Making Our Water Work

Grade 5 Matter
Problem-Based Learning Unit

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Unit Overview

Topic

Matter

Goals/Objectives

SOL 5.4

The student will investigate and understand that matter is anything that has mass and takes up space; and occurs as a solid, liquid, or gas. Key concepts include

a) distinguishing properties of each phase of matter;
b) the effect of temperature on the phases of matter;
c) atoms and elements;
d) molecules and compounds; and
e) mixtures including solutions.

Theme

Providing Drinkable Water

Scenario

Due to an increased demand on the local reservoir, Richmond needs to find a new source of water for its citizens. Fortunately, we have a large source of water in the James River running right through our neighborhood. Unfortunately, the water in the river needs to be cleaned up before we can use it.

They city is currently accepting designs for new filters to be developed for local households in order for them to get clean water directly from the river.

Culminating Activity

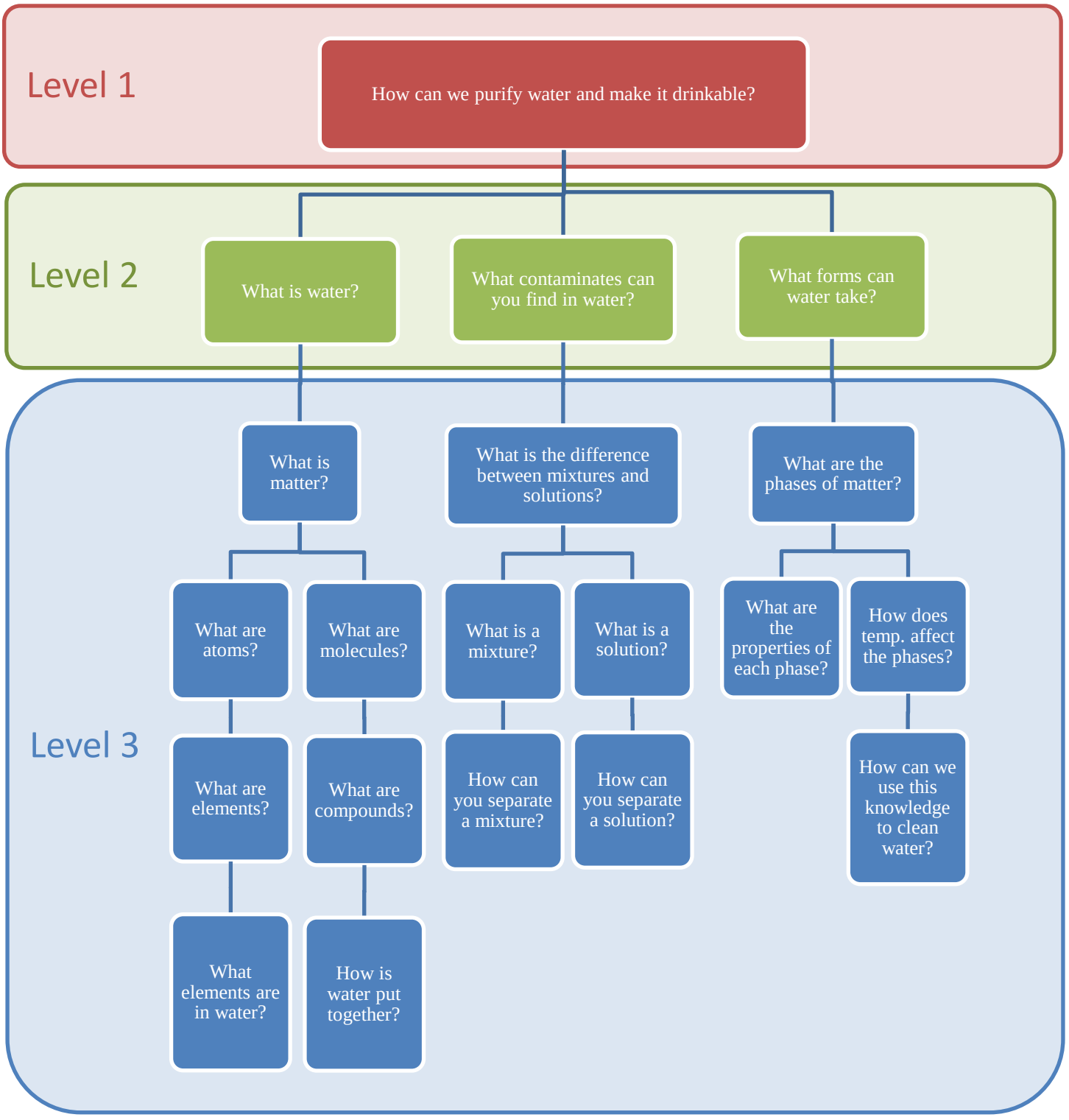
The students will design and present a filter prototype.

Problem Question

How can we purify water and make it drinkable?

Student Role
Water Filter Engineers

Question Map



Lesson Plans

Day 1 – What is Matter?

Level 3 Question(s) Addressed:

- What is matter?

Date(s) Day 1

Content Standard(s):	**NOS Aspects**
• Standard 1- 5.1 • Standard 2- 5.4	• Tenet 2 – Reliable & Tentative • Tenet 3 – Observation & Inference • Tenet 4 – Logic & Imagination • Tenet 7 – Social Activity

Student Objective(s) for this lesson:

1. Objective 1 – Know what matter is
2. Objective 2 – know that matter is everywhere
3. Objective 3 – Know that water is a form of matter.

Misconceptions to address in this lesson:

A. Misconception 1 – Water is not the same matter when it freezes, evaporates, or liquefies.
B. Misconception 2 –Matter is only something you can see and hold.
C. Misconception 3 – Water does not disappear when it evaporates.

Safety Concerns in this lesson:

- Safety 1 – Watching students around hot plate

Activities

#1	Intro to matter/water
Time	Approximate time to complete this activity 20 min.
Materials	• Material 1 – Sticky notes • Material 2 - Markers

Guiding Questions

A. Question 1 – What is water.
B. Question 2 – What is matter.

Plan

- Plans for part 1 of activity: What do we know
  - Guiding Questions to ask during this part of the activity: *What is matter?*
  - Anticipated Student Responses to guiding questions: Stuff you can see.
- Plans for part 2 of activity: What do we know about water?
  - Guiding Questions to ask during this part of the activity: *What is water?*
  - Anticipated Student Responses to guiding questions: Stuff we drink, use for cleaning, bathing, and it can be liquid, solid, or gas.

