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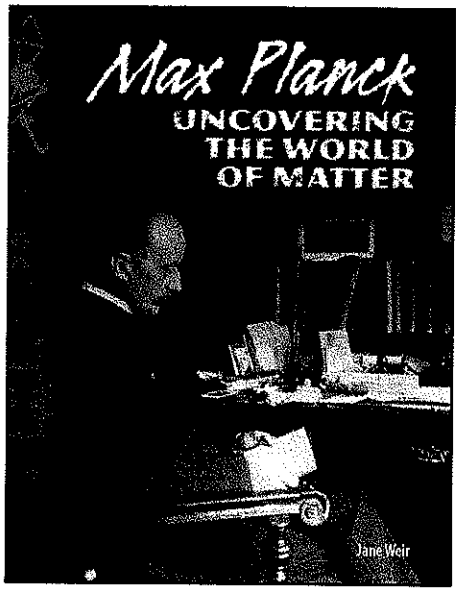
Science Readers

Lesson Plans for

Max Planck Uncovering the World of Matter



Authors
Jennifer Overend Prior, PhD. and Kathleen Kopp, M.S.Ed

Teacher Created Materials Publishing
5301 Oceanus Drive
Huntington Beach, CA 92649
http://www.tcmpub.com
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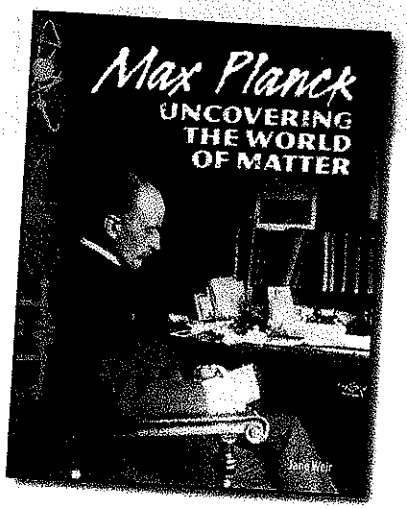
Max Planck: Uncovering the World of Matter Reader



Learning Objectives

Students establish and adjust purposes for reading (Nonfiction Reading Objective).

Students summarize and paraphrase information in texts (Nonfiction Reading Objective).

Students know that matter is made up of tiny particles called atoms, and different arrangements of atoms into groups compose all substances (Science Content Objective).

Students know that atoms often combine to form a molecule, the smallest particle of a substance that retains its properties (Science Content Objective).

Materials

- notebook paper
- note cards
- chalkboard or whiteboard
- chalk or wipe-off markers
- Crystal Clear transparency and activity sheet (page 42)
- Heat Me Up! activity sheet (page 43)
- Back to Normal activity sheet (page 44)
- materials for Lab (see page 30)
- *Reader Quiz* (page 45)

Before Reading

Complete the Introductory Activity (page 26) with the whole class. Then divide the students into reading groups. The students who read this book should be reading below grade level.

Explain to students that expository writing provides facts to the reader. Their job during this unit will be to use the information they gather from the text to summarize the facts they learn. Before reading, have students skim through the reader, jotting down their initial ideas about the content to be presented in the book. Collect these lists for use with Step 12.

Introduce the scientist, Max Planck, to students. Distribute the readers and ask the students to brainstorm what they might learn about Planck and how the work of this man might relate to the concept of matter presented in the Introductory Activity. Ask the students to consider the following questions:

- What is matter?
- What kind of scientist studies matter?
- What would interest a scientist in the study of matter?
- How do you think the study of matter contributes to advancements in our society?
- Is matter something you would want to study? Why or why not?

Encourage students to think of questions of their own about Max Planck and his work as a scientist. Have students share one question they hope to have answered when they read. Each student should write their question on a note card. Collect them to redistribute after the reading (Step 13). Ask students to share their ideas about the purpose of reading this book.

Before Reading *(cont.)*

Max Planck was interested in an area of science called physics. Help students understand the general areas of science and how each specialty works together to paint a full picture of the world. On the board write a heading, "Areas of Science." Underneath this heading list the general areas of science: Life Science, Physical Science, Earth and Space Science.

