

Didactic Scenario

1. Title

The journey of heat in a matter

2. Keywords

heat, temperature, solid, liquid, gas

3. Basic Information

STEAM Subject: Science, Social Science

Typical interaction time with the instructional scenario in teaching hours for in-school work:
40'+40'

General description of the scenario:

<u>Phases</u>	<u>Stage</u>	<u>Time</u>
Heat conduction of solid matter	implementation stage	40'+40'
Heat conduction of liquid matter	implementation stage	40'+40'
Heat conduction of gaseous matter	implementation stage	40'+40'

Age group: 10-11 years

Estimated difficulty level:

Very Easy	Easy	Moderate	Challenging	Very Challenging
		X		

Teaching resources

Secondary School Science Course Book - Bilsem Course Curriculum Plan- Tübitak Bilim Genç, EBA (Educational Sciences Network)

Material: heat conduction rod, candle pin, cardboard scissors, heater, convection rod, two different colours of food colouring, spirit stove, binding part, cast foot, iron rod, iron rod, garbage skewer, thermometer, heat conducting pot, metal, wooden, plastic spoon

School infrastructure: smart board, computer, non-contact thermometer

Additional material from external sources/online tools:

<https://bilimgenc.tubitak.gov.tr/makale/konveksiyon-yontemiyle-isi-akisini-gozlemleyelim>

https://ders.eba.gov.tr/ders/proxy/VCollabPlayer_v0.0.992/index.html#/main/curriculumResource?resourceID=8d8daa7242f8d6d53c54778e5c341aa3&resourceTypeID=3&loc=0&locID=31830af6996f96dacbf4b628e5d88b9c&showCurriculumPath=false

https://ders.eba.gov.tr/ders/proxy/VCollabPlayer_v0.0.993/index.html

Differentiated Instruction for students of differing abilities and learning styles in the same class: N/A

Developed by: Sıdıka Kök

4. Educational Problem

It was realised that the concepts of heat and temperature were confused and it was necessary to eliminate the confusion and to understand that the measured variable was temperature. It was realised that the students could not look at the events they saw in their immediate surroundings with a scientific point of view and that a scientific point of view should be gained. It was seen that they did not pay attention to the heat conduction in solids and the heat conduction in liquids and gases that they had previously observed.

With this study, it has been understood that the teacher is in the role of guiding, helping and encouraging the students and supports them to reach the acquisitions at the level of analysis and synthesis and to gain scientific attitude. Ayrıca sınavı yanılma, neden-sonuç ilişkileri kurma, aktif düşünme ve akıl yürütme gibi kazanımları elde etmelerini sağlayacaktır. Students are active in the lesson as learning by doing and experiencing is emphasised. Students who tend to remain passive in group work due to lack of self-confidence can be recognised and supported.

5. Learning Objective (-s)

1. It is aimed to make students realise that heat is an energy and that the heat energy of the substances whose temperature rises increases.
2. It is among our goals to show that heat transfer occurs from the substances in contact with each other from the higher temperature to the lower temperature.
3. It is aimed to show that differences in the granular structure of substances cause substances to conduct heat at different rates.
4. It is aimed to make students realise that materials that conduct heat well are called heat conductors and materials that do not conduct heat well are called heat insulators.
5. It is aimed to make students feel that heat conduction in solid is by conduction and convection in liquid and gas.

6. Phases of the Scenario

Phase 1

Title: Heat conduction of solid matter

Indoor	Outdoor	Mixed
X		

Phase duration in minutes: 40'+40'

Detailed description of the scenario phase:

Spoon with no Hand Burn

Outcomes:

1. Demonstrates heat conduction in solids by experiment.
2. Solids that conduct heat well are called heat conductors.
3. Solids that do not conduct heat well are called heat insulators.
4. From daily observations, he deduces that heat transfer can occur without direct contact.

Learning Scenario:

Ata's mother is a teacher and will come home later than usual because there is a parent-teacher meeting that day. Knowing that his wife will come home late, Ata's father decides to cook soup for dinner. Determined to help his father, Ata takes the metal ladle and starts stirring the soup. After a while, he could not hold the ladle because his hand was burnt and his father gave him a wooden spoon. Ata was able to stir the soup with the wooden spoon until it was cooked.

According to the scenario above discuss the following questions in groups:

1. What could be the reason why Ata could not stir the soup with a metal spoon but could stir it with a wooden spoon until the soup was cooked? Have you experienced different situations similar to this situation in daily life?
2. How can this situation be explained in the context of our science and technology course?
3. Can an experiment be designed for the situation in this scenario, and if so, what kind of experiment can it be?