Differentiation	• Strategy 1- Visuals/pictures for matter • Strategy 2- Visuals of the types of water and uses
ELL Modification	• Modification 1- Visuals used

	• Modification 2- social interaction
Check for Understanding	How you will assess or check for student understanding throughout this activity. Have students pair and share with a partner their ideas of what matter and water are.

#2	Disappearing Water
Time	20 Minutes
Materials	• Material 1- 3 Plastic plates or lids of the same size • Material 2- 3 Sponges • Material 3- Water • Material 4- Triple Beam Balance • Material 5-Measuring cup • Material 6-Permanent Magic Marker • Material 7 – Journal • Material 8 - Camera
Guiding Questions	
C. Question 1- What is Evaporation? D. Question 2- What is Mass?	
Plan	
• Plans for part 1 of activity o Guiding Questions to ask during this part of the activity: What is mass? o Anticipated Student Responses to guiding questions: Weight…..Misconception to be cleared up! o Students are to put a sponge in each of 3 plastic bins or lids of the same kind. o Label each container with 1, 2, or 3. o After pouring 250ml of water on each sponge, measure the mass of the container using a triple beam balance. (Make sure to balance the scales before measurement.) o Place one container in a closet, one container in a window sill, and the third container on a counter in the room. o Students will photograph their sponge and record initial observations in their journals. • Plans for part 2 of activity……**24 hrs. later** • After balancing the triple beam balance, measure the mass of each of the containers again. • Students will again photograph and record their observations. • Plot the change over the 24 hrs. on a line graph using different colors. o Guiding Questions to ask during this part of the activity: What happened to the water? Where did it go? o Anticipated Student Responses to guiding questions: The water went into the air. o Analyze the graph and discuss the changes in the mass of each container. o Be sure to discuss that the water did not disappear, that it evaporated and this caused the water to go into a gaseous state.	
	• Strategy 1- Practice and discussion on using the triple beam balance • Strategy 2- Powerpoint on evaporation for further discussion
ELL Modification	• Modification 1- Powerpoint on evaporation for further discussion • Modification 2- social interaction
Check for Understanding	How you will assess or check for student understanding throughout this activity. Students will journal about the activity and what is happening.

#3	Is it still matter?
Time	10 Minutes
Materials	• Material 1- Hot Plate • Material 2- Coffee Filters……MUST be white and 10-12 cup size • Material 3- Food Coloring • Material 4- Water
Guiding Questions	
E. Question 1- Is liquid water still water when evaporation occurs? F. Question 2- Is evaporated water still matter?	
Plan	
• Plans for part 1 of activity o Guiding Questions to ask during this part of the activity: Is liquid water still water when evaporation occurs? Is evaporated water still matter? o Anticipated Student Responses to guiding questions: No, because it disappears. o Put 250 ml into a pot and color the water blue. Turn on the hotplate and let the water boil. Having the coffee filter over the pot will pick up the color from the water as it evaporates into the air. • Plans for part 2 of activity o Guiding Questions to ask during this part of the activity: Is liquid water still water when evaporation occurs? Is evaporated water still matter? o Anticipated Student Responses to guiding questions: Yes, it is still water just in a gaseous form. It is still matter, just in the air. o Discuss that boiling the water changed its state but did not change the matter itself. The blue on the coffee filter proves that the water went through the filter as it was entering the gaseous state.	
Differentiation	• Strategy 1- Peer discussion • Strategy 2- Visual of coffee filter with color
ELL Modification	• Modification 1- Visual of coffee filter with color • Modification 2- social interaction
Check for Understanding	How you will assess or check for student understanding throughout this activity. Students will journal about the activity and what is happening.

Day 2 – What Are Atoms and Elements?

Level 3 Question(s) Addressed:

- What are atoms and elements? Which elements are in water?

Date(s)

Content Standard(s):	**NOS Aspects**
• 5.4c – atoms and elements	• Tenet 1 – The natural world is understandable. • Tenet 2 – Science uses a blend of logic and imagination. • Tenet 3 – Scientific knowledge is the product of observation and inference.

Student Objective(s) for this lesson:

4. Objective 1 – Understand atoms and elements.
5. Objective 2 – Be able to identify an atom by its composition.
6. Objective 3 – Know which elements are in water.

Misconceptions to address in this lesson:

D. Misconception 1 – Things are made up of only what we see.

Safety Concerns in this lesson:

- Safety 1 – Dropping and breaking plastic "electron clouds"

Activities

#1	Follow up on phase change activity.
Time	40 mins
Materials	• Material 1 – journals • Material 2 – pencils • Material 3 – Atom Building Kit • Material 4 – Class set of periodic tables

Guiding Questions

G. Question 1 - How has the water in the phase change activities changed?
H. Question 2 - What caused those changes and how is heat related?

Plan

- **Plans for part 1 of activity:**
  - Students will be shown a picture of a structure made of building blocks and will relate that to atoms.
  - Students will be shown a diagram of an atom and learn the parts.
  - The students will be each given a pre-made atom and will be asked to disassemble it, count all of the parts, sketch it in their journals, and label all of the parts.
  - **Guiding Questions to ask during this part of the activity:**
    - *What is a building block?*
    - *How many neutrons, electrons, and protons are there?*

- **Anticipated Student Responses to guiding questions:**
  - *Its what structures are made out of.*
  - *Variuous responses*
- **Plans for part 2 of activity:**
- The students will then share their atoms and discus why they had different numbers of parts.
- The students will be introduced to the periodic table and be told that it organizes all of the different elements based on their composition. The students will then identify their atom.
- Students will be given an element and asked to build an atom for it.
- **Guiding Questions to ask during this part of the activity:**
  - *What do you see on the periodic table?*
  - *What patterns do you see in the periodic table?*
- **Anticipated Student Responses to guiding questions:**
  - *Symbols and numbers*
  - *Increasing numbers and colors*

Differentiation	• Strategy 1 – Manipulatives • Strategy 2 – teacher can assign elements to provide each student with the appropriate level of difficulty
ELL Modification	• Modification 1 – steps for building displayed in 1, 2, 3 order • Modification 2 – visual representations used with instructions
Check for Understanding	The students will be assessed through the data they collect in their journals and building their atom.