Brainstorm together topics of study that fall under each heading. For instance, the study of light, heat, chemical reactions, atoms, and nuclear energy would all be considered physical science. The study of rocks, planets, and global warming would fall under earth and space science. Life cycles, the human body, cells, and plants are studied by those interested in life science.

During Reading

Review the Table of Contents with the students. Explain that they will be assigned a portion of the book to read. Keep in mind the reading abilities of the students as you determine which students will read which parts of the reader and the number of total pages they will be required to read.

Allow students time to read. If necessary, pair struggling readers or second language learners during this time.

After students have the chance to read their assigned sections for the first time, ask them to recall the information they read. Ask them about the author's purpose for writing and the big ideas the author attempts to share. Explain that the big ideas are main ideas or central messages in the book. Write the students' main ideas on the board.

Encourage the students to read their sections again. This time, ask them to read aloud, quietly, focusing on the accuracy and fluency of their reading. Invite all students to then share with the group the information they gathered from their portions of text.

As the students look out their classroom or bus window, or their window from home, have them consider what is happening to the heat energy as it approaches, then collides with the window. Reread pages 10 through 13 with the class. Display the transparency. Review the effects of heat energy for each of the different types of windows. Distribute *Crystal Clear* (page 42) to students. Read through the questions and answers together. Have several students share their ideas for question #8, then allow the students time to write their responses.

Reread pages 12 and 13 with the class. Have students consider additional examples of conduction, convection, and radiation. Distribute *Heat Me Up!* (page 43) to students. Discuss the image of the beach, and discuss how these three related concepts occur there. Allow time for students to answer the questions independently.

After Reading

Review with the students what they read. If necessary, allow students to reread their assigned portion of the book. Distribute students' lists from Step 2. Remind them that this was the list they created of what they thought they would encounter in the text. Have students review their lists. Then have them add new ideas or make corrections about the actual content of the reader.

Return the students' note cards with the question they posed prior to reading in Step 3. Have them reread a part of the reader that addresses their questions and write the answer. Help students as needed find the appropriate place in the reader by using the Table of Contents or the Index. If the student's question was not answered, have him or her write "not answered in the book" and consider an alternative place to look for a response (experimentation, internet, scientist at a nearby university, company or organization related to the topic such as a power company or medical facility, etc.). Have students share their question and answer with the class.

Lead a class discussion. The author claims that "Quantum theory was Planck's greatest success" (page 18). Discuss why the author made this statement. What do the students consider to be Planck's greatest achievement? Are their ideas different from the author's?

Demonstrate how to use the Index to find the pages related to specific topics. Pose the following questions to students. Have pairs of students reread and answer the questions with their partner. Share two or three pairs' responses to each question with the class.

- What is entropy? How does entropy relate to a messy bedroom?
- What is equilibrium and what are equilibrium reactions?
- What does it mean if something is radioactive?

Discuss how students keep things hot or cold. Reread pages 10 and 11, especially the side bar which discusses Zeroth Law. Distribute *Back to Normal* (page 44) to students. Read the information related to thermal energy and Zeroth Law. Then read the experiment summary. Review the data in the chart. Allow time for the students to answer the questions independently. Lead a discussion as to what outside influences affect the storage of heat energy. Would the surface area of the liquid play a role?

Remind students of the discussion related to expository writing before they read (Step 2). Explain again that this kind of writing presents factual information. Have students think about the factual information the author presented in the reader. What were the most important ideas the author communicated? List these main ideas on the board. Then instruct each student to use the ideas on the board to summarize the reader. Encourage students to limit their summaries to five to seven sentences.

Use the *Reader Quiz* (page 45) to further assess student learning. For ELL students, you may need to read the test questions aloud to them to assess their comprehension.

Gather students together as a whole group to complete the Lab (pages 29–30).

Gather the students together as a whole group and have them complete the Concluding Activity (page 27).

Crystal Clear

Directions: Look at the transparency showing several types of windows. Use what you read about thermal heat energy to answer these questions.