Activity sheets:

Solid, Liquid and Gas words are written on the papers and thrown into a bag. The class is divided into three groups and one student in each group is asked to draw a paper from the bag. According to the result, the groups are given heat conduction experiment instructions and asked to set up an experimental setup.

Heat conduction of solid experiment's instructions 1. Group

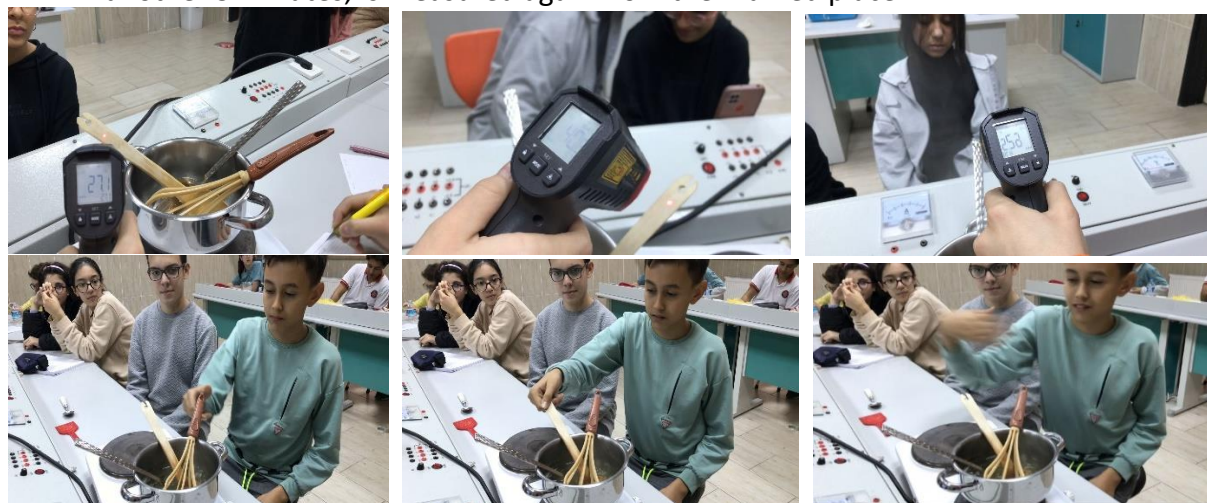
Heat conduction experiment instructions of liquid matter 2. Group

Heat conduction of gaseous material experiment instructions 3. Group

1. Heat conduction experiment instruction of solid matter

Activity 1

- A metal pot that can provide heat conduction is taken and placed on the hob.
- Wooden, plastic and metal spoons are marked 5 cm back from the handle by observing their initial temperature and placed in the pot.
- After the boiling point, the temperature of the substances, which are heated for another 5 minutes, is measured again from the marked place.



Temperature Measurement Results	Plastic	Wooden	Metal
Initial Temperature	27.2	27.1	27.4
Final Temperature	29.8	40.0	62.3

In heat conduction, the particles that will form the substance must collide with each other and transfer the energy they have to each other. The heat conduction of substances whose particles are regular and close to each other is good.

As the heat conduction of solids, liquids and gases are different from each other, heat conduction is different between different solids. The difference in the particle structure of solids causes solids to conduct heat at different rates.

For this reason, metals such as copper, aluminium and silver are good heat conductors.

Because the particles that make up metals are regular and very close to each other.

The fact that your hand burns when you touch the spoon is the result of the metal spoon being a good conductor.

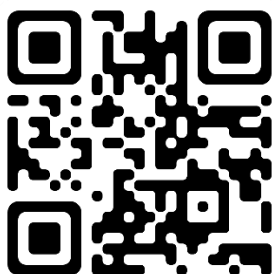
2. Heat Conduction Experiment Instruction Of Solid Matter

Activity 2:

- rip wax on the heat conduction rod.
- Pins are glued perpendicularly on the candle sticks.
- A lighted candle is placed in the centre where the chukas meet.
- The drop times of the needles are measured and recorded in the table.



Let's follow another experimental setup using heat conduction tongs.



<https://www.youtube.com/watch?v=-mZx2aHdsh8>

There will be differences between our conductive solids due to the structure of their particles. Heat conduction depends on the type, temperature, thickness and pressure of the substance. With our activity in the same environment, the thickness and pressure of the temperature were kept constant. The type of substance was determined as our independent variable. They are asked to write the drop times of the pin on the blank table.

Metals	Copper	Aluminium	Brass	Steel
Dropping time of a pin	30 s	58 s	65s	108s



Marbles game

The game is reminded that when a marble thrown with energy hits the marble on the ground, it transfers its energy to it.