#2	Identifying the elements in water
Time	20 mins
Materials	• Material 1 – Atom building kit • Material 2 – journals • Material 3 - pencils

Guiding Questions

I. Question 1 – What elements are in water?

Plan

- **Plans for part 1 of activity**
  - The students will brainstorm all of the different thinks they have heard water called. If no student thinks of H2O, the teacher will guide them to it.
  - The students will be asked what they think it means; where have they seen letters as symbols like that.
  - The students will identify hydrogen and oxygen.
  - The students will work in groups of 3 to make two H models and one O model.
  - They will save these models for the next day.
  - **Guiding Questions to ask during this part of the activity:**
    - *What does H stand for? O?*
    - *How can we model water?*
  - **Anticipated Student Responses to guiding questions:**
    - *Hydrogen, Oxygen*
    - *Build Hydrogen and Oxygen*
- **Plans for part 2 of activity**
  - Students will wrap up by writing facts they learned about atoms and elements on post-its and posting them on a designated spot on the wall
  - **Guiding Questions to ask during this part of the activity:**
    - *What have you learned about atoms and elements?*
  - **Anticipated Student Responses to guiding questions:**
    - *Various responses*

Differentiation	• Strategy 1 - small groups • Strategy 2 - manipulatives
ELL Modification	• Modification 1- steps for building displayed in 1, 2, 3 order • Modification 2 – visual representations used with instructions
Check for Understanding	The students will be assessed based on their models and the facts the write on the post-its.

Day 3 – What Are Molecules and Compounds?

Level 3 Question(s) Addressed:

- Water…molecule/compound?

Content Standard(s):	**NOS Aspects**
• Standard 1- 5.1 • Standard 2- 5.4	• Tenet 2 – Reliable & Tentative • Tenet 3 – Observation & Inference • Tenet 4 – Logic & Imagination • Tenet 7 – Social Activity

Student Objective(s) for this lesson:

7. Objective 1 – All matter is made of atoms, which may combine to form molecules.
8. Objective 2 – Compounds are composed of two or more separate elements.

Misconceptions to address in this lesson:

E. Misconception 1 – Atoms and molecules are the same.

Safety Concerns in this lesson:

- Safety 1 – none

Activities

#1	What is a molecule?
Time	Approximate time to complete this activity 15 min.
Materials	• http://www.sciencekids.co.nz/videos/chemistry/molecules.html

Guiding Questions

J. Question 1 – What is a molecule?
K. Question 2 – How are molecules formed?

Plan

- Plans for part 1 of activity: Video from Science Kids
  - Guiding Questions to ask during this part of the activity: *What is a molecule? How are molecules formed?*
  - Anticipated Student Responses to guiding questions: Pieces of matter that stick together.

Differentiation	• Strategy 1- Visuals
ELL Modification	• Modification 1- Visuals used • Modification 2- social interaction
Check for Understanding	How you will assess or check for student understanding throughout this activity. Have students pair and share with a partner their ideas of a molecule is and how they are formed.

#2	Molecules and Compounds
Time	30 Minutes
Materials	• Copies of water molecules • Copies of salt compounds
Guiding Questions	
L. Question 1- What are water molecules and salt compounds made of?	
Plan	
	• Plans for part 1 of activity o Guiding Questions to ask during this part of the activity: What is a water molecule made of? o Anticipated Student Responses to guiding questions: Varied o Students will take the water molecule and dissect it to show all of the parts. Students will then glue all of the parts of the molecule into the science journal and label them. o Students will photo journal a picture of an actual salt compound in the journal. • Plans for part 2 of activity o Guiding Questions to ask during this part of the activity: What is a salt compound made of? o Anticipated Student Responses to guiding questions: Varied o Students will take the salt compound and dissect it to show all of the parts. Students will then glue all of the parts of the compound into the science journal and label them. o Students will photo journal a picture of an actual salt compound in the journal.
Differentiation	• Strategy 1- Visuals
ELL Modification	• Modification 1- Visuals used • Modification 2- social interaction
Check for Understanding	How you will assess or check for student understanding throughout this activity. Have students pair and share with a partner their ideas of a water molecule and a salt compound and how they are each formed.

#3	Making Molecules and Compounds
Time	30 Minutes
Materials	• http://www.flinnsci.com/store/Scripts/prodView.asp?idproduct=16346 Molecular Model Kits (Chips of different colors that can be marked for elements) • http://www.3dmoleculardesigns.com/news2.php Water Molecular Model kit that each group of students can make water molecules and also each kit allows for several other compounds. o Each Water Kit© cup includes pieces for 12 water molecules, 1 sodium, 1 chloride, 1 ethane, and 1 hydroxyl group. All atoms are magnetized to reflect their positive or negative charges (except for non-polar ethane). Your students can make ice, dissolve salt, evaporate water, explore transpiration, create ethanol, and much, much more! CD with lesson plans and activities included in each kit. Molecules are packaged unassembled. Meets National Science Education Standards. Project Lead the Way® selected the Water Kit© for its BioMedical Sciences™ Program.
Guiding Questions	
M. Question 1- What are water molecules and salt compounds made of and how are they put together?	
Plan	
	• Plans for part 1 of activity o Guiding Questions to ask during this part of the activity: Review of what a water molecule is made of? o Anticipated Student Responses to guiding questions: Varied o Students will in groups construct a water molecule and discuss how they are held together. o Students will photo journal a picture of a water molecule in the journal. • Plans for part 2 of activity o Guiding Questions to ask during this part of the activity: Review of what a salt compound made of? o Anticipated Student Responses to guiding questions: Varied o Students will watch under the Elmo to see the other compounds constructed and discuss. o Students will photo journal a picture of compounds in the journal with and explanation of what they are each made of.
Differentiation	• Strategy 1- Visuals
ELL Modification	• Modification 1- Visuals used • Modification 2- social interaction
Check for Understanding	How you will assess or check for student understanding throughout this activity.