1. How is heat energy getting to the outside of the windows?
   a. from the heating and cooling system in the building
   b. from the building itself
   c. from the ground
   d. from the sun

2. This is an example of what kind of energy transfer?
   a. conduction b. convection c. radiation d. can't tell

3. If a single-pane window is directly facing the sun, what happens when the heat hits the window?
   a. The heat transfers through the glass to the room.
   b. The heat changes to light energy.
   c. The heat reflects off the glass.
   d. The window glows brightly.

4. This is an example of what kind of energy transfer?
   a. conduction b. convection c. radiation d. can't tell

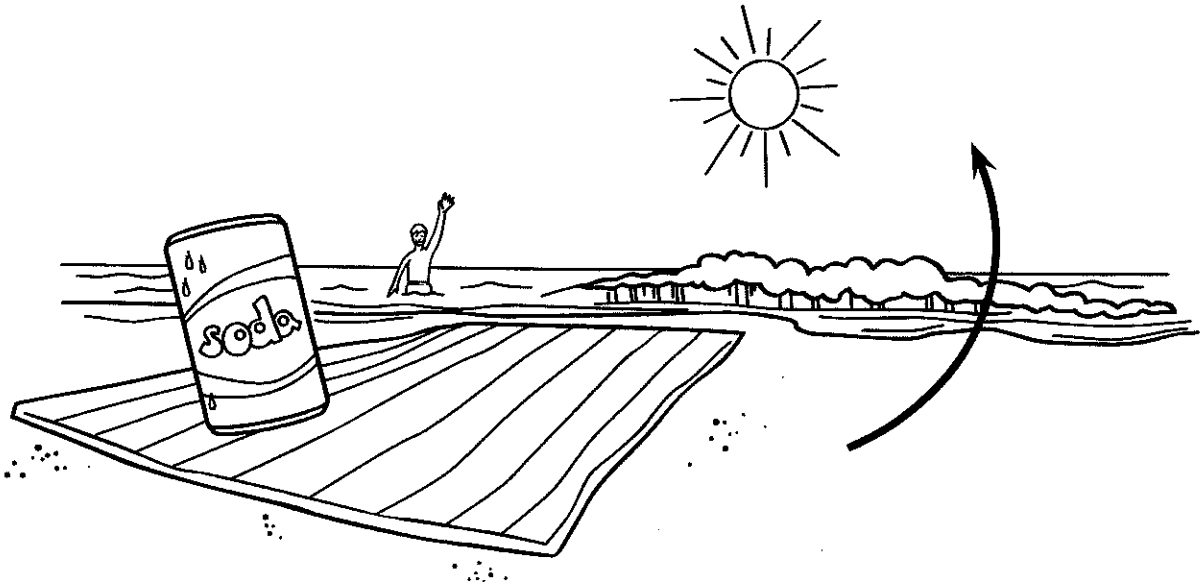
5. If you were the builder of a large office building that faced the sun, which type of windows would you want on your building?
   a. plain b. mirrored c. tinted d. double pane

6. Use information about energy transfer to explain your answer to number 5.

7. If you were an herb grower and needed to keep your plants warm, which window would you choose for your greenhouse?
   a. plain b. mirrored c. tinted d. double pane

8. Use information about energy transfer to explain your answer to number 7.

Heat Me Up!



Directions: Look at the illustration. Use these words to complete the sentences.

conduction convection radiation

1. The sun heats the water through _____.
2. The person gives off heat in the water through _____.
3. The water current heats the water through _____.
4. Food left in the sun is heating through _____.
5. When a pot of water boils, the water heats through _____.
6. Boiling spaghetti in a pot of water, the spaghetti heats through _____.