In the particles in matter, when a fast moving particle hits a slow moving particle, it transfers some of its energy and causes this particle to accelerate and thus to heat up. Thus, heat energy is transmitted throughout the matter as a result of billions of moving particles hitting each other until the temperature is the same. This way of heat dissipation is called "conduction". The diffusion of heat by conduction usually takes place in solid objects.

Phase 2

Title: Heat conduction of liquid matter

Indoor	Outdoor	Mixed
X		

Phase duration in minutes: 40'+40'

Detailed description of the scenario phase:

What happened to the heated milk?

Expected Outcomes:

- By making observations, he/she concludes that molecules accelerate as substances heat up.
- Establishes a relationship between heat transfer between substances and the collision of atom-molecules.



They are asked to interpret what they see in the picture. The milk in Ata's house overflowed.

Scenario: Ata drinks milk every morning when he wakes up. One day when he wakes up in the morning, he goes to his mother in the kitchen and sees her heating milk. At that moment, Ata's younger brother wakes up from sleep and cries, so his mother runs to him. At that moment, the milk on the stove starts to swell slightly and then overflows. Panicked by this situation, Ata calls out to his mother and tells her that the milk has overflowed.

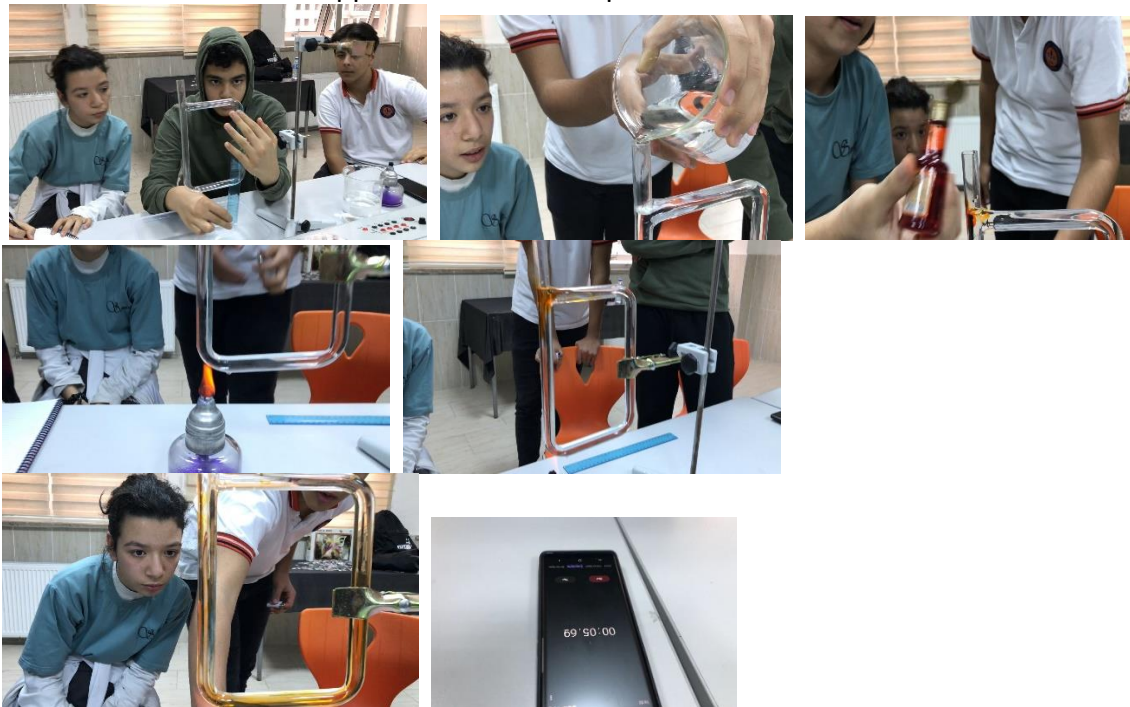
According to the scenario above students do brainstorming by discussing the following questions:

1. Why might the warmed milk have moved? Have you experienced different situations similar to this situation in daily life?
2. How can this situation be explained in the context of our science and technology course?
3. How can an experiment be designed for the situation in this scenario?

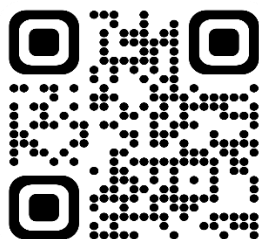
Activity sheets:

Heat conduction experiment instruction of liquid matter

- The convection pipe is fixed with fittings.
- Food colouring is added to cold (3 C) water
- The coloured liquid is placed in the convection tube.
- The lower end of the convection pipe is placed by lighting a spirit burner
- Another food colouring of a different colour is dripped from the end of the convection tube.
- The distribution of the dripped colour in the liquid is observed.