	Have students pair and share with a partner their ideas of a water molecule and a salt compound and how they are each formed.

Day 4 – What Contaminants Can You Find in Water?

Level 3 Question(s) Addressed:

- What contaminants can you find in water?

Content Standard(s):	**NOS Aspects**
• Standard 1- 5.1 • Standard 2- 5.4 • Standards 3-5- 4.1, 4.5, 4.9	• Tenet 2 – Reliable & Tentative • Tenet 3 – Observation & Inference • Tenet 4 – Logic & Imagination • Tenet 7 – Social Activity

Student Objective(s) for this lesson:

9. Objective 1 – Identify sources of water pollution.
10. Objective 2 – Describe types of natural and man-made methods of filtration
11. Objective 3 – Investigate, predict and determine the most effective materials for constructing a filter.

Misconceptions to address in this lesson:

F. Misconception 1 – Trees and sediment are not pollutants.
G. Misconception 2 –Pollution is only liter and run-off from factories.

Safety Concerns in this lesson:

- Safety 1 –

Activities

#1	What things are pollution?
Time	Approximate time to complete this activity 15 min.
Materials	• Who Polluted the Water Power Point • Teach Populations' "Who Polluted the River?" Story • Large clear bowl • Toy fish • Polluter cards • Container labeled "Trees" containing crumbled leaves • Container labeled "Building Site" containing dry soil • Container labeled "Farmer" containing baking soda • Container labeled "Family Picnic" containing assorted litter • Container labeled "People Fishing" containing pieces of fishing line • Container labeled "Barnyard" containing water colored with food coloring • Container labeled "Factory" containing water colored w/red food coloring • Container labeled "Cars/Drivers" containing vegetable oil • Container labeled "Washing the Car" containing soap • Container labeled " Motorboat" containing vegetable oil • Examples of man-made filters

Guiding Questions

N. Question 1 – What is pollution?
O. Question 2 – How can pollution be filtered?

Plan

- Plans for part 1 of activity: What do we know
  - Guiding Questions to ask during this part of the activity: *Where does pollution come from?*

Anticipated Student Responses to guiding questions: Litter and factories

Procedures

1. Ask students to brainstorm local sources of water. Encourage students to think about where these water sources start. Discuss how these sources are connected and form watersheds.
2. Ask students if they know where pollution comes from. Come up with a list of possible pollution sources. Tell students you are going to share a story with them about sources of pollution and they will need to figure out who is responsible for the pollution.
3. Pass out polluter cards to students. Explain they will be helping to act out the story. When their card is read in the story, they will come up to do something to the river. Have a bowl of water in the front of the classroom as well as the matching containers. Present Teaching Populations' "Who Polluted the River" story. When the students come up to the river, have them put a spoonful of the pollution. Throughout the story ask students what they think about the quality of the water. Would it be safe for you to drink the water? Is the water safe to swim in? Is it safe for animals? Once the story is finished, ask students to identify the sources of pollution. Ask, "Who is responsible for the pollution?" Students should come up with everyone is responsible for the pollution. How do we clean it up?
4. Use power point to discuss natural filters like wetlands and filter feeding animals. Also to discuss how humans use different types of filters to clean the water. Who Polluted the Water PowerPoint

- Plans for part 2 of activity:
  - Guiding Questions to ask during this part of the activity: *What are the best materials to filter pollution from water?*
  - Anticipated Student Responses to guiding questions: Nets and rocks

Activity: Build a Filter

1. Tell students they will now have the chance to clean up the river. Put students into groups of two. Explain that they will have their choice of two materials to make their filters. Each group will get a cup of polluted water filled to the blue line; an empty cup; and a cup with holes in the bottom. Review the materials with students. Students will design a filter using the materials given. Students will predict which materials will work best and why.
2. Before students use their filter they will need to make observations about their water. They will also need to weigh their filter to the nearest hundredth. Students will hold the cup with the holes over the empty cup and pour the polluted water into the filter. Emphasize that the purpose of this filter is to allow the water to flow through the filter, cleaning out/trapping the pollution. We are trying to retrieve all of the water we started with (marked with the blue line) but there will be no pressing out of water from the filter because that involves a mechanical component to the filter and that is not what we were testing in this experiment. Also have students consider if the material chosen holds the water, then is it really filtering the water? Students should aim for less than 10 grams, finishing weight, to be considered a good filter.
3. After the water has been filtered have students make observations about the filtered water and then weigh their filter. Students will calculate the difference between the before and after weight to determine how much pollution was removed.
4. Discussion about what materials worked best should be done after results are recorded. Students should be reminded of the overall goal at the end of the unit and the product that will be produced.

Differentiation	• Strategy 1- Visuals • Strategy 2- Visuals of the types of pollution
ELL Modification	• Modification 1- Visuals used • Modification 2- social interaction

Check for Understanding	How you will assess or check for student understanding throughout this activity. Have students pair and share with a partner their ideas of what matter and water are. Students will also journal about the things they used to filter and how they worked for later reference.

Day 5 – What is the Difference between a Mixture and a Solution?

Level 3 Question(s) Addressed:

What is a mixture?
What is a solution?
How can you separate a mixture?
How can you separate a solution?

Date(s) Day 5

Content Standard(s):	**NOS Aspects**
• SOL 5.1 a,h,and i • SOL 5.4 e mixtures and solutions	• Tenet 1 – Understandable • Tenet 2 – Demands evidence • Tenet 5 – Social • Tenet 8 – Observation and Inference

Student Objective(s) for this lesson:

12. Objective 1 – Know what a mixture is.
13. Objective 2 – Know what a solution is.
14. Objective 3 – Know how to separate a mixture.

Misconceptions to address in this lesson:

H. Misconception 1 – Solutions can be separated.
I. Misconception 2 – Mixtures and solutions are the same.
J. Misconception 3 - Everything can be separated.

