTON BALLS : TRAP LARGE DEBRIS.
 - RICE : HELPS REMOVE FINER SEDIMENTS.
 - SAND : REMOVES SMALLER DIRT PARTICLES.
 - ACTIVATED CARBON : ABSORBS CHEMICALS AND ODORS.
 - COFFEE FILTERS : ACTS AS AN INITIAL COARSE FILTER.
 - ELECTRICAL TAPE : HELPS SECURE FILTER LAYERS
- 

GROUPWORK

- DRAW/DESIGN POTENTIAL FILTER DESIGNS.
- [MATERIALS: CUT WATER BOTTLE, COTTON BALLS, SAND, RICE, ACTIVATED CARBON, COFFEE FILTERS, AND ELECTRICAL TAPE]
- LABEL MATERIALS USED IN DESIGN.
- BE ABLE TO SUPPORT THE ORDER OF MATERIALS IN YOUR DESIGN.
- SET TIMER

WRAP UP!

- WHAT MATERIAL DID YOU THINK WAS THE MOST EFFECTIVE IN FILTERING DIRTY WATER? WHY?



DAY 3: BUILDING AND TESTING THE FILTERS

BY THE END OF LESSON STUDENTS WILL BE ABLE TO:

- CONSTRUCT WATER FILTERS AND TEST THEM.
- COMPARE RESULTS AND DISCUSS IMPROVEMENTS.

QUICK REVIEW!

- CONSIDER DESIGNS FROM YESTERDAY'S CLASS
 - WHAT DO YOU THINK WILL HAPPEN WHEN YOU RUN WATER THROUGH YOUR FILTER DESIGN?
 - HOW WILL CLARITY OF WATER CHANGE?
- 

BUILD!

- GET INTO YOUR GROUPS AND BEGIN BUILDING YOUR FILTERS!
- [TIMER](#)

FILTER TESTING!

- SET TIMER FOR FILTER TESTING!
- MEASURE TURBIDITY BEFORE AND AFTER FILTRATION [WORKSHEET]
- HAVE STUDENTS TAKE NOTES OF WHAT WORKED WHAT DIDN'T FOR EACH GROUP.



WRAP- UP

- EVALUATE YOUR DESIGN WORKSHEET
 - WHAT WORKED AND WHAT DIDN'T?
 - BRAINSTORM ONE WAY YOU COULD HAVE IMPROVED YOUR DESIGN.
- 



DAY 4: IMPROVING AND FINALIZING DESIGN

BY THE END OF THE CLASS STUDENTS SHOULD BE ABLE TO:

- ANALYZE FILTER EFFECTIVENESS.
 - MODIFY DESIGNS FOR BETTER RESULTS.
 - DISCUSS REAL-WORLD APPLICATIONS.
- 



REVIEW & DISCUSS

- GET IN YOUR GROUPS AND SHARE RESULTS FROM YESTERDAY'S EXPERIMENT.
 - WHAT WORKED BEST FROM EACH DESIGN? WHY DID IT WORK?
 - COMPARE CLARITY WITH RESULTS FROM TURBIDIMETER.
- 

DESIGN IMPROVEMENT

- MAKE MODIFICATIONS TO DESIGN BASED ON YESTERDAYS TESTING.

TIMER

FINAL TEST!

- RETEST IMPROVED DESIGN AND COMPARE RESULTS FROM YESTERDAY.



WRAP-UP

- WHAT DID YOU LEARN FROM THIS EXPERIMENT?
 - HOW IS THIS IMPORTANT IN THE WORLD WE LIVE IN?
 - CONSIDER HOW SCIENCE AND ENGINEERING WORK TOGETHER TO PROVIDE CLEAN WATER.
- 