**CLEAN WATER CHALLENGE:**

**Teacher’s Instructions**

Provide a variety of the filtration materials from the list below for the teams to choose from, feel free to add to the suggested list.

**NOTE:** **All plastic bottles MUST be the same size and shape to keep the competition fair.**

• Clear 2-liter or 1.5-liter plastic bottles (one per team)

• Scissors

• 1 Clear graduated 250-ml beakers and 1 plastic cup (one per team)

• Sharpie or marker to mark 150ml line (on plastic cup)

• Screening materials: wire mesh screen, nylon stockings, cheesecloth,

 coffee filter, paper towels or cotton balls etc.

• Rubber bands to attach screen to bottle

• Filtration Materials: soil, sand, gravel, marbles, potting soil, clay, cotton

 balls, woodchips, mulch, sawdust, packing peanuts, crushed charcoal

 bricks, coffee filters, shredded newspaper—be creative on materials

 provided, but be sure to **include sand, gravel and crushed charcoal in**

 **the selection.**

**NOTE: The teams will design their filters without knowing exactly what materials are in the Polluted sample provided, so do not reveal this until after the students have passed in their design sketches/diagrams.**

• 4-liters of “Polluted” Tap Water -- can use coffee grounds, tea, soil,

 sand, vegetation, bits of Styrofoam or plastic, food colouring, dish

 liquid, vegetable oil, etc. Be creative, but make sure that polluted liquid

 includes suspended particles, and is not clear. REMEMBER the more

 disgusting the mix the better! Make enough so each team tests 250ml of the

 same polluted water sample. Make a list of the “contaminants” used.

**CLEAN WATER DESIGN CHALLENGE:**

**Student Instructions**

Your group will design, evaluate, build, test and refine a water filtration system that can filter at least 150ml of dirty water within 15 minutes.

The filter system will be built using a plastic bottle like the one shown as an example. The bottle is cut in half, resulting in a funnel shaped top half with a cap and a cylindrical base that will collect the filtered water. As a group you will decide on which materials to test/use in your filter design.

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**NOTE: You will not know what is in the polluted water until after your system is constructed. Your filtration system may have to filter out both large and small particles from the dirty water, so think about this when choosing your filter materials. Water purity is considered the most important result and is given more points in the competition. However, if 150ml of water does not pass through your filter system in 15 minutes, your team is disqualified and will not earn any points for water purity**. **Think about this when choosing your materials and the order in which they are placed, when designing your filtration system.**

* Look at the competition scoring system as you design. Each team will receive points based both on the purity of the water that passes through their filter, as well as how quickly 150 ml is filtered through their system.
* As a group, brainstorm on the materials you should use, what they will do and why. Decide on the **3** (no more) filtration materials from the list you wish to test, and write them down.
* Decide on the order of placing each material to maximize filtration, and make a sketch or diagram of your team design.
* Pass your team’s design to the SMILE leader.
* Each group will talk briefly about their filter design and explain why they chose particular materials and layers, and why their filter will be the best.

**EVALUATE**

* After listening to each groups explanation of their filter design, predict which team will score highest on water purity, and which team will score highest on speed of filtration (how quickly 150 ml of dirty water flows through the system) **NOTE:** they might be different designs
* Write down your predictions on your worksheets.

**BUILD**

* Carefully cut the bottle in half so you have a funnel shaped top half with a cap and a cylindrical base to collect the filtered water.
* Remove the cap from the bottle and choose **1** type of screen to place over the opening to stop the filtering materials from falling out. Use a rubber band if necessary to attach the screen to the neck/opening of the bottle.
* Measure and pour 150ml of clean water into the collection chamber (base of bottle). Mark a line on the outside of the bottle with a Sharpie to show the level of 150ml of water. **Empty container of all water.**
* Place filtration system (funnel) into the collection chamber. The filter unit should be suspended above the base, and not be submerged at any time by water being filtered. If the funnel is too low in the base it will not filter properly. Adjust the funnel with tape if necessary to raise it well above the 150ml line.
* Build filtration system to your team’s design. Each of the three layers should be approximately 2 inches thick.

**TEST**

* Get a 250 ml sample of the polluted water from your teacher.
* Record the types of pollutants in the sample on the competition sheet. (Your teacher will tell you what the contaminants are).