Safety Concerns in this lesson:

- Safety 1 – Any food
- Safety 2 – Any liquid

Activities

#1	Intro to Mixtures and Solutions
Time	Approximate time to complete this activity 30 min.
Materials	• Material 1 – Trays • Material 2 - Clear plastic cups • Material 3 – Trail Mix • Material 4 – Powdered Drink Mix • Material 5 – Water • Material 6 – Salt • Material 7 – Sugar • Material 8 – Powdered Cocoa • Material 9 – Milk

	• Material 10 - Yogurt with fruit mixed in • Material 11 - Mixed fruit salad • Material 12 - Sand • Material 13 - Marbles • Material 14 – Pepper • Material 15 – Plastic spoons • Material 16 – Recording sheet

Guiding Questions

P. Question 1 –What is a mixture?
Q. Question 2 - What is a solution?
R. Question 3 – How do you separate a mixture?
S. Question 4 – How do you separate a solution?

Plan

- Plans for part 1 of activity:
  Recording Sheet and pencils
  - Guiding Questions to ask during this part of the activity: *Is this a mixture or a solution? How do you know?*
  - Anticipated Student Responses to guiding questions:
- Plans for part 2 of activity – *class discussion of observations*
  - Guiding Questions to ask during this part of the activity: *Which stations were mixtures? Which were solutions? What is the difference between a mixture and a solution?*
  - Anticipated Student Responses to guiding questions:

Differentiation	• Strategy 1 Students will work in groups • Strategy 2 Prepared lab sheets
ELL Modification	• Modification 1 Visuals • Modification 2 Social interaction
Check for Understanding	Class discussion

#2	Exploring Mixtures and Solutions – Part 2
Time	15 minutes
Materials	• Material 1 – Recording Sheet and pencils

Guiding Questions

T. Which stations were mixtures?
U. How do you know?
V. Which stations were solutions?
W. How do you know?
X. Can a mixture be separated?
Y. Can a solution be separated?

Plan

- Plans for part 1 of activity
  - Guiding Questions to ask during this part of the activity: Which stations were mixtures? How do you know? Which stations were solutions? How do you know?
  - Anticipated Student Responses to guiding questions: Students will respond that the mixtures were the stations that had items that could be easily separated. Students will respond that the solutions were the stations that had items that could not be easily separated.
- Plans for part 2 of activity

	o Guiding Questions to ask during this part of the activity: How can a mixture be separated? How can a solution be separated? o Anticipated Student Responses to guiding questions: Students will respond that mixtures can easily be separated. Students will respond that solutions cannot be easily separated.
Differentiation	• Strategy 1 Norms for discourse will be reviewed. • Strategy 2 All students will be encouraged to participate.
ELL Modification	• Modification 1 Visuals • Modification 2 Social interaction
Check for Understanding	Responses to questions about observations. Comments during discussion.

#3	Closing of session
Time	15 minutes
Materials	• Computer • Screen
Guiding Questions	
Z. What is an atom? AA. What is a molecule? BB. How are mixtures and solutions different?	
Plan	
• Plans for part 1 of activity – students will watch and the class will discuss a power point Mixtures_and_Solutions_Mod4[1].pdf-Adobe Reader o Guiding Questions to ask during this part of the activity: questions on power point o Anticipated Student Responses to guiding questions: Appropriate to questions asked. • Plans for part 2 of activity – o Guiding Questions to ask during this part of the activity: go over each question o Anticipated Student Responses to guiding questions: discuss student responses	
Differentiation	• Strategy 1 All students will be encouraged to participate • Strategy 2 Information will be given visually and orally
ELL Modification	• Modification 1 Information will be given visually and orally • Modification 2 Think time will be given before answers are accepted.
Check for Understanding	How you will assess or check for student understanding throughout this activity. Answers to questions on power point

Day 6 – What Are the Phases of Matter?

Level 3 Question(s) Addressed:

- What are the phases of matter?
- What are the properties of the different phases of matter?
- What forms of matter does water take?

Date(s) Day 6

Content Standard(s):	**NOS Aspects**
• Standard 1 SOL 5.4 b • Standard 2 SOL 5.1 h, i, j, k • Standard 3	• Tenet 1 – Understandable • Tenet 3 – Demands Evidence • Tenet 4 – Logic & Imagination • Tenet 6 – Observation & Inference

Student Objective(s) for this lesson:

15. Objective 1 – Know the phases of matter.
16. Objective 2 – Know the properties of matter in each phase.
17. Objective 3 – Know the forms water takes.

Misconceptions to address in this lesson:

K. Misconception 1 – Water disappears when it turns into a gas.

Safety Concerns in this lesson:

- Safety 1 – Use of scissors
- Safety 2 – Ball bearings

Activities

#1	Intro to Phases of Matter
Time	Approximate time to complete this activity 20 min.
Materials	• Material 1 – Scissors • Material 2 - Glue • Material 3 – Illustrations and properties of phases • Material 4 – Paper • Material 5 – Colored Pencils

Guiding Questions

CC. Question 1 –How are the molecules spaced in each phase of matter?
DD. Question 2 - How do molecules move in each phase of matter?

Plan

- Plans for part 1 of activity: RVW ?'s
  Students cut out illustrations of phases of matter, glue onto paper, cut out properties of each phase and glue with appropriate phase to make a foldable for their science notebooks.
  - Guiding Questions to ask during this part of the activity: *How are the molecules spaced in each phase of matter? How do molecules move in each phase of matter?*
  - Anticipated Student Responses to guiding questions: Appropriate for questions asked.
- Plans for part 2 of activity *show online videos for Phases of Matter:*
  - Guiding Questions to ask during this part of the activity: What are the phases of matter? How do molecules move in each phase of matter? What forms does water take?
  - Anticipated Student Responses to guiding questions: Appropriate for questions asked.

Differentiation	• Strategy 1 All students are encouraged to participate. • Strategy 2 Assistance with using scissors.
ELL Modification	• Modification 1 Examples provided • Modification 2 Illustrations used
Check for Understanding	How you will assess or check for student understanding throughout this activity. Student responses to questions.