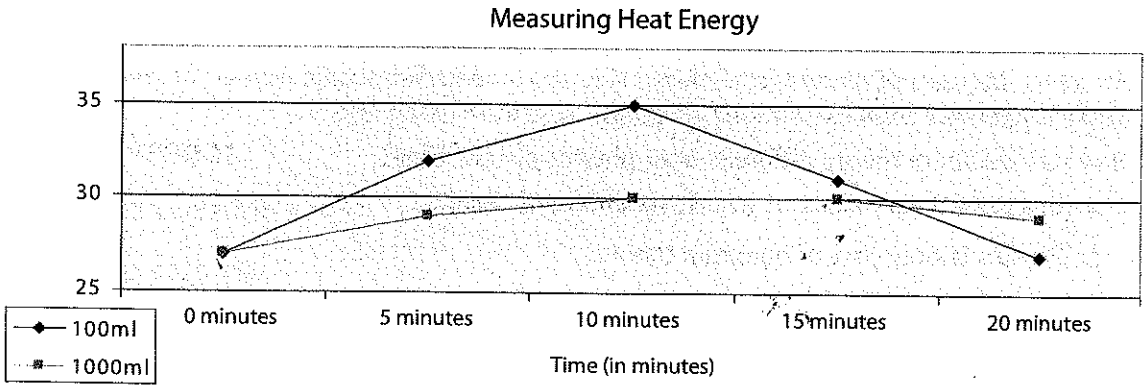
Back to Normal

Thermal energy is the amount of heat energy in a substance. The more particles a substance has, the greater its thermal energy.

The Zeroth Law states that heat moves from hotter objects to cooler ones until they are both the same temperature. For example, if you leave a cooler full of ice open all day, the temperature of the room and the cooler will eventually become the same.

This chart shows data collected during an experiment to measure thermal energy. Sam wanted to find out which held its thermal energy longer: a tea cup, or a swimming pool?

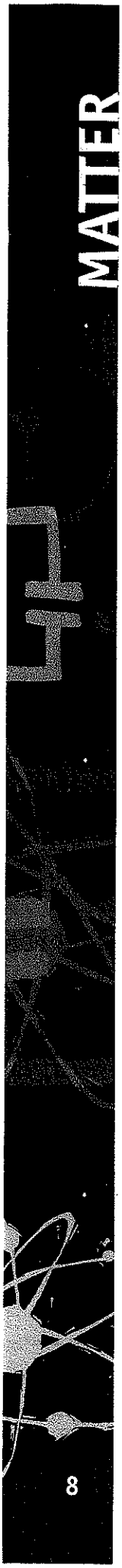
He measured 100ml of water in a small container, and 1000ml in a larger container. He placed a thermometer in both, and set them in a solar oven at the same time. He measured each container's temperature every five minutes for ten minutes. Then he brought the two containers inside to measure how fast they cooled down. Sam observed that the smaller container heated up more quickly, but it also lost all its heat energy quickly. The large container heated up slowly, but lost heat energy more slowly after it was brought inside.



Directions: Look at the chart. Answer the questions.

1. Which container had a greater temperature after heating for 10 minutes? _____
2. Which container had a greater temperature after cooling for 10 minutes? _____
3. Which container held its thermal energy longer? _____
4. Which container had the most thermal energy? _____
5. Can thermal energy be measured by temperature? _____
6. According to the Zeroth Law, what will happen after the two containers sit in the room for a long time? _____
7. To answer Sam's question, which would hold its thermal energy longer, a tea cup or a swimming pool? Why? _____

_____



Reader Quiz

Directions: Circle the best answer.

1. The three methods of heat transfer are...
   a. conduction, convection, and radiation.
   b. fire, sun, and electricity.
   c. molecules, atoms, and elements.
   d. thermal energy, temperature, and equalization.

2. An example of a high entropy system is...
   a. a new stack of playing cards.
   b. a newly cleaned hotel room.
   c. an orderly library.
   d. a town after a tornado has hit it.

3. Read these sentences from the book.
   For years, the laws of physics were clear. They explained what people wanted to know. But they didn't explain the movement inside of atoms. Quantum theory did.
   How was Quantum theory different from physics of that time?
   a. Quantum theory explains events on an atomic level.
   b. Physics is only part of quantum theory.
   c. Physics is the study of matter and energy.
   d. Quantum theory explains how energy affects matter.

4. Quantum theory led to what important discovery?
   a. prisms b. lasers c. space travel d. light waves

5. Why did the author write this book?
   a. to tell about molecules
   b. to compare states of matter
   c. to show how one scientist's work can affect many areas of science
   d. to persuade people to give money to scientific research

Directions: Write two to three sentences to answer this question. Use details and examples from the book to explain your answer.

