LifeStraw

Level : S3 (Chemistry)

Topic: LifeStraw

Introduction:

The ELA is designed to promote learning through reading. With short reading passages and a video clip in English, the activity presents to students a problem concerning drinking water in developing countries and a task of designing a purifying tool to solve the problem. Through the activity, students learn how to explain the problem in English and some English terminology for methods of water purification and treatment. Although reading is prime focus of the ELA, students are also provided with opportunities to practise writing, speaking and listening.

In this ELA, students are first introduced to the problem of shortage of safe drinking water in developing countries. After a brief revision of the methods of water purification and treatment they are required to design a portable water purifier, named 'LifeStraw', for solving the problem. To design the purifier, students will apply the methods of water purification and treatment that they have learned in S1, at that time through the medium of Chinese. A brief revision using CMI helps students to recall their prior knowledge on water purification; at the same time, relevant English terms are introduced.

This set of ELA materials includes a lesson plan, a set of worksheets and a quiz.

Acknowledgement

This set of materials was produced jointly by the teachers of Christ College and the ELA research team.

ELA Lesson Plan – Life Straw

Description:

The ELA involves the application of knowledge about water purification and treatment, covered in Section 5.1 and 2, Unit 5 of the CDC Science syllabus, that students have learned through the medium of Chinese in S1.

The ELA lasts for two lessons, each 50 minutes. In the first lesson, students learn about the problem of water shortage in developing countries through watching one part of a video clip followed by completing worksheets in English. Then, they discuss in groups possible solutions to the problem. Each group presents one of their suggested solutions to the class. Students are encouraged to discuss and present in English as far as they can. Afterwards, through watching another part of the video clip followed by reading two short passages, students are introduced a novel tool, named LifeStraw, which can instantly make water safe to drink. As a homework assignment, they are required to work in groups to design a LifeStraw by applying the methods of water purification and treatment learned in S1. Before the end of the first lesson, a brief revision of these methods is provided to students, in which students also acquire the English terms relevant to these methods. In the second lesson, students compare and evaluate their designs of LifeStraw through group and class discussions.

The ELA promotes learning through reading English as well as providing opportunities for students to practise writing, listening and speaking. Students are encouraged to express themselves in English as far as they can during discussion and presentation. Those who have difficulty in speaking English should be allowed to supplement their expressions with Chinese and the teacher should provide language support when necessary.

A quiz is designed to assess students' understanding of the ELA content after the lesson. The assessment objectives focus on students' learning outcomes achieved through reading.

Content Objectives:

After completing the activity, students should be able to:

- discuss the problem of shortage of safe drinking water in developing countries.
- compare and evaluate the design of LifeStraw, a portable water purifier.

Language Objectives:

After completing the activity, students should be able to:

- understand and use the English terms related to this topic (e.g., *available, safe drinking water, bacteria, parasites, viruses, portable tool, surface water, sucked up, filter, filtering, coarse, fine, particles, iodine, active carbon, remove, smell, factors to consider, design, LifeStraw, material, light, cost, low, durable, electrical power*);
- comprehend and use the English expressions for discussing the problem of shortage of safe drinking water in developing countries, e.g.,

- *When water is contaminated, it is not safe for drinking.*
- *Contaminated water may have waterborne diseases such as diarrhea.*
- *Safe drinking water is not available to everyone in the world.*
- *People living in developing countries, especially in the rural areas may not have access to safe drinking water.*
- *Surface water unsafe for drinking because it may contain impurities such as sand, mud, micro-organisms, (contaminants: heavy metals, chemicals), etc., which are hazardous to our health.*

- understand and use the English expressions for describing the function, structure, and design of LifeStraw, a portable water purifier, e.g.,
  - *Surface water can be turned into safe drinking water with a tool called LifeStraw*
  - *LifeStraw is a portable tool that can remove insoluble impurities of large sizes and kill micro-organisms.*
  - *LifeStraw could be designed for people living in developing countries to access safe drinking water.*
  - *Water sucked up through the LifeStraw passes through two filters.*
  - *The first one is a coarse filter for filtering out big particles.*
  - *The second one is a fine filter for filtering out smaller particles and some bacteria.*
  - *The water then passes through some iodine to kill bacteria, viruses and parasites.*
  - *Finally, the water passes through some active carbon to remove the smell of iodine and any remaining parasites.*
  - *Hence, after passing through LifeStraw, the water is safe for drinking.*
  - *There are factors to consider in designing LifeStraw for this purpose:*
  - *The materials used in LifeStraw have to be light.*
  - *The cost of LifeStraw has to be low.*
  - *LifeStraw can be used for a long time.*
  - *LifeStraw does not need electrical power.*

Activities:

<u>ELA Lesson 1</u>

- Introduction and Vocabulary Building– whole-class activity (5 min)
- Watching a Video Clip (Part I) – whole-class activity (5 min)
- Group Discussion on Query 1 – group work (10 min)
- Watching a Video Clip (Part II) – whole-class activity (10 min)
- A Brief Revision on Methods of Water Purification and Treatment - whole-class activity (5 min)
- Group Discussion on Query 2 and 3 – group work (15 min)

<u>ELA Lesson 2</u>

1. Group Discussion – group work (10 min)
2. Class Discussion – whole-class activity (25 min)

3. Final Discussion – whole-class activity (15 min)

Materials:

- 1 set of worksheets (WS)
- 1 quiz
- 1 teacher's reference

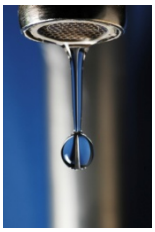
Remark: 1 computer and 1 visualizer, both connected to a projector, are required.