**NOTE: BEFORE POURING THE POLLUTED SAMPLE INTO YOUR TEAM’S FILTER:**

* Have 2 or more team members act as time keepers.
* Record start time and SLOWLY pour polluted sample into your filter.
* Record how long it takes to produce 150ml of filtered water on worksheet.
* Observe how water flows through the system and record which layer it seemed to flow through quickest and where it went more slowly.
* Once you have collected 150 ml of water, remove the sample for evaluation. Put the funnel over an empty plastic cup to collect any remaining liquid.
* Compare your sample to the polluted sample and then follow instructions on the worksheet and answer the questions.

IF TIME ALLOWS, POUR YOUR TEAM’S FILTERED WATER SAMPLE THROUGH

YOUR FILTER AGAIN AND SEE IF IT IMPROVES THE CLARITY OF THE WATER.

CLEAN WATER WORKSHEET

TEAM NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* PREDICT which team will have the cleanest/purest water

TEAM: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_­­­\_\_

* PREDICT which team will have the fastest filtering time TEAM:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**NOTE: Your teacher will identify the pollutants in the mystery sample**

 **to be filtered. Each contaminant that your filter removes**

 **is worth 2 points.**

LIST ALLTHE CONTAMINANTS IN THE POLLUTED WATER SAMPLE:

1. 6.

2. 7.

3. 8.

4. 9.

5. 10.

CLEAN WATER WORKSHEET

TEAM NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| --- |
| WATER CLARITY/PURITY: TEST 1: VISUAL TEST |
| **OBSERVE & COMPARE FILTERED SAMPLE TO POLLUTED SAMPLE****CIRCLE ONE ONLY** | **WATER CLOUDY/****DARK** | **SOME PARTICLES VISIBLE** | **A FEW PARTICLES VISIBLE** | **CLEAR-** **NO PARTICLES****VISIBLE** | TOTAL POINTSTEST 1 |
| 0 pt | 1 pt | 2 pt | 3 pt |  |
| SOAP OR OIL CONTAMINANTS: TEST 2: SHAKE TEST |
| **GENTLY SHAKE SAMPLE & COMPARE TO POLLUTED SAMPLE****CIRCLE ONE ONLY** | **MANY BUBBLES/ OIL VISIBLE** | **SOME BUBBLES/ OIL VISIBLE** | **A FEW BUBBLES/ OIL VISIBLE** | **NO BUBBLES/OIL VISIBLE** | TOTAL POINTSTEST 2 |
| 0 pt | 1 pt | 2 pt | 3 pt |  |

|  |
| --- |
| FLOW RATE TO COLLECT 150ML OF LIQUID: TEST 3: TIME TEST |
| 0-60SECS  | 61-120 SECS | 121-180 SECS | 181-240 SECS | 241-899SECS | 900 +SECS | TOTAL POINTS TEST 3 |
| 4 pt | 3 pt | 2 pt | 1 pt | ½ pt | **DISQUALIFIED** |  |

 RECORD YOUR TIME HERE:\_\_\_\_\_\_\_SECS TOTAL PTS: \_\_\_\_\_\_\_

TEAM NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Which pollutants did your filter remove? (**Score 2 pts for each)**
2. Which pollutants did your filter allow to pass through the system?
3. Did the order of the filtration layers make a difference? Why?
4. Did the type of screen material used make a difference to filtration? Why?
5. Did the type of screen material used make a difference to flow rate? Why?
6. What would you change in your system to remove **all** the pollutants from your sample?
7. What changes could you make to your design to improve the speed of filtration?

 TOTAL PTS:\_\_\_\_\_\_\_\_\_\_

SCORING:

BONUS POINTS:

* 4 pts for predicting the team that produced the cleanest water.
* 4 pts for predicting the team that filtered 150ml fluid the fastest.

**TOTAL ALL** points from tests 1-3 and add points for each contaminant filtered out plus any bonus points. In the event of a tie, the team with the fastest filtration time is the winner!

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| --- |
| GRAND TOTAL |
|   PTS  |

Material adapted from activity created by:

Dennis Ruez Jr., Environmental Science Institute, University of Texas at Austin