6. How did Max Planck's study of thermodynamics benefit future scientists?

Max Planck Answer Key

Crystal Clear

1. d 2. c 3. a 4. a
5. Any answer is correct, as long as students can justify their response.
6. Accept responses that justify the student's answer to number 5. For example, if a student chose **b. tinted**, he or she might write that some of the heat energy from the sun would be reflected away from the building. This would keep the cooling costs down.
7. c is the best choice
8. Accept responses that justify the student's answer to number 7. For example, if a student chose **c. tinted**, he or she might write that the energy would be trapped inside the room, which would keep it warm.

Heat Me Up!

1. radiation 2. conduction 3. convection
4. radiation 5. convection 6. conduction

Back to Normal

1. the small container
2. the large container
3. the large container
4. the large container
5. no
6. Both containers and the room will all become the same temperature.
7. swimming pool

Reader Quiz

1. a 2. d 3. a 4. b 5. c
6. Answers will vary. Students may include information related to the work of Marie Curie, Stephen Hawking, Sally Ride, or Frances Hellman.

MATTER

Lab Lesson Plan: Separating Mixtures

Before the Lab

Review with students what they learned about the properties of matter. Guide students to include concepts related to essential vocabulary: atom, compound, conservation of mass, element, energy, matter, and particle.

Review the concept of a mixture. Discuss how mixtures compare or are related to compounds, elements, and solutions.

Review the idea of a theory. Have students hypothesize, using their knowledge of matter, how they might separate mixtures with similar properties.

Introduce the Lab

Read the introductory paragraph with students. Which laws of physics will the students apply with this lab? (magnetism, gravity, evaporation)

Read the list of materials. Provide each lab group with the necessary materials, or have the materials ready to complete as a demonstration lesson in front of the class.

Read through all the procedures with the students at least once before they engage in the lab. Check for understanding of the required steps.

Conduct the Lab

Allow time for lab groups to conduct the lab, or follow the steps as a class if conducting a demonstration lab.

After the Lab

Have each lab group summarize how the mixture changed between the beginning of the lab and at the end of the lab, or complete a class summary. Can all mixtures be separated into their separate compounds? Have volunteers explain their theory as it relates to the students' knowledge of matter.

Lab: Separating Mixtures

Scientists who study physics need to know all about matter. They need to know what it is made of and how it behaves. One important thing to know is how different substances act when together. Sometimes they join, as when hydrogen and oxygen make water. Other times, they simply mix. What is mixed can also be unmixed. This lab will help you to learn how to separate mixtures. You will need to know some laws of physics in order to do it.

Materials

- mixture of pebbles, sand, salt, and iron filings
- sieve with 1 cm holes
- filter paper
- filter funnel
- two large beakers
- strong magnet
- tripod
- gauze
- tongs
- water

Procedure

Mix the pebbles, sand, salt, and iron filings.

Now, you will separate them again. In order to do it, you will need to use what you have learned and know about mixtures, their properties, and how to separate them.

Think about what you know about the materials in the mixture. Think about their properties. How can you separate them? Follow these remaining steps:

Sift out the pebbles using the sieve.

Use the magnet to remove the iron-filings.

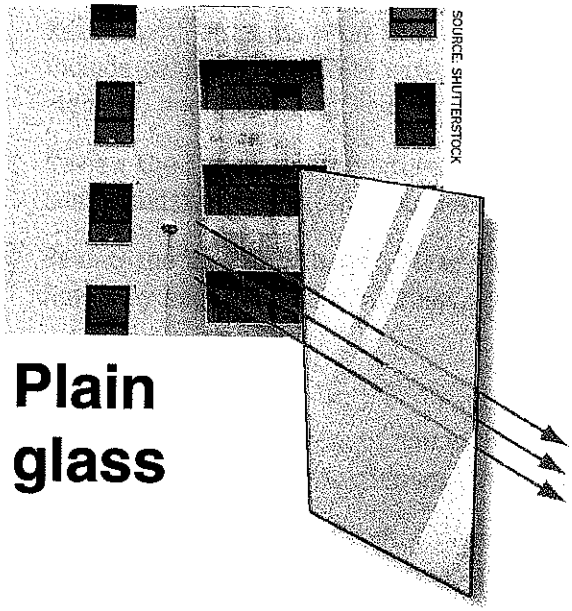
Put the sand and salt mixture into the large beaker. Add water and stir until all the salt is dissolved.

Put the filter paper inside the filter funnel. Stand a second large beaker below the funnel spout. Pour the mixture through the funnel. The sand will be left in the paper.

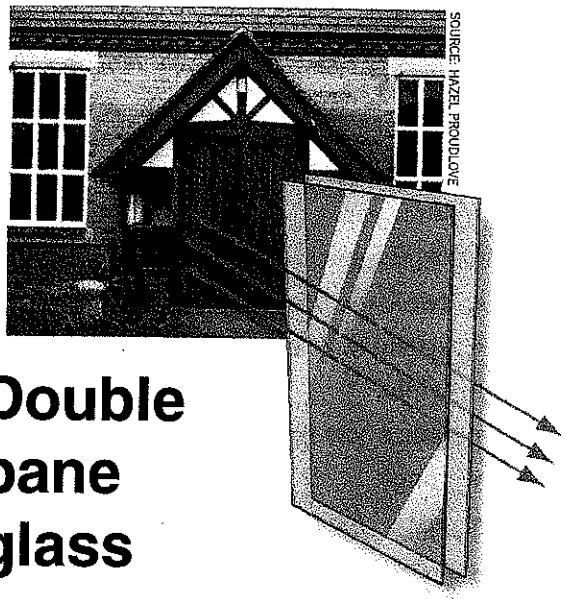
Leave the remaining mixture in a very warm or hot place until it evaporates.

If you follow these steps, you should be able to separate all the materials by using their physical properties.

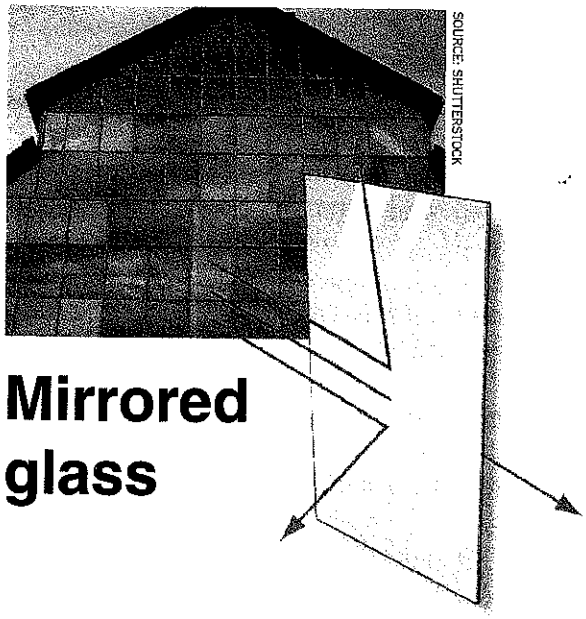
Crystal Clear Transparency



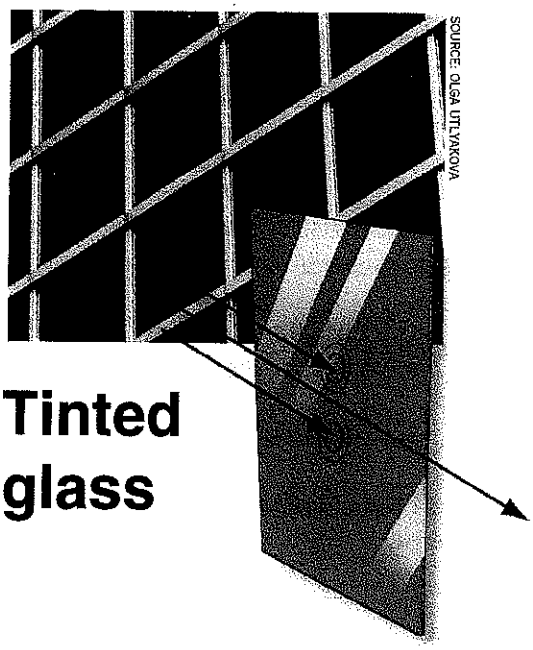
Plain glass



Double pane glass



Mirrored glass



Tinted glass