Steps:

ELA Lesson 1

Introduction and Vocabulary Building – whole-class activity (5 min)

1. Display a photo showing a drop of water dropping down from a tap and ask students whether they are worried about running out of safe drinking water. Conduct a simple survey in the class.



Refer to Teacher's note (TN1)

2. Ask some students why they think so.

3. After collecting students' opinions, ask the whole class the follow-up questions below:

   Teacher: Is safe drinking water available to everyone in the world?

   Does everyone in the world have access to safe drinking water?

   Who suffer from the shortage of safe drinking water? People living in developing countries such as India, especially those living in the rural area.

4. Display the following pictures and ask

   Teacher: Do we have plenty of water? Why do we worry? The water is contaminated and not safe for drinking.

Teacher: What will happen to us if we drink the contaminated water? We may have waterborne diseases such as diarrhoea.

Refer to Teacher's note (TN2)

Watching a Video Clip (Part I) – whole-class activity (5 min)

5. Distribute the worksheets (WS).

6. Ask students to read statements (a) to (e) in Section *Why is water so important?* Teachers explain key points where necessary.
7. Play a video clip (session time: 0:00 – 0:48) downloaded from the following link
   http://www.youtube.com/watch?v=SzzCSATFiyM&eurl=http://49677022.blogspot.com/2007/12/alllifestraw.html#
8. Ask students to decide whether statements (a) to (e) are true according to the video clip. Then, check the answers.

Group Discussion on Query 1 – group work (10 min)

9. Ask students to form groups. Tell them that each group will work as a team of engineers to help people in the developing countries obtain safe drinking water.
10. Ask students to discuss in groups the question in Query 1 and write their suggested solutions on the WS.
11. After about 5 minutes, ask each group to report one of their suggested solutions.

Watching a Video Clip (Part II) – whole-class activity (10 min)

Refer to Teacher's note (TN3)

12. Play the video clip (session time: 2:31 – 3:58) used in Step 6.
13. Ask students the following questions:

    Teacher: In the video, a soldier turns surface water into safe drinking water with a tool. What is the tool called? LifeStraw

    Teacher: Why is surface water unsafe for drinking? It contains impurities such as sand, mud, micro-organisms, (contaminants: heavy metals, chemicals), etc., which are hazardous to our health.

    Teacher: What should LifeStraw be able to do to turn surface water into safe drinking water? LifeStraw should be able to remove insoluble impurities of large sizes and kill micro-organisms. (Let students check their answers with those mentioned in the coming session of the video clip.)

    Note that students may not be able to use the same wordings as suggested; any similar wordings should be accepted. The teacher should also give hints to help students answer the questions.
14. Play the video clip (session time: 5:00 – 5:25).
15. Check if students can grasp from the video the following ideas about the functions of LifeStraw.
    - Through a 2-stage particle filtration process, LifeStraw can remove particles from 125 microns down to 6 microns. (According to another reference http://www.vestergaard-frandsen.com/lifestraw-specifications.htm, the smallest size of particles that can be removed is claimed to be 15 microns).
    - LifeStraw could help solve the problem of waterborne diseases. (This implies that LifeStraw can kill some harmful micro-organisms.)

Refer to Teacher's note (TN4)

A Brief Revision on Methods of Water Purification and Treatment - whole-class activity (5 min)

16. Ask students to recall methods used to remove particles and kill micro-organisms in water.

Refer to Teacher's note (TN5)

Group Discussion on Query 2 and 3 – group work (15 min)

17. Ask students to read the passage on p.2 of WS and underline the sentences that describe what LifeStraw is able to do.
18. Ask each group to discuss the questions in Query 2. Prompt students to consider the technical, the practical and the economic factors.

Refer to Teacher's note (TN6)

19. After 5 minutes, move on to Query 3. Let students read the passage on p.3 of WS, which describes in detail how LifeStraw works.
20. Ask each group to design a LifeStraw as a homework assignment. They should draw a labelled diagram to illustrate their design in the space provided. In next lesson, they will compare and evaluate each other's design.

Refer to Teacher's note (TN7a)

Teacher's notes

TN 1: Underlined words are terms students should focus on, which will later be recycled in a video clip. Write them on the board.

TN2: Before moving on to the next activity of watching a video clip, teachers may review the pronunciation of the underlined words with the whole class and check students' understanding of these words if necessary.

TN3: In this activity, students will be watching another part of the video clip used in Step 6. This part which introduces LifeStraw includes two sessions. In the first session (2:31 - 3:58), the video clip shows how LifeStraw is used. A soldier uses LifeStraw to turn surface water into safe drinking water by sucking water through it. Teachers may prompt students to think what LifeStraw should be able to do to make surface water safe for drinking. In the second session (5:00 – 5:25), the functions of LifeStraw are briefly mentioned. It provides a 2-stage particle filtration process removing particles from 125 microns down to 6 microns. Besides, it is claimed that LifeStraw could help solve the problem of waterborne diseases, implying that LifeStraw can kill some harmful bacteria.