#2	Making models of phases of matter
Time	25 minutes
Materials	• Material 1 – Plastic petri dishes • Material 2 – Ball bearings • Material 3 – Tape
Guiding Questions	
EE. Question 1 – What are the physical properties of each phase of matter? FF. Question 2 – How do molecules move in each phase of matter?	
Plan	
• Plans for part 1 of activity – show two videos. 1. Properties of Matter w/song (2:56) (www.youtube.com/watch?v+CiyJPhOMF6I and 2. Phases of Matter (Bill Nye) (:38) www.youtube.com/watch?v+PjZ5Mu25X14 o Guiding Questions to ask during this part of the activity: What are the phases of matter? How do molecules move through each phase of matter? o Anticipated Student Responses to guiding questions: Appropriate for questions asked. • Plans for part 2 of activity – Students will make models of each phase of matter. o Guiding Questions to ask during this part of the activity: What are the phases of matter? How do molecules move through each phase of matter? o Anticipated Student Responses to guiding questions: Appropriate for questions asked.	
Differentiation	• Strategy 1 Students will work in groups • Strategy 2 All students will be encouraged to participate
ELL Modification	• Modification 1 Hands on activity • Modification 2 Example given
Check for Understanding	How you will assess or check for student understanding throughout this activity. Their models will be assessed and discussed.

#3	Closing of Session
Time	15 minutes
Materials	• Material 1 – plastic cups • Material 2 – water • Material 3 – salt • Material 4 – magic marker
Guiding Questions	
GG. Question 1 What forms does water take? HH. Question 2 How do molecules move in each phase of matter?	
Plan	
• Plans for part 1 of activity – Students will prepare cups of water and place in room and in freezer for tomorrow's activities. o Guiding Questions to ask during this part of the activity: What are the phases of matter? What forms does water take? o Anticipated Student Responses to guiding questions: Appropriate for questions asked. • Plans for part 2 of activity – These cups of water will be used in tomorrow's lesson. o Guiding Questions to ask during this part of the activity: o Anticipated Student Responses to guiding questions:	
Differentiation	• Strategy 1 – All students will be encouraged to participate.
ELL Modification	• Modification 1 Working with other students. • Modification 2 Example given
Check for Understanding	How you will assess or check for student understanding throughout this activity. Appropriate placement and labeling of cups.

Day 7 – How Does Temperature Affect the Phases of Matter?

Level 3 Question(s) Addressed:

- How does temperature affect the phases of water?

Date(s) Day 7

Content Standard(s):	**NOS Aspects**
• 5.4b - The effect of temperature on the phases of matter	• Tenet 1 – The natural world is understandable • Tenet 2 – Scientific knowledge is the product of observation and inference.

Student Objective(s) for this lesson:

18. Objective 1 – Understand how temperature affects the phases of matter.

Misconceptions to address in this lesson:

L. Misconception 1 – Heat is a form of energy.
M. Misconception 2 – Cold is the absence of heat, not a separate force.
N. Misconception 3 – The difference between evaporation and boiling.

Safety Concerns in this lesson:

- Safety 1 – Spillage of water, creating a slipping hazard.

Activities

#1	Follow up on phase change activity.
Time	Approximate time to complete this activity 25 min.
Materials	• Material 1 – journals • Material 2 – pencils • Material 3 – phase change activity from the previous lesson • Material 4 – scales • Material 5 – camera and photo printer • Material 6 – glue sticks

Guiding Questions

II. Question 1 - How has the water in the phase change activities changed?
JJ. Question 2 - What caused those changes and how is heat related?

Plan

- **Plans for part 1 of activity:**
  - Students will photograph and record visual observations of their phase change activity in their journals.
  - Students will find the mass of their activity and calculate the change from the previous lesson in their journals.
  - Students will record their ideas about what caused the changes observed.
  - **Guiding Questions to ask during this part of the activity:**
    - *What differences do you see?*
    - *What differences can you measure?*
    - *What caused the changes?*
  - **Anticipated Student Responses to guiding questions:**
    - *Phase changes, loss of water*
    - *Mass*
    - *Temperature, various responses*
- **Plans for part 2 of activity:**
  - Students will gather into a discourse circle to share their observations.
  - **Guiding Questions to ask during this part of the activity:**
    - *What caused the changes and why do you think that? What is your evidence?*
    - *How does one group's results compare to another's results?*
    - *What do you mean by temperature? What is heat? What is cold?*

	○ **Anticipated Student Responses to guiding questions:** ▪ *Various responses*
Differentiation	• Strategy 1 – small group work • Strategy 2 – technology used to aid in the collection of observations
ELL Modification	• Modification 1 – steps for collecting observations displayed in 1, 2, 3 order • Modification 2 – visual representations used with instructions
Check for Understanding	The students will be assessed through the observations they collect in their journals and what they share during the discourse circle.

#2	Phase Change Simulations
Time	30 mins
Materials	• Material 1 – laptops and Explore Learning access • Material 2 – journals • Material 3 – pencils • Material 4 – post-its • Material 5 – long ropes or tape marked areas for human simulation
Guiding Questions	
KK. Question 1 – Why does temperature cause phase changes?	
Plan	
• **Plans for part 1 of activity:** ○ Students will explore the Gizmo: *Phases of Water* (http://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=661). ○ Students will sketch the positioning of the molecules in each phase on post-it notes and stick them in their journals. ○ Underneath each post-it, students will record the temperature and their observations of the behavior of the molecules in each phase. ○ The students will be led to label the specific type of phase change between each post-it with directional arrows using the simulation for assistance. ○ Students will share out their observations. ○ **Guiding Questions to ask during this part of the activity:** ▪ *How does the behavior of the molecules change?* ▪ *What does anything need to change its behavior?* ▪ *How is it related to the change in temperature?* ○ **Anticipated Student Responses to guiding questions:** ▪ *They spread out, move greater distances as the temp. increases, in a pattern as a solid* ▪ *Energy* ▪ *Various responses* • **Plans for part 2 of activity:** ○ In their small groups, students will make a human model of the molecular behavior of phase changes. ○ The teacher will call out solid, liquid and gas. To increase difficulty use freezing, melting, condensation, boiling. ○ As an extension, challenge a group to model evaporation.	
Differentiation	• small group work • use of computer simulation and physical simulation
ELL Modification	• Modification 1 – visual cues and labels on simulation • Modification 2 – social interactions • Modification 3 - being a physical piece in a simulation
Check for Understanding	The students will be assessed for understanding through their journal responses and the small group human model.