It was observed that cold water with higher density was replaced by hot water whose density decreased by heating. While the heated water rises upwards, the cold water moves downwards, causing the food colouring to be displaced, i.e. convection occurs.



<https://cutt.ly/0wDzqhtR>

Let's observe heat dissipation by convection with another experiment.

Phase 3

Title: Heat conduction of gaseous matter

Indoor	Outdoor	Mixed
X		

Phase duration in minutes: 40'+40'

Detailed description of the scenario phase:

Where does the warming air go?

Expected Outcomes:

- Realises that heat flow occurs from hot to cold.
- Understands that the heated air rises



Students are shown the cartoon above and asked to interpret it. While the entry of cold air into the room is shown with an arrow, attention is drawn to the arrow coming out. It is discussed that the air coming out can be hot air. The point is reached that the air coming out from the top and the air entering from the bottom is also remarkable. Reasons are discussed and brain gymnastics is done.

According to the scenario above students will discuss the questions below:

- What do you know about convection heat conduction?
- How can this situation be explained in the context of our science and technology course?
- Can a model be designed for the situation in this scenario?

Activity sheets:

Heat conduction experiment instruction of gaseous material

- The experimental set-up shown in the picture is set up by connecting the stative rod to the casting leg.
- A4 paper is cut in a helozonic shape.
- A skewer is passed through the centre of the helical cut paper to keep the paper in balance.
- The spirits stove is lit and placed under the helozon shape.



Heat flow passes from hot to cold. In the room we are in, the heated air moves upwards. Therefore, when we open the window, hot air comes out from the upper part. The cold air outside also enters from the lower part. In other words, when we open the window, not only cold air enters, but also hot air comes out. This air movement is an example of the spread of heat by convection.

Convection is the sum of "entrainment" and "diffusion" movements. It refers to the movement of liquid and gas particles, in general terms, fluids from high temperature to low temperature.

Video of the work done with students in the classroom environment



<https://youtu.be/dw0QrNq4vk0?si=HYKUSxqYy1Eei0Y6>



https://drive.google.com/file/d/1t5L5h5jpW4tYMkoWRt0Z_T2dkpTKwX5C/view

Watch the lecture activity of heat propagation in particles taken from Morpa Kampüs education portal.

7. Evaluation Methodology

Peer assessment scale

Course: Science

Activity Name: The journey of matter heat

Instruction: This assessment activity has been prepared to determine the performance of your friends in the 'Substances Conduct Heat' activity. You are asked to choose two friends from two groups outside the group you are in. Please indicate your opinion about your friend by using the letter 'Y' if Yes, 'S' if Sometimes, and 'N' if No.

Name and Surname

CRITERIA/SCALE	Y	S	N
Willingly participated in the study			
Correctly transmitted data in the study			
Correctly conveyed how the heat conduction of matter occurs			
Used Turkish correctly, beautifully and effectively in the study			

8. Additional Resources for the teacher

Korkmaz, H. ve Çakmakçı, G. (2006). Proje tabanlı öğrenme yaklaşımı. Bahar, M. (Ed.). Fen ve teknoloji öğretimi. Ankara: Pegem A Yayıncılık.

Korkmaz, H. ve Kaptan, F. (2002). Fen eğitiminde proje tabanlı eğitim yaklaşımının ilköğretim öğrencilerinin akademik başarı, akademik benlik kavramı ve çalışma sürelerine etkisi. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 22, 91-97.



Özmen H. (2004).Fen öğretiminde öğrenme teorileri ve teknoloji destekli yapılandırmacı öğrenme. TheTurkishOnline Journal Of EducationalTecnology, Vol.3(1), 14.

Uzal,G., Erdem, A., Ersoy, E. (2011). Proje tabanlı fen/matematik eğitimi projesinden yansıtımlar-II: kazanılan yeterlilikler ve öğretmen görüşleri. Araştırma Raporu, TFV Yayınları, Tekirdağ.

<https://yayinlar.tubitak.gov.tr/kategori/dergi-16>

<https://bilimgenc.tubitak.gov.tr/>

<https://www.fenbilim.net/2017/12/5-sinif-fen-bilimleri-konulari.html>

<https://www.eba.gov.tr/>

<https://www.youtube.com/watch?v=-mZx2aHdsh8>

<https://bilimgenc.tubitak.gov.tr/makale/isinin-yayilma-yollari>(6)

<https://www.youtube.com/watch?v=djgxZMk> NIE(7)