KEEPING WATER CLEAN

GETTING RID OF BIOFILMS

FOR ISS AND FOR EARTH

WHAT ARE BIOFILMS?

- A THIN, SLIMY FILM OF BACTERIA THAT ADHERES TO A SURFACE.

- BIOFILMS ARE A COLLECTIVE OF ONE OR MORE TYPES OF MICROOGRANISMS THAT CAN GROW ON MANY DIFFERENT SURFACES. MICROORGANISMS THAT FORM BIOFILM INCLUDE BACTERIA, FUNGI AND PROTISTS.

- EXAMPLES OF BIOFILMS ARE DENTAL PLAQUE, SCUM IN WATER PIPES, AND POND SCUM, BUT THEY CAN FORM IN ANY AREA THAT HAS MOISTURE OR WATER.

ISS WATER ISSUES

CURRENT BIOFILM ISSUES ON ISS

- BOEING HAS NOTED THREE DIFFERENT BACTERIUM IN THE ISS WATER SYSTEM
  - BURKHOLDERIA CEPACIA, RALSTONIA PICKETTII, AND SILVER-RESISTANT CUPRIAVIDUS METALLIDURANS.
- CURRENT ISS METHOD IS USING SILVER TO "CLEAN" THE WATER.
- ONE OF THE BACTERIUM IS RESISTANCE TO SILVER.
- MOST BACTERIUM THAT FORM BIOFILMS ARE RESISTANT TO SOME TREATMENT METHODS

SOLUTION CONSTRAINTS

- BIOHAZARDOUS MATERIALS ARE NOT ALLOWED ON ISS
- ANY SOLUTIONS FOR TREATMENT OF BIOFILMS OR PREVENTATIVE OF BIOFILMS HAS TO BE NATURAL AND NON-HAZARDOUS.
- THINK "GREEN" FOR SOLUTIONS

HERE ON EARTH

WATER

- THERE ARE MANY CONTAMINANTS IN DIFFERENT WATER SYSTEMS HERE ON EARTH
- SOME OF THESE CONTAMINANTS WILL CREATE BIOFILMS.
- COMING UP WITH A “GREEN” METHOD FOR REMOVING BIOFILMS OR PREVENTING THEM WILL BE HELPFUL FOR MANY ASPECTS HERE ON EARTH

CHALLENGE (CHOOSE ONE)

1. REMOVE OR DISINTEGRATE BIOFILMS CREATED

- WITHOUT USING BIO -HAZARDOUS MATERIALS, CREATE A SOLUTION FOR REMOVING OR DISINTEGRATING A BIOFILM
  - BIOHAZARDOUS –
    - CHLORINE
    - ALCOHOL

2. CREATE A PREVENTATIVE SOLUTION

- PREVENTING BIOFILM GROWTH BY NOT ALLOWING THE BACTERIUM (OR OTHER SOURCE) TO PROLIFERATE AND PRODUCE A BIOFILM.

PROJECT GOALS
FOR GETTING RID OF OR DISINTEGRATING BIOFILMS

STEP 1: RESEARCH

- UNDERSTAND THE MECHANICS OF BIOFILMS. WHAT MAKES UP A BIOFILM? HOW DO YOU KNOW IF WHAT YOU COLLECT IS A BIOFILM?
- RESEARCH POTENTIAL "GREEN" SOLUTIONS THAT WOULD DISINTEGRATE OR GET RID OF A BIOFILM.
- MAKE A PLAN OF A FEW DIFFERENT POTENTIAL SOLUTIONS.

TESTING SOLUTIONS

- AFTER RESEARCHING POTENTIAL "GREEN" SOLUTIONS TO BIOFILM REMOVAL OR DISINTEGRATION.
- COLLECT A BIOFILM IN YOUR HOME OR LOCAL WATER SOURCE. (DO NOT JUST COLLECT SAMPLES OF WATER- WATER MAY HAVE BIOFILMS IN IT BUT LOOK FOR SOMETHING THAT WOULD HAVE DEFINITE CHARACTERISTICS OF A BIOFILM.). TALK WITH BIOLOGY TEACHERS ABOUT STREAKING PETRI DISHES WITH YOUR BIOFILM. MAKE SURE YOU KNOW HOW TO STORE YOUR BIOFILM AS YOU ARE PERFORMING YOUR TESTS.
- TRY YOUR SOLUTION ON THE BIOFILM
  - PROPOSE A SCIENTIFIC RESEARCH SOLUTION
  - CREATE YOUR HYPOTHESIS
  - DOES IT REMOVE THE BIOFILM? WHAT HAPPENS AFTER SO MUCH TIME HAS ELAPSED?
  - DOES ADDING SILVER HELP THE SOLUTION TO LAST LONGER?

PROJECT GOALS
PREVENTION OF BIOFILMS

RESEARCH:

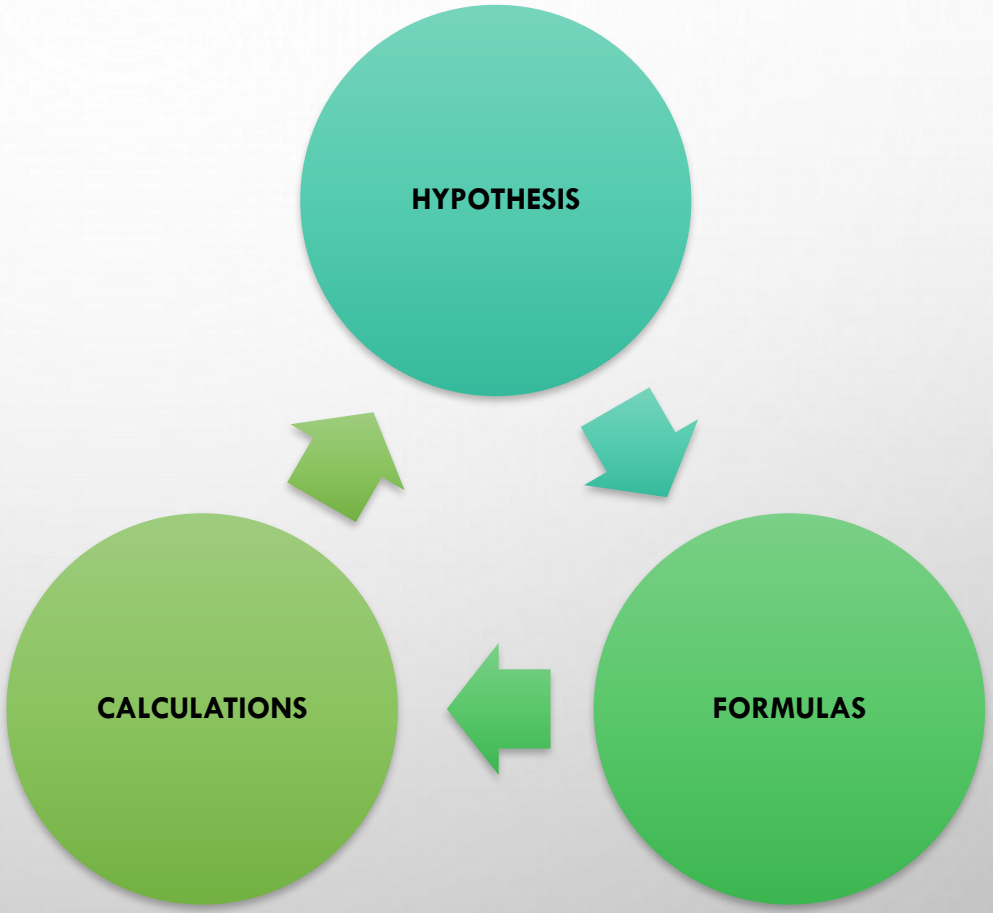
- IF YOU CHOSE THIS DIRECTION IN THE PROJECT YOU ARE LOOKING TO FIND PREVENTION OF BIOFILM GROWTH.
- USUALLY THIS WOULD BE BASED ON THE MATERIAL OF THE PIPE OR TUBE FOR THE WATER SYSTEM.
- RESEARCH DIFFERENT MATERIALS THAT MAY HELP KEEP BIOFILM ATTACHMENT FROM HAPPENING.
- YOU MAY ALSO NEED TO LOOK AT THE SMOOTHNESS OR ROUGHNESS OF A MATERIAL
- YOU MAY NEED SEVERAL MATERIALS TO OBTAIN YOUR GOAL.

- **TESTING:**
- DETERMINE YOUR PLAN FOR TESTING MATERIALS THAT WOULD PREVENT THE ATTACHMENT OF THE BIOFILM
- COLLECT A BIOFILM IN YOUR LOCAL AREA (ASK YOUR BIOLOGY TEACHER HOW TO STREAK PETRI DISHES TO COLLECT YOUR BIOFILM). UNDERSTAND HOW TO STORE YOUR BIOFILM.
- USING YOUR MATERIAL PLAN, TEST YOUR SOLUTION USING YOUR BIOFILM
- IF YOUR TESTING DOESN'T WORK OUT AS PLANNED TRY ANOTHER POTENTIAL SOLUTION.

COLLECTING DATA

- REMEMBER THAT COLLECTION OF DATA IS CRITICAL IN ANY SCIENTIFIC EXPERIMENT
  - THIS MEANS PHYSICAL DATA, VIDEOS, PICTURES
  - YOU NEED TO HAVE QUANTITATIVE AND QUALITATIVE DATA
  - YOU NEED TO TELL THE STORY FROM HYPOTHESIS, TESTING , TO CONCLUSION.

SUCCESSFUL TESTING



CREATING ORIGINAL TESTING METHODS

CAN YOU CREATE A METHOD TO TEST FOR CERTAIN CONTAMINANTS IN YOUR WATER SOURCE?

CAN YOU CREATE A METHOD TO TEST IF A WATER SOURCE WILL PRODUCE BIOFILMS OVER TIME?