Day 8 – How Can We Clean Water?

Level 3 Question(s) Addressed:

- How can we use our knowledge of phase changes to clean water?

Date(s) Day 8

Content Standard(s):	**NOS Aspects**
• 5.4b - the effect of temperature on the phases of matter • 5.4e - mixtures including solutions	• Tenet 1 – The natural world is understandable. • Tenet 2 – Science uses a blend of logic and imagination. • Tenet 3 – Scientific knowledge is the product of observation and inference.

Student Objective(s) for this lesson:

19. Objective 1 – Understand the similarities and differences between mixtures and solutions.
20. Objective 2 – Explore ways to separate solutions.

Misconceptions to address in this lesson:

O. Misconception 1 – A solution is a type of mixture not a compound.
P. Misconception 2 – Solutions can be separated into their original compounds.
Q. Misconception 3 – Dissolving is a not chemical process.

Safety Concerns in this lesson:

- Safety 1 – Spillage of water, creating a slipping hazard.

Activities

#1	Follow up on mixture activity.
Time	20 mins
Materials	• Material 1 - journals • Material 2 - pencils • Material 3 - mixture and solution samples for previous lesson • scales • Material 5 – camera

Guiding Questions

LL. Question 1 - How have the mixtures and solutions changed?
MM. Question 2 - What caused those changes?

Plan

- **Plans for part 1 of activity:**
  - Students will photograph and record observations of the samples in their journal.
  - Students will talk about the thinks that changed and why with their small groups and write predictions in their journals.
  - Students will share predictions with the whole group.
  - **Guiding Questions to ask during this part of the activity:**
    - *What has changed and why?*
  - **Anticipated Student Responses to guiding questions:**
    - *Various Responses*

Differentiation	• Strategy 1 – small group work • Strategy 2 – technology used to aid in the collection of observations
ELL Modification	• Modification 1 – steps for collecting observations displayed in 1, 2, 3 order • Modification 2 – visual representations used with instructions

Check for Understanding	The students will be assessed through the data they collect in their journals and what they share with the class.

#2	Separating Solutions
Time	40 minutes
Materials	• Material 1 – solutions (lemonade) • Material 2 – various containers • Material 3 – various plastic (bags, plastic wrap, etc.) • Material 4 – heat source
Guiding Questions	
NN. Question 1 – How can you separate water from lemonade? OO. Question 2 – How can collect the water?	
Plan	
• **Plans for part 1 of activity:** o The students will design their own experiments to separate the water from lemonade. o Students will write the experiment in their journals. o The students will build the experiment and the teacher will use the heat source to test. o Students will record results in their journals. o **Guiding Questions to ask during this part of the activity:** ▪ *Where does the water vapor go?* o **Anticipated Student Responses to guiding questions:** ▪ *Up into the air.* • **Plans for part 2 of activity** o The students will share their experiment and results with the class. o **Guiding Questions to ask during this part of the activity:** ▪ *How effective was your design?* ▪ *What areas are there for improvement?* o **Anticipated Student Responses to guiding questions:** ▪ *Various responses*	
Differentiation	• Strategy 1 – small group work • Strategy 2 – technology used to aid in the collection of observations
ELL Modification	• Modification 1 – steps for collecting observations displayed in 1, 2, 3 order • Modification 2 – visual representations used with instructions
Check for Understanding	The students will be assessed through the data they collect in their journals and what they share with the class.

Day 9 – How Can You Build an Environmentally Friendly Filter?

Level 3 Question(s) Addressed:

- How can you build an environmentally friendly filter?

Date(s) Day 9

Content Standard(s):	**NOS Aspects**
• 5.4b - the effect of temperature on the phases of matter • 5.4e - mixtures including solutions	• Tenet 1 – Scientists use many methods to develop scientific knowledge. • Tenet 2 – Science uses a blend of logic and imagination. • Tenet 3 – Science is a social activity.

Student Objective(s) for this lesson:

21. Objective 1 – Understand the similarities and differences between mixtures and solutions

Misconceptions to address in this lesson:

R. Misconception 1 – A solution is a type of mixture not a compound.
S. Misconception 2 – Cold is the absence of heat, not a separate force.
T. Misconception 3 – The difference between evaporation and boiling.

Safety Concerns in this lesson:

- Safety 1 – Spillage of water, creating a slipping hazard.

Activities

#1	Follow up on phase change activity.
Time	Approximate time to complete this activity 25 min.
Materials	• Material 1 - journals • Material 2 - pencils • Material 3 - camera • Material 4 - scales • Material 5 – design brief • Material 6 – all materials listed in design brief (sand, paper, screens, rocks, straws, coffee filters) • Material 7 – funnels • Material 8 – various containers

Guiding Questions

PP. Question 1 – How can you build an environmentally friendly filter to clean water?

Plan

- **Plans for part 1 of activity:**
  - Students will design and build a filter to clean water.
  - Students will use their design brief to guide them.
  - The students will consider the environmental ramifications for their designs (does it require outside energy? Is it reusable? Etc.).
  - **Guiding Questions to ask during this part of the activity:**
    - *Is it effective?*
    - *How do you know?*
  - **Anticipated Student Responses to guiding questions:**
    - *Various responses*

Differentiation	• Strategy 1 – small group work • Strategy 2 – technology used to aid in the collection of observations
ELL Modification	• Modification 1 – steps for collecting observations displayed in 1, 2, 3 order • Modification 2 – visual representations used with instructions
Check for Understanding	The students will be assessed through the filter they build.

Day 10 – Filter Demonstrations

Level 3 Question(s) Addressed:

- Does our filter work?

Date(s) Day 10

Content Standard(s):	**NOS Aspects**
• Standard 1 – SOL 5.4 a, b, c, d, e • Standard 2 – SOL 5.1 h, i, j, k • Standard 3	• Tenet 2 – Demands Evidence • Tenet 4 – Logic & Imagination • Tenet 5 – Social • Tenet 7 – Observation & Inference

Student Objective(s) for this lesson:

22. Objective 1 – Know how a filter works.
23. Objective 2 – Demonstrate knowledge of mixtures/solutions.
24. Objective 3 – Demonstrate knowledge of phases of matter.
25. Objective 4 – Demonstrate knowledge of pollutant removal from water.

