

Heat Pack

Level: S.3

Subject: Physics

Topic: Heat Pack

Introduction

This set of ELA materials will be used for an 80-minute lesson. Knowledge about latent heat which is needed for this lesson has been taught in Chinese in previous lessons. This lesson makes use of videos, discussion and an experiment to help students learn how a heat pack works.

The lesson is designed so that students are provided with opportunities to practise all four English skills, namely listening, speaking, reading and writing. To meet different needs of students, tasks are designed with progressive difficulty levels. The teacher can make adjustment according to students' needs.

The lesson starts with a brainstorming discussion about how to keep warm, students are then introduced to the use of heat pack by means of a video. The final exploring task requires students to find out by themselves how the heat pack works; they have to carry out an experiment using a heat pack and to learn more about it by reading a passage. Questions of different difficulty levels are developed to guide students step by step to find out the answers by themselves.

Acknowledgement

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

ELA Lesson Plan – Heat Pack

Description: This ELA lesson is about latent heat, which is covered in Section 1 Heat of the CDC S.4 – 5 Physics syllabus. It starts with a discussion on how we keep our body warm. Students are then introduced to the use of heat packs for keeping warm by another video which gives instruction on how to use a heat pack. This is followed by an experiment and then a reading activity to encourage students to find out the working principle of the heat pack by themselves.

Content After completing the activity, students should be able to:

- Objective:**
- understand the concepts of undercooling and latent heat, and
 - understand how the heat pack works

Language After completing the activity, students should be able to:

- Objective:**
- understand and use the English terms related to latent heat and undercooling (e.g., *heat pack, produce heat, flex, metal plate, liquid, solidify, crystallize, generate, automatically, magic, working principle, phenomenon, undercooling, pure, stable condition, below freezing point, trigger, latent heat*. understand and use English expressions for explaining how a heat pack works, e.g.,
 - *The heat pack is very special because it does not need any hot water or batteries to produce heat.*
 - *All you have to do is to gently flex the metal plate in the heat-pack.*
 - *Then the liquid will begin to solidify, or crystallize.*
 - *When the liquid becomes solid, it generates heat automatically.*
 - understand and use English expressions in different tasks for discussing the working principles of heat packs, e.g.,
 - *The working principle of the heat pack can be explained with a phenomenon called undercooling.*
 - *Let us take water as an example to show what undercooling means.*
 - *When water is pure and in a stable condition, it can be cooled well below freezing point (0°C) without becoming ice.*
 - *We call liquid water with a temperature below 0°C undercooled water.*
 - *It may remain in the liquid state even at a temperature as low as -40°C .*
 - *When undercooled water is not pure or not stable, such as if we shake the undercooled water, the shaking will trigger the water to freeze.*

- *Undercooling happens not only in water but also in some other liquid substances such as the undercooled liquid inside the heat pack.*
- *When you flex the metal plate inside the heat pack, the action triggers the undercooled liquid to become solid and give out latent heat.*
- *This is how the heat pack warms up.*

- Material/Tools
- Worksheets – Task A, Task B and Task C
 - Experiment – heat packs, beakers with water, thermometers (The quantity of these tools depends on the no. of student groups)
 - An internet accessible computer and a projector for showing online video clips.

Steps:

Task A: Ways to Keep Warm (pair/group discussion: 20 mins)

1. Distribute the worksheet.
2. Direct students to Task A.
3. Ask students to suggest ways to keep warm and write their answers on the worksheet. Remind them to use the pattern **verb + noun** as shown in the examples.
4. Discuss with the class what they would do if they found themselves in a very cold place without having brought enough warm clothes.
5. Introduce some methods of keeping warm by using mime – rubbing our hand together, jumping up and down – and pictures as necessary.
6. Ask students to describe the methods you demonstrate and remind them to use the sentence pattern ‘verb + noun’ (e.g. rub hands together, ‘jump up and down’, ‘light a fire’, use a heater)
7. Ask students to compare the answers they’ve written for Task A with the suggestions coming from the discussion. Ask a few students to read aloud those answers not suggested in the discussion.
8. Jot down students answers on the board. Correct mistakes if necessary (see TN1).
9. If any student gave “use the heat pack” as the answer to Task A, go to Step 11. If no student gives this answer, ask them what other methods they can think of and introduce

the idea that they can use the heat pack to keep warm.

10. Circulate some heat packs among students. Remind them NOT to touch the metal dot. Briefly explain what it is.
11. Ask students if they know how to use a heat pack and ask them to try giving the explanation in English.

Listening and speaking – Task B: How to Use the Heat pack?