TN4: If students have difficulty in grasping the main ideas about the functions of LifeStraw through listening, they could find more supports from reading the passage in the following activity.

TN5: Teachers should require students to specify whether the methods they proposed are used for removing particles or killing micro-organisms. If students provide answers in Chinese, teachers can take the opportunities to introduce the English key terms such as filtration, filter, chlorination, chlorine, etc.

TN6: Some examples of factors to be considered are suggested below.

Types of factor	Examples	Suggested answers
Technical	LifeStraw should be able to remove insoluble impurities and kill micro-organisms. => What methods can be used to purify water?	Filtering for removing insoluble impurities, chlorination for killing micro-organisms, etc.
Practical	LifeStraw is a portable tool. => Should it be light or heavy? How does it affect the selection of materials?	The materials used in making LifeStraw must be light.
Economic	The people who will need LifeStraw most are the poor suffering from waterborne diseases in the developing countries. => What does it mean to the cost of a LifeStraw?	The cost must be low and affordable by the people.

TN7a: Teachers should collect and pre-view students' designs before the next lesson. They should prepare a worksheet on which all students' designs are presented. (Refer to Teacher's Reference for an example) This worksheet will facilitate the discussion in next lesson.

Steps:

ELA Lesson 2

Group Discussion – group work (10 min)

1. Group students as in Lesson 1. Distribute the worksheet showing all students' designs.
2. Let students discuss for about 10 minutes to evaluate and compare the designs shown on the worksheet. Each group should select the best one, and write their choice and the underlying reasons on the worksheet.

Refer to Teacher's note (TN7b)

Class Discussion – whole-class activity (25 min)

3. After 10 minutes, stop the discussion and record the choice of each group on the board.
4. Ask the groups selecting the same design to give reason for their choice. Then, invite other groups to give comments and put forward their own choice with reasons.
5. After one round of discussion, ask students if they will change their mind and make their final decision. Let students have the final poll for the best design.

Refer to Teacher's note (TN8)

6. Let students compare the best design of their class with the one suggested from a website. Ask students to find out the similarity and difference between them.

Refer to Teacher's note (TN9)

Final Discussion – whole-class activity (15 min)

Refer to Teacher's note (TN10)

7. Ask students if there are any limitations to the use of a LifeStraw. Focus students' discussion on the water sources that a LifeStraw may not be able to work on.

   The question posted on the worksheet is open-ended. Students are encouraged to brainstorm any conditions in which LifeStraw may not work on a water source. If necessary, the teacher may narrow down the discussion to the following three kinds of water sources:

   - muddy water
   - sea water
   - water contaminated with heavy metals

Refer to Teacher's note (TN11)

8. Let students discuss in groups for about 5 minutes. Invite some groups to present their ideas in response to the open-ended question or their comments on using LifeStraw to drink the water from the three kinds of water sources.
9. Round up the lesson by stating (or asking student to state) the strengths and weaknesses of LifeStraw in helping people in the developing countries to solve the problem of shortage of safe drinking water.

Teacher's notes

TN7b: Teachers may have to clarify the criteria for selecting the best design, including meeting all the functions described in the passage in Query 3, clear descriptions and practicality.

TN8: In the final poll, the unit of vote can be individual students or groups. However, in latter case, extra time may be needed for group decision-making.

TN9: A suggested design of LifeStraw adapted from the website *HowStuffWorks* (http://express.howstuffworks.com/lifestraw2.htm) is given in Teacher's Reference

TN10: This final discussion aims at helping students to understand that any design has its own limitations. LifeStraw cannot be used on water sources in some conditions. However, it could still be very useful when fresh water not contaminated by heavy metals is available.

TN11: Large particles in muddy water may block the LifeStraw which then requires regular backwashing for cleaning. Dissolved salt and heavy metals cannot be removed from the water by LifeStraw. For more information about the queries on the capability of LifeStraw, teachers may refer to Teacher's Reference or the Question and Answer section under the link **http://lifestrawdefence.com/lifestraw.pdf.**

Worksheets

LifeStraw

Why is clean water so important?

Watch the video carefully and √ all the points listed in the video about the importance of clean water.

a. More than one billion people in the world cannot get safe drinking water - that is 1/6th of the world's population (人口). ❒

b.. Five hundred people in the world die each year from waterborne diseases. ❒

c. A huge proportion of the Indian rural population suffers from diseases caused by contaminated water. ❒

d. The average distance that women in India walk to collect water is 6 km. ❒

e. All across India, rural families get their water only from wells. ❒

Query 1

How can we solve the problem of water shortage, especially in third-world developing countries?

Suggested Solution 1

Suggested Solution 2

Suggested Solution 3

Suggested Solution 4

LifeStraw is the answer to the problem!

About half of the poor in the world suffer from waterborne diseases, and more than 6000 people, mainly children, die each day due to unsafe drinking water. LifeStraw is a portable tool to turn any surface water into drinking water. It is effective against waterborne diseases and removes particles as small as 15 microns*.

*1 micron (微米) = 1/1000 mm

Query 2 What factors will you consider when you make a LifeStraw?

Query 3 Design of a LifeStraw

How it works:

Water sucked up through the LifeStraw passes through two filters to remove big particles. Sometimes bacteria (細菌) are also filtered out. The water then passes through some iodine (碘) to kill bacteria, viruses (過濾性病毒) and parasites (寄生蟲). Finally, the water passes through some active carbon (活性碳) to remove the smell of iodine and any remaining parasites. The water we get is better than tap water in many developed countries.

In the space below, draw a diagram to show the interior (內部) of a LifeStraw. In the diagram, label the substances and materials used in each part, and the water inlet and outlet of LifeStraw.

Query 4 Are there any limitations to the use of a LifeStraw?

Could LifeStraw be used on water sources in any conditions?

LifeStraw

Why is clean water so important?
Watch the video carefully and √ all the points listed in the video about the importance of clean water.

(http://www.youtube.com/watch?v=SzzCSATFiyM&eurl=http://49677022.blogspot.com/2007/12/alllifestraw.html#)

a. More than one billion people in the world cannot get safe drinking water - that is 1/6th of the world's population (人口). ❒✓

b.. Five hundred people in the world die each year from waterborne diseases. ❒✗

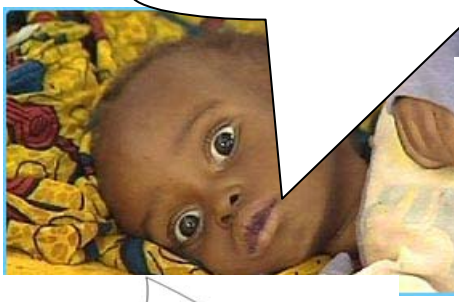
c. A huge proportion of the Indian rural population suffers from diseases caused by contaminated water. ❒✓

d. The average distance that women in India walk to collect water is 6 km. ❒✗

e. All across India, rural families get their water only from wells. ❒✗

Query 1

How can we solve the problem of water shortage, especially in third-world developing countries?



Suggested Solution 1

Suggested Solution 2

Suggested Solution 3

Suggested Solution 4

LifeStraw is the answer to the problem!

About half of the poor in the world suffer from waterborne diseases, and more than 6000 people, mainly children, die each day due to unsafe drinking water. LifeStraw is a portable tool to turn any surface water into drinking water. It is effective against waterborne diseases and removes particles as small as 15 microns*.

*1 micron (微米) = 1/1000 mm

(adapted from *LifeStraw* http://other90.cooperhewitt.org/Design/lifestraw)

Query 2 What factors will you consider when you make a LifeStraw?

Query 3 Design of a Life Straw

How it works:

Water sucked up through the LifeStraw passes through two filters to remove big particles. Sometimes bacteria (細菌) are also filtered out. The water then passes through some iodine (碘) to kill bacteria, viruses (過濾性病毒) and parasites (寄生蟲). Finally, the water passes through some active carbon (活性碳) to remove the smell of iodine and any remaining parasites. The water we get is better than tap water in many developed countries.

(adapted from *Here's how it works* http://express.howstuffworks.com/lifestraw2.htm)

In the space below, draw a diagram to show the interior (內部) of a LifeStraw. In the diagram, label the substances and materials used in each part, and the water inlet and outlet of LifeStraw.

Query 4 Are there any limitations to the use of a LifeStraw?

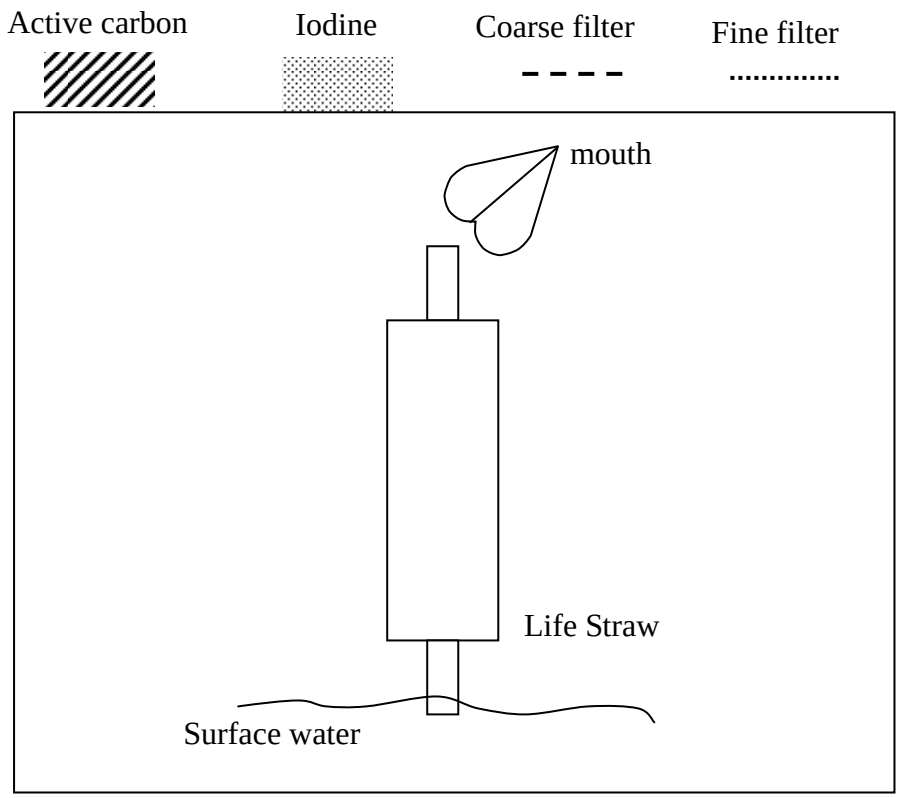
Could LifeStraw be used on water sources in any conditions? *What will the problems be when a LifeStraw is used to drink (i) muddy water, (ii) sea water and (iii) water contaminated with heavy metals such as lead and iron?*

Quiz

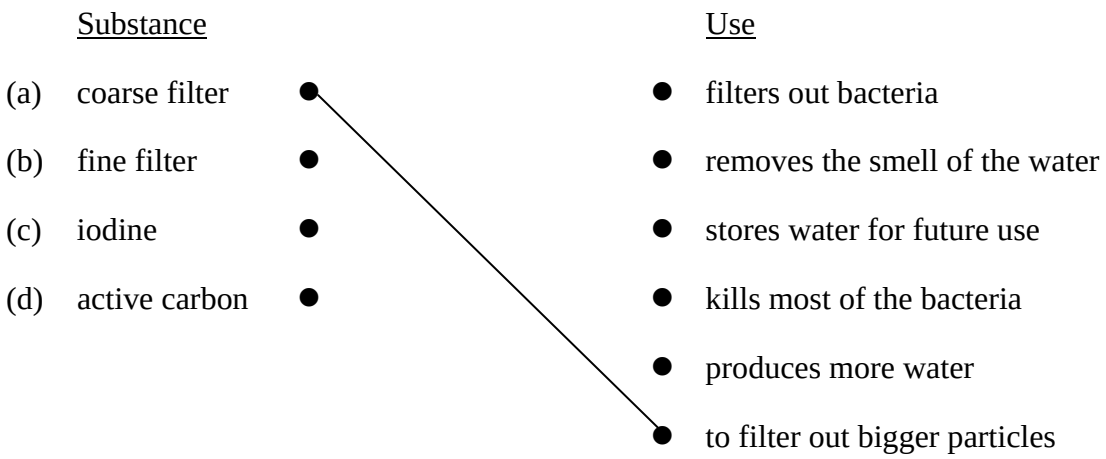
1. After reading the passage below, answer the questions that follow.

LifeStraw is a portable tool to turn any surface water into drinking water. Water sucked up through the LifeStraw passes through two filters. The first one is a coarse filter for filtering out big particles. The second one is a fine filter for filtering out smaller particles and some bacteria. The water then passes through some iodine to kill bacteria, viruses and parasites. Finally, the water passes through some active carbon to remove the smell of iodine and any remaining parasites. Hence, after passing through LifeStraw, the water is safe for drinking.

1. In the figure below, put in the four substances – active carbon, iodine, coarse filter and fine filter – inside a LifeStraw. You should show clearly the position of each substance. (Use the symbols given below.) (8 marks)



2. Matching: join the “substance” with its “use” with a straight line. Question (a) has been done as an example.
(6 marks)



3. John and you walk by a river. John wants to drink the river water. You try to stop him because surface water like river water is not safe for drinking. Complete the following sentence to give your reason to John.

John: I am thirsty. I want to drink the river water.

You: Don’t do that. River water is not safe for drinking because it has _____

_____

(2 marks)

4. John and you discuss the uses of LifeStraw in developing countries.

You: LifeStraw could be designed for people living in developing countries to access safe drinking water.
John: I think so. But, what factors do we have to consider to design LifeStraw for this purpose?
You: ……..

Suggest two factors to be considered. (4 marks)

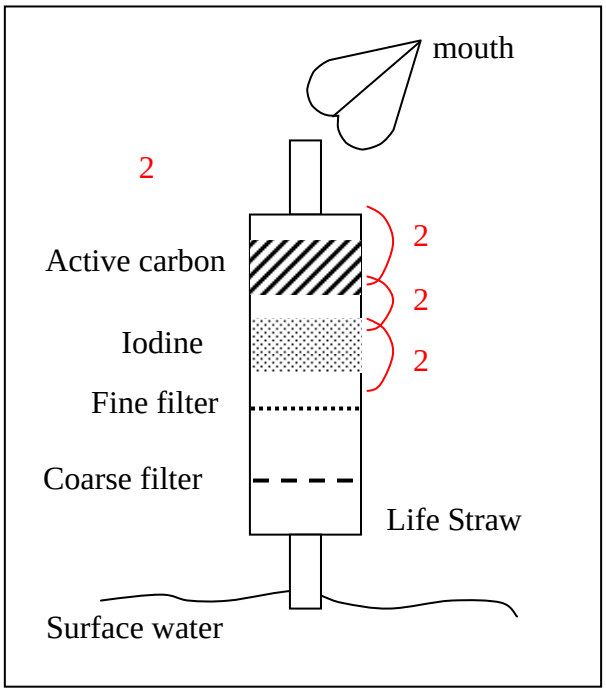
_____

_____

_____

Answers to the Quiz

1.



2. (2 marks for each correct march)

Substance		Use
(a)	coarse filter	filters out bacteria
(b)	fine filter	removes the smell of the water
(c)	iodine	stores water for future use
(d)	active carbon	kills most of the bacteria
		produces more water
		to filter out bigger particles

3. **You**: Don't do that. River water is not safe for drinking because it has _____

bacteria / viruses / parasites

4. Suggest two factors to be considered. (4 marks)

The materials used in LifeStraw have to be light.

The cost of LifeStraw has to be low.

LifeStraw can be used for a long time.

LifeStraw does not need electrical power.

or any two reasonable factors

Teacher's Reference

Video about Lifestraw on Youtube

http://www.youtube.com/watch?v=SzzCSATFiyM&eurl=http://49677022.blogspot.com/2007/12/alllifestraw.html#

Script of the video clip

More than one billion people in the world do not have access to safe drinking water, that is around 1/6th of the world's population.
Five million people, mostly children, die each year from waterborne diseases.
In India alone, sixteen hundred (1600) people die each day from diarrhoea diseases.
A huge proportion of India seven hundred (700) million rural population suffers from diseases, all due to contaminated water.
All across India, rural families use water from any source available to them such as rivers, springs and wells.

SOME IMPORTANT WATER FACTS (excerpted from http://swrf.wordpress.com/facts/)

- More than one billion people worldwide do not have access to safe drinking water – i.e. around 1/6th of the world's population.
- Five million people, mostly children, die each year from waterborne disease.
- In the past 10 years diarrhoea has killed more children than all the people lost to armed conflict since World War II.
- At any one time, approximately half of the world's hospital beds are occupied by patients suffering from waterborne disease.
- Diarrhoea kills over three million people per year and chronic diarrhoea is a leading killer of people with AIDS.
- The average distance that women in Africa and Asia walk to collect water is 6 km.
- The average weight of water that women in Africa and Asia carry on their heads can be anything up to 20kg - the equivalent of your airport luggage allowance!
- One of the Millennium Development Goals of the UN is: "By 2015, reduce by half the proportion of people without sustainable access to safe drinking water".
- The WHO default levels for the quantities of drinking water are:
  1 litre water/day for a 10 kg child
  2 litre water/day for a 60 kg adult

LifeStraw® personal - Claims (excerpted from http://lifestrawdefence.com/lifestraw.pdf)

- Portable water purifier offering relief from common diarrhoeal diseases – can be carried around for easy access to safe and clean drinking water.
- Purifies minimum 700 litres of water.
- Kills and removes 99.999% of waterborne bacteria.
- Kills and removes 98.7% of waterborne viruses.
- Removes particles down to 15 microns.
- Requires no electrical power or spare parts for the life time of the straw.
- Easy to mass-distribute in areas where drinking water is contaminated.

LifeStraw Data: (excerpted from http://news.bbc.co.uk/2/hi/africa/4967452.stm)

- The straw is made of plastic and resembles a flute.
- Inside are disinfectant filters. They kill bacteria.
- There is also a chamber containing iodine. The iodine removes parasites from the water as it is drunk and it gives the water a better taste.
- Lastly, there is active carbon which removes parasites and gives the water a better taste and smell.
- You just need to suck a few times to get the water through all the filters.
- It is made in China, where production costs are lower. The cost is around US$3.50 (£1.85) a straw. Each one will last for around 700 litres, around six months to a year.

N.B. **No moving parts: little maintenance**

No use of electricity. Just use suction, which babies can master.

At regular intervals, it is recommended to blow out the last mouthful of water as well as some air through the LifeStraw. This will clean the pre-filters of whatever sand, silt and debris that might have got stuck in the textile filters.

Limitations of LifeStraw

(excerpted from http://news.bbc.co.uk/2/hi/africa/4967452.stm)

- US$3.50 is expensive for developing countries where most people earn less than one dollar a day. They also have to feed their families.
- Many people live very far away from their water. Often they have to walk a total of 20km or more carrying a weight of 25 kilos. They're not going to have the education, because they're not going to have the time. It's girls in particular who suffer, because it's women and girls who have to collect the water.
- People having thyroid problems and allergic reaction to iodine must seek medical advice before using this tool.

LifeStraw® (excerpted from http://www.rmbsecurity.com/lifestrawqa.html)

Q7. Where has LifeStraw® personal been tested?

LifeStraw® personal has been tested at the University of North Carolina, USA.

Q8. What happens if LifeStraw® personal is used beyond 700 litres or one year?

LifeStraw® personal has been tested for its efficacy beyond 700 litres and it still retains considerable efficacy on the bacteria and viruses. Therefore, drinking water beyond 700 litres does not pose any health risks.

Q9. What is the shelf life of LifeStraw® personal?

LifeStraw® personal can be stored for three years at a maximum temperature of 30 degrees. Storage at a higher temperature will not hamper the working of LifeStraw® personal but in such a case, the first few millilitres of water consumed will have an initial lower killing effect on the bacteria and viruses.

Q10. What must one do if LifeStraw® personal gets blocked?

At regular intervals, it is recommended to do 'backwashing' that can be done by blowing out some air through the LifeStraw® personal. This will clean the pre-filters of whatever sand, silt and debris that might have got deposited in the textile filters.