Misconceptions to address in this lesson:

U. Misconception 1 – Our filter does not need any adjustments.
V. Misconception 2 –
W. Misconception 3 -

Safety Concerns in this lesson:

- Safety 1 – Water spills
- Safety 2 –
- Safety 3

Activities

#1	**Complete water filter group projects**
Time	**Approximate time to complete this activity 20 min.**
Materials	• Material 1 – Selected filtering materials • Material 2 - Pollution items • Material 3 – Water • Material 4 – Large buckets

Guiding Questions

QQ. Question 1 – Does our filter work?
RR. Question 2 – Why or why not?
SS. Question 3 – What changes need to be made?

Plan

- Plans for part 1 of activities: Students complete their water filter group projects.
  - Guiding Questions to ask during this part of the activity: *Does our filter work? Why or why not? What changes need to be made?*
  - Anticipated Student Responses to guiding questions: Appropriate for questions asked.
- Plans for part 2 of activity
  - Guiding Questions to ask during this part of the activity:
  - Anticipated Student Responses to guiding questions:

Differentiation	• Strategy 1 Students work in groups • Strategy 2 All students are encouraged to participate
ELL Modification	• Modification 1 Social Interactions • Modification 2 Model for reference
Check for Understanding	How you will assess or check for student understanding throughout this activity. Success of filter.

#2	Presentation of Water Filter Projects to Class
Time	30 minutes
Materials	• Filter project • Group members
Guiding Questions	
TT. Question 1 – Does our filter work? UU. Question 2 – Why or why not? VV. Question 3 – What changes would we make?	
Plan	
• Plans for part 1 of activity – Each group will present its water filter project to the class. o Guiding Questions to ask during this part of the activity: Does our filter work? Why or why not? What changes would we make? o Anticipated Student Responses to guiding questions: Appropriate for questions asked. • Plans for part 2 of activity o Guiding Questions to ask during this part of the activity: o Anticipated Student Responses to guiding questions:	
Differentiation	• Strategy 1 Students work in groups. • Strategy 2 All students are encouraged to participate.
ELL Modification	• Modification 1Social interactions • Modification 2 Examples to follow
Check for Understanding	How you will assess or check for student understanding throughout this activity. Success of filter OR what changes they would make for success.

#3	Discourse Circle
Time	10 minutes
Materials	• Science notebooks
Guiding Questions	
WW. Question 1 What did you learn about removing pollutants from water? XX. Question 2 What positive comments do you have about someone else's project? YY. Question 3 Do you agree/disagree with someone else's statement?	
Plan	
• Plans for part 1 of activity – Norms for discourse circle will be reviewed. Sentence starters will be posted on board. o Guiding Questions to ask during this part of the activity: What did you learn about removing pollutants from water? What positive comments do you have about someone else's project? Do you agree/disagree with someone else's statement? o Anticipated Student Responses to guiding questions: Appropriate for questions asked and for norms in place. • Plans for part 2 of activity o Guiding Questions to ask during this part of the activity: o Anticipated Student Responses to guiding questions:	
Differentiation	• Strategy 1 All students are encouraged to participate. • Strategy 2 Discourse norms will be in place.
ELL Modification	• Modification 1 Social interactions • Modification 2 Journal to reference
Check for Understanding	How you will assess or check for student understanding throughout this activity. Comments made during discourse session.

Water Filter Design Challenge

Background:

In this unit, you will learn all about matter. You will be investigating atoms, molecules, compounds, elements, phases of matter, mixtures, solutions, temperature effects on matter, and removing pollutants from water. As student engineers you will be putting your skills and knowledge to use.

Design Challenge:

Your group will create an environmentally friendly water filter system. The system must remove solid pollutants from water. Group members should be able to describe all the processes used in their system.

Criteria:

Your filter must:

- be able to produce one cup of clean water.
- use at least two filter materials.
- have little to no environmental impact.
- be accompanied by a paragraph explaining how your filter works.

Materials:

Coffee filters	Screens	Assorted materials from recycle bin
Paper	Rocks	
Sand	Straws	

*** Additional materials may be used with teacher approval.**

Tools:

Scissors	Pencils	
Markers		Rulers

Measuring Cups
Tape/Glue

Freezer/Refrigerator
Hot Plate (Teacher Assistance

Water Filter Design Challenge

Engineers: _____ _____

_____ _____ _____

1. What is the challenge?

State the challenge in your own words.

_____

_____

_____

_____

_____

_____

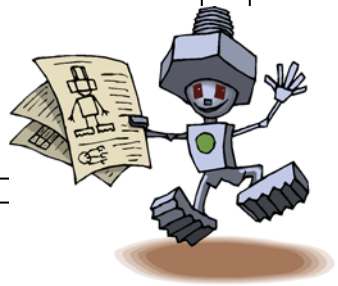
_____

_____

2. **Brainstorm designs**: Sketch or describe some possible designs.

Filter Designs

Ways to Filter



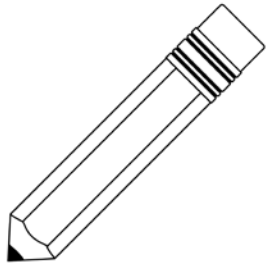
3. **Create the design you think is best.**

Keep notes below about the problems you have and how you solve them.

Resources: (represented by the materials used in your model)

Keep track of all the resources you may need to build your filter. Are these things that most people have available to them? How environmentally friendly are your materials? Would these be the most efficient forms of filtration?

4. What have you learned?



Does your filter meet all the requirements? _____

How long does your filter take to produce 1 cup of clean water? _____

What filtration materials were used in the final filter?

_____

_____

_____

How did you use phase changes in your model?

_____

_____

_____

What is the environmental impact of your filter?

_____

5. Evaluate your design.

Was it the best design? Would one of your other ideas have been better? Why or why not?

6. Reflection.

How do you feel about your role in the project?

Self Reflection:

How do you feel your group worked together?

Group Reflection: