THE MATERIAL WORLD

TEACHER GUIDE

LAUNCH

PLANNING

Here's a suggested schedule for this kit! The activities should be completed in order, but you can choose when the lessons take place over time.

ACTIVITY INFORMATION	SECTION (S)	TIME REQUIRED	DAY/ LESSON
ACTIVITY 1: ENERGY SWITCH Use an electric current to produce a fast change in temperature. **Time required: 1 h 15 min**	☐ Heat in a Hurry ☐ Everyday Energy	75 minutes	Day 1
ACTIVITY 2: SOMETIMES SOFT Find out how changing temperatures can make a plastic polymer squishy or stiff. **Time required: 2 h 45 min**	☐ Bend It, Shape It	45 minutes	Day 2
	☐ A Place for Polymers	60 minutes	Day 3
	☐ Plastics Are Polymers	60 minutes	Day 4
ACTIVITY 3: METAL MEMORY Compare the behaviors of metals to those of plastics with a strange sample. **Time required: 3 h**	☐ Nostalgic Nitinol	60 minutes	Day 5

Full schedule available with purchase

2

EVERYDAY ENERGY

CONTENT

• In this section, your student will learn what a thermoelectric generator is and how it is used.
• The following vocabulary terms are defined: kinetic energy, thermal energy, electrical energy, material, materials engineering, and materials science.
• The student will gain more understanding of thermoelectric generators as they continue with the kit, so it's preferable if they don't seek out more information about these devices quite yet.
• Later, there will be more opportunities for diving deeper into the history and uses of thermoelectric generators.

THINK ABOUT IT!

Question 1: At this point, you have limited information about how the thermoelectric generator works. Based on what you know so far, develop an initial model of the flow of energy within the device and draw its internal structure.

Answer: Answers will vary but should not include much detail at this point in the kit.

How To Help:

• Each activity will ask the student to again show their modified model of a thermoelectric generator based on new information they gain and concepts they build while completing this kit.
• This first model will likely not include any specifics and it may some incorrect information.
• The point is not to be correct and complete yet, but to have a starting point to which they can compare their later models.
• The sequence of models also provides an opportunity for the student to practice metacognition (or "thinking about their thinking") as they notice how they knowledge and understanding of several related concepts grow.

activity 2

SOMETIMES SOFT

Differences in temperature are linked to many other types of changes. In Activity 1, your student observed a difference in temperature resulting from an electric current. Now, they will see how a difference in temperature can change the physical properties of a material.

LEARNING GOALS:

I can use scientific and technical information to explain why the molecular-level structures of materials are important to their functions.

BEND IT, SHAPE IT

WARNING! CHOKING HAZARD - Small parts. Not for children under 3 years.

WARNING! Water over 120 degrees F (50 degrees C) can cause burns in seconds. Do not touch hot water!

3

PREPARATION AND SUPERVISION

■ Your student will melt and shape the thermoplastic polymer pellets.
■ Encourage them to melt and reshape the polymer many times, if needed.
■ The key to success here is making sure the water is the right temperature using the thermometer.

NOSTALGIC NITINOL

PREPARATION AND SUPERVISION

WARNING! CHOKING HAZARD - Small parts.
Not for children under 3 years.

WARNING! Water over 120 degrees F (50 degrees C) can cause burns in seconds. Do not touch hot water!

- Your student will shape a piece of nitinol wire into a coil and drop it into hot water, and they will likely be surprised that the wire returns to its original straight shape (and does so very quickly!).
- Take care that the student doesn't wind the nitinol wire too tight around the stir rod; when it returns to the straight shape, it could propel itself out of the beaker and into someone's face.
- This phenomenon is explained in detail in the next section for the student.
- Be sure to have your student check the water temperature using the thermometer. If the wire doesn't straighten out, try raising the temperature by 5 or 10 degrees for another attempt.
- It is possible to change the "set" shape of the wire, but you will need to heat it to 400 to 500 degrees Celsius while stressing it into the new shape. This can be accomplished with additional heating and safety equipment, such as an open flame and something to hold the wire.

MULTIPLE AGES AND ABILITIES:

As with the thermoplastic polymer, you can have multiple students take turns with the nitinol wire since it is reusable. In fact, it would take many, many rounds before fatigue of the metal would occur and make is snap. Therefore, you can have each student try a different shape.

THINK ABOUT IT!

Question 1: What happened to the nitinol wire when it was placed in hot water? Why do you think that happened?
Answer:
• The wire quickly returned to its straight shape.
• Explanations will vary but might include something about states of matter or electrons at this point.

Question 2: What are some properties of the nitinol wire that make it well-suited to certain purposes? Explain.
Answer:
• Wire with a memory might be useful in situations in which the original shape or position of an object must be restored.
• The wire also has a very high melting point and is easily shapeable.
How To Help: *Nitinol wire is used in orthodontic braces, artery stents, wire loops for bacteria inoculation, chemical flame test needles, eyeglass frames, mobile phone antennas, and more.*

Question 3: What are two questions you have about this material?
Answer: Answers will vary.

LAUNCH

Science Unlocked

Contact us at: www.homesciencetools.com/customer-service/

A Product of Homesciencetools.com

Kit	SU-MATWOR
Instructions	IN-MATWORO
Revision Date	8/2021