Q11. What effect does LifeStraw® personal have on turbid water?

LifeStraw® personal does not remove complete turbidity from water; however, it removes the bacteria and viruses as well as undissolved particles down to the finest microns. If you need to consume turbid water, use LifeStraw® personal to drink only from the surface i.e. the top layer. Excessive intake of turbid water would clog the filters and therefore regular backwashing would be required.

Q12. What effect does LifeStraw® personal have on salt water? Does it make saline water potable?

LifeStraw® personal does not make saline water potable; however, it still removes the bacteria and viruses from the salty water.

Q13. Does LifeStraw® personal filter heavy metals like arsenic, iron and fluoride?

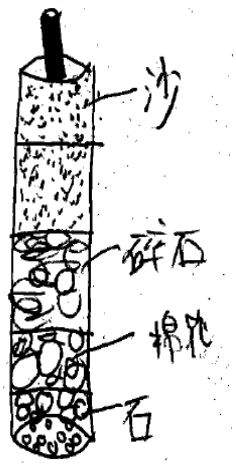
No, the present version does not filter any of the heavy metals.

Q14. Does LifeStraw® personal remove parasites like cryptosporidium and giardia?

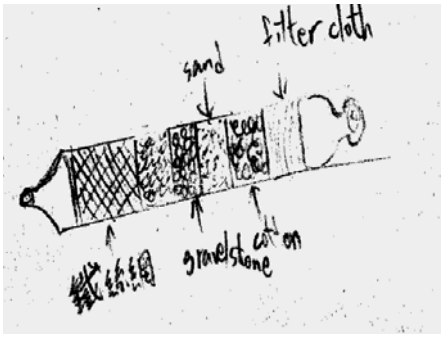
No, the present version does not filter any parasites.

Example of worksheet presenting students' designs

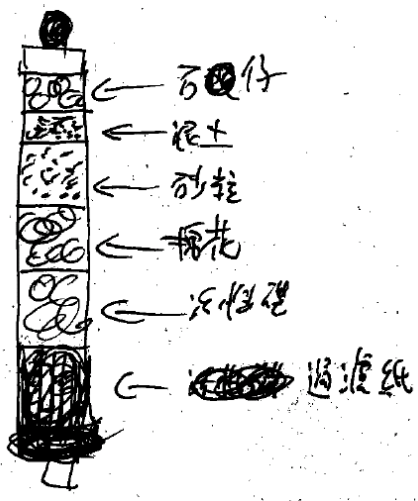
A



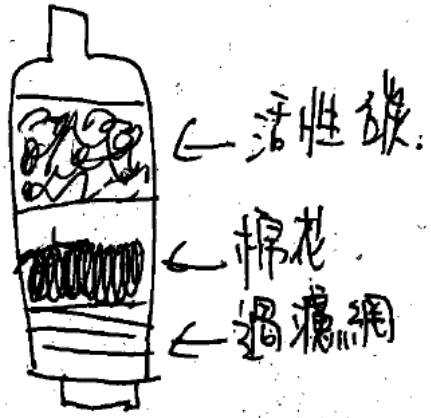
B



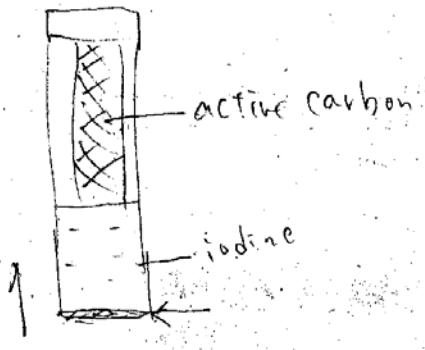
C



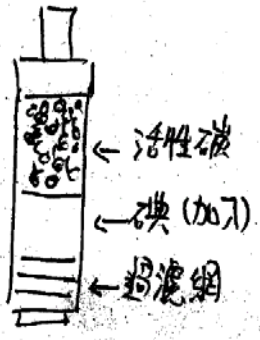
D



E

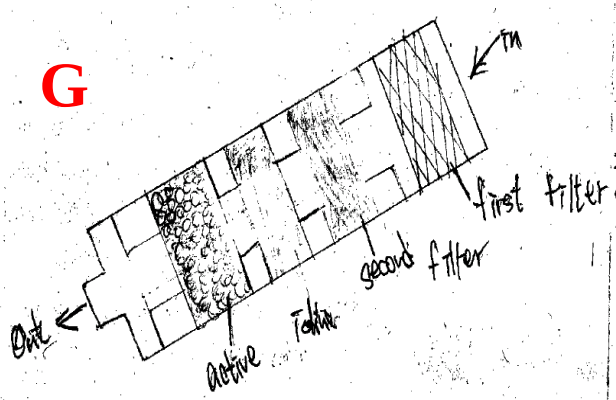


F



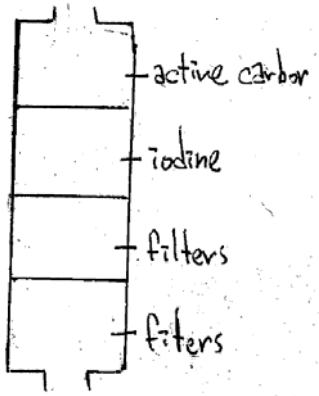
How do you think of these designs? Which one is the best? Why?

G

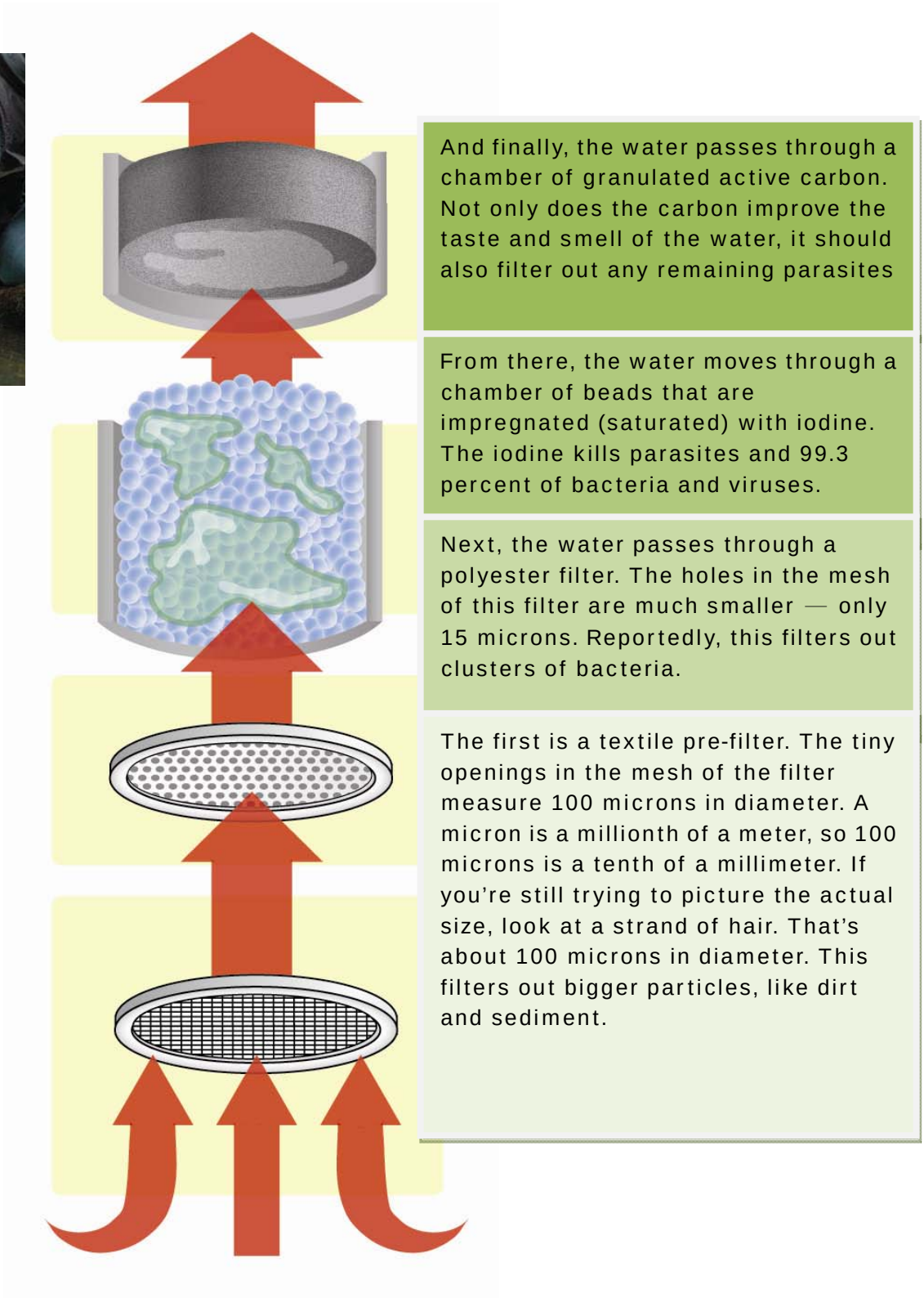


1. First, the dirty water will go in the first filter, it will filt a big particles such as stone
2. second, it will go in the second filter, it will remove viruses and particles.
3. third, it will go in iodine, iodine will kill off bacteria
4. Last, the active carbon can remove the smell of iodine and any remaining parasites

H



A suggested design of LifeStraw (reference: http://express.howstuffworks.com/lifestraw2.htm)



And finally, the water passes through a chamber of granulated active carbon. Not only does the carbon improve the taste and smell of the water, it should also filter out any remaining parasites

From there, the water moves through a chamber of beads that are impregnated (saturated) with iodine. The iodine kills parasites and 99.3 percent of bacteria and viruses.

Next, the water passes through a polyester filter. The holes in the mesh of this filter are much smaller — only 15 microns. Reportedly, this filters out clusters of bacteria.

The first is a textile pre-filter. The tiny openings in the mesh of the filter measure 100 microns in diameter. A micron is a millionth of a meter, so 100 microns is a tenth of a millimeter. If you're still trying to picture the actual size, look at a strand of hair. That's about 100 microns in diameter. This filters out bigger particles, like dirt and sediment.