(pair/group discussion: 20 mins)

12. Direct students to Task B. Tell students they will be shown a video to show them how to use the heat pack.
13. Before playing the video, prepare students to understand the instruction given in the video by going through the questions and vocabulary of Task B.
14. Let students watch the video – *How to Use the Heat Pack* (about 1 min)
<http://www.youtube.com/watch?v=1Eka0rsj43E>
15. Then ask students to complete Questions 1 to 6.
16. Check answers by asking students to read aloud their answers in complete sentences.
17. Highlight the key vocabulary by reading aloud the vocabulary once/twice with the class. This quick revision can help them do Task C.

Reading and Writing – Task C: Find It Out Yourself (Group work – 40 mins)

18. Direct students to Task C.
19. Explain to students that they are going to find out how a heat pack works by carrying out an experiment and reading a passage.
20. Distribute to each group a heat pack, a beaker with water in it and a thermometer. Tell students to follow the steps in Task C and record the changes of the temperature of the heat pack. Complete Items 1 to 5.
21. Move on to the reading passage. Ask students to read *Magical Heat Pack* and complete Questions 6 to 9. Remind students that they should refer to the previous tasks for the necessary vocabulary (see TN2).
22. Ask students to read aloud their answers in complete sentences.
23. Summarize the key concepts and vocabulary.

Teacher's Notes (TN)

TN1: Since this is only a warm up exercise, the teacher need not amend students' spelling or grammatical mistakes.

TN2: The tasks are developed in progressively more difficulty levels. The teacher may need to give students more support/guidance/hints on the later questions.

Task A : Ways to Keep Warm (Pair/group discussion)

How do you keep warm? Discuss with your partner or group members, and list possible ways to keep warm by using the pattern – verb + noun.

E.g. 1. Put on clothes.

Eg.2. Have hot food.

_____	_____
_____	_____
_____	_____
_____	_____

Task B: How to use the heat pack? (Pair/group work)

Watch the video – *How to Use the Heat Pack* http://www.youtube.com/watch?v=ILha_hBDhKE.

Listen carefully to the instruction given in the video. Answer the following questions by choosing correct answers from the list below.

liquid state	crystallization	generate heat
solid state	54 degree centigrade (54 °C)	generate gas
gas state	84 degree centigrade (84 °C)	flex the metal dot
heat pack	4 to 5 hours	break the metal dot
cold pack	1 to 2 hours	dissipate

1. What is the purpose of the video?

The video shows how to use the _____

2. What is the heat pack for?

We use the heat pack to _____ to warm up parts of our body.

3. What is the state of the substance inside the heat pack before you flex the metal dot?

It is in _____

4. What change will take place in the heat pack after you flex the metal dot?

The liquid will change into solid crystal. This process is called _____

5. What is the temperature of the heat pack when it works?

6. How long will the heat pack be hot?

The heat will dissipate gradually. It will be hot for about _____ hours.

Task C: Find It Out for Yourself (Pair/group work)

To find out how the heat pack works, you are given a heat pack, a beaker with water and a thermometer. You will also be given a reading passage *Magical Heat Pack*

Follow the steps below and record the changes of the heat pack.

Steps	Record
1. Observe, touch and describe the heat pack.	1. The heat pack is filled with substance in _____ state. There is a _____ inside for activating the process of crystallization.
2. Fill the beaker with water at room temperature and record the initial temperature.	_____ °C
3. Activate the heat pack by flexing the metal dot. Put it into the water.	
4. Continue recording the temperature, once every minute for 10 minutes.	After 1 mins _____ °C After 2 mins _____ °C After 3 mins _____ °C After 4 mins _____ °C After 5 mins _____ °C After 6 mins _____ °C After 7 mins _____ °C After 8 mins _____ °C After 9 mins _____ °C After 10 mins _____ °C
5. What has happened to the temperature after 10 minutes?	The temperature has *risen/dropped from _____ to _____. *Circle the correct answer.

What's next?...

Now you may have this question in mind – “How does the heat pack generate heat?” Find out how from the passage – *Magical Heat Pack*

(Adapted from *Magical Heat Pack*, http://www.phy.cuhk.edu.hk/phyworld/articles/heatpack/heatpack_e.html)

What is the Magic Behind the Heat Pack?

The heat pack is very special because it does not need any hot water or batteries to produce heat. All you have to do is to gently **flex** 屈曲 the **metal plate** 鐵片 in the heat-pack. Then the liquid will begin to **solidify** 固化, or **crystallize** 結晶. When the liquid becomes solid, it generates heat automatically. What is the magic behind this amazing heat pack?



F i g . 1 T h e
h e a t
p a c k
~ ~ ~

The working **principle** 原理 of the heat pack can be explained with a **phenomenon** 現象 called

undercooling 過冷. Let us take water as an example

to show what undercooling means. When water is

pure 純淨的 and in a **stable** 穩定的 condition, it can be cooled well below freezing point

(0°C) without becoming ice. We call liquid water with a temperature below 0°C **undercooled**

water 過冷水. It may remain in the liquid state even at a temperature as low as -40°C. When

undercooled water is not pure or not stable, such as if we shake the undercooled water, the

shaking will **trigger** 引發 the water to **freeze** 結冰.

Undercooling happens not only in water but also in some other liquid substances such as the

undercooled liquid 過冷液體 inside the heat pack. When you flex the metal plate inside the heat

pack, the action triggers the undercooled liquid to become solid and give out **latent heat** 潛熱. This is

how the heat pack warms up.

After reading *Magical Heat Pack*, discuss with your partner/ group members and answer the following questions.

6. What is the purpose of having a metal plate inside the heat pack?

We use the metal plate to trigger the liquid to solidify or _____ . If you gently

_____, the undercooled liquid

inside the _____ will _____ and

_____.

7. What causes the change in temperature of the heat pack?

8. How does the heat pack warm up?

9. Could water in the sea be undercooled? Explain your answer.

Teacher's Version

Task A Key : Ways to Keep Warm (Pair/group discussion) 20 mins

How do you keep warm? Discuss with your partner or group members, and list any possible ways to keep warm by using the pattern – verb + noun.

E.g. 1. Put on clothes.

Eg.2. Have hot food.

Rub our body	Take a hot shower.
Use a heater.	Hug our friends.
Share body heat.	Move our body.
Do exercise.	Have hot drinks.

Task B Key: How to use a heat pack (Pair/group work) 20 mins

Watch the video – *How to Use the Heat Pack* http://www.youtube.com/watch?v=ILha_hBDhKE.
Listen carefully to the instruction given in the video. Answer the following questions by choosing correct answers from the list below.

liquid state	crystallization	generate heat
solid state	54 degree centigrade (54 °C)	generate gas
gas state	84 degree centigrade (84 °C)	flex the metal dot
heat pack	4 to 5 hours	break the metal dot
cold pack	1 to 2 hours	dissipate

1. What is the purpose of the video?
The video shows how to use the **heat pack**.
2. What is the heat pack for?
We use the heat pack to **generate heat** to warm up parts of our body.
3. What is the state of the substance inside the heat pack before you flex the metal dot?
It is in a **liquid state**.
4. What change will take place in the heat pack after you flex the metal dot?
The liquid will change into solid crystal. This process is called **crystallization**.
5. What is the temperature of the heat pack when it works?
54 degree centigrade or **54 °C**.
6. How long will the heat pack be hot?
The heat will dissipate gradually. It will be hot for about **1 to 2 hours**.

Task C Key: Find It Out for Yourself (Pair/group work) 40 mins

To find out how the heat pack works, you are given a heat pack, a beaker with water, a thermometer, and a passage called *Magical Heat Pack*

Follow the steps below and record the changes of the heat pack.

Steps	Record
1. Observe, touch and describe the heat pack.	1. The heat pack is filled with substance in a liquid state. There is a metal dot/plate/disc inside for activating the process of crystallization.
2. Fill the beaker with water at room temperature and record the initial temperature.	_____ °C
3. Activate the heat pack by flexing the metal dot. Put it into the water.	
4. Continue recording the temperature, once every minute for 10 minutes.	After 1 mins _____ °C After 2 mins _____ °C After 3 mins _____ °C After 4 mins _____ °C After 5 mins _____ °C After 6 mins _____ °C After 7 mins _____ °C After 8 mins _____ °C After 9 mins _____ °C After 10 mins _____ °C
5. What has happened to the temperature after 10 minutes?	The temperature has *risen/dropped from _____ to _____. *Circle the correct answer.

After reading *Magical Heat Pack*, discuss with your partner/ group members and answer the following questions.

6. What is the purpose of having a metal plate inside the heat pack?

We use the metal plate to trigger the liquid to solidify or crystallize. If you gently

flex the metal plate/disc/dot, the undercooled liquid

inside the heat pack will freeze/solidify/crystallize and

give out/generate/produce heat.

7. What causes the change in temperature of the heat pack?

Flexing the metal plate causes the change.

Or any answers with similar meaning.

8. How does the heat pack warm up?

When you flex the metal plate inside the heat pack, the action triggers the undercooled liquid

to become solid and give out latent heat.

Or any answers with similar meaning.

9. Could water in the sea be undercooled? Explain your answer.

Water in the sea cannot be undercooled because the water is not pure and moving / not

stable.