NATURALLY NUCLEAR

TEACHER GUIDE

LAUNCH

PLANNING

Here's a suggested schedule for this kit! The activities are designed to be completed in order, but you can decide when to do them over time. The time required for each lesson may vary.

ACTIVITY INFORMATION	SECTION (S)	TIME REQUIRED	DAY/ LESSON
ACTIVITY 1: ENVIRONMENTAL ENERGY Learn about natural nuclear reactors. **Time required: 1 h**	☐ Nuclear Knowledge ☐ Radioactive Rocks	60 minutes	Day 1
ACTIVITY 2: HARNESS THE POWER Compare the energy released by chemical and nuclear reactions. **Time required: 3 h**	☐ Energy is Essential	90 minutes	Day 2
	☐ Nuclear Power	90 minutes	Day 3
ACTIVITY 3: RADIOACTIVE DECAY Explore radioactivity on a particle level. **Time required: 3 h**	☐ Nuclear Equations	90 minutes	Day 4
	☐ Breakin[illegible]		Day 6
ACTIVITY 4: MEASUR[illegible] **RADIOA[illegible]**			

activity 1

ENVIRONMENTAL ENERGY

Where does nuclear energy come from? How powerful are nuclear reactions? These questions and more will begin to be addressed in this activity.

LEARNING GOALS:

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

NUCLEAR KNOWLEDGE

1

CONTENT

• Beginning in this section, your student will organize their thoughts about nuclear reactions using the KWLQA graphic organizer in the Student Workbook.
• The abbreviation KWLQA stands for Know, Want to Know, Learned, Questions, Actions.

- **Know:** the student should write what they already know about the topic before they engage with the instructional materials. It doesn't matter if the information in this part is correct. It's important for the student to be aware of how their ideas change throughout the learning process.
- **Want to Know:** This is for the student's questions about a topic before they gain any new knowledge. These questions may or may not be answered by the learning experience.
- **Learned:** This should include brief summaries, worked examples, important vocabulary, standout facts, and personal connections the student gains during instruction. You can decide how much depth and breadth you want the student to include in this column, using separate paper if appropriate.
- **Questions:** This is for questions that the student generates about content throughout the learning experience. They can be directly related to concepts in the instruction, or they can be indirectly related, such as how something connects to an everyday-life example.
- **Actions:** Here, the student should write what they can do to answer the questions or reinforce their learning. This could include things like doing the extension activities, reviewing previous content, or doing additional research in a textbook or online.

• The student will begin the KWLQA chart and come back to it at the end of every activity. For now, they should complete only the K and W parts of the chart. They will fill in the rest of the sections later.

RADIOACTIVE ROCKS

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CONTENT

• This section details the discovery of a natural nuclear reactor.

- The definition of a nuclear reactor, as well as several related terms, will be introduced in the later activities.
- For now, have your student focus on how the story relates to their prior knowledge and feelings about nuclear reactions.

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CHANGING ISOTOPES

PARENTS AND DAUGHTERS

• Your student will find out how nuclear reactions start with unstable parent isotopes and produce more stable daughter isotopes.
• The following vocabulary terms are defined: parent isotope, daughter isotope, and radioactivity.

THINK ABOUT IT!

Question 1: Why do you think isotopes in nuclear reactions are called "parents" and "daughters"?
Answer: The daughter isotopes come from the parent isotopes like people who are daughters come from parents.
How to Help: *Your student may think there is a more complex reason but this one is a simple analogy.*

Question 2: In each of the nuclear equations below, label the parent isotope and daughter isotope.
Answer: The parent isotopes are always on the left side of the arrow, while the daughter isotopes are after the arrow.
How to Help: *When there are more than two groups of isotopes, as in a three-step nuclear reaction, an isotope in the middle (not the first or last isotope) is both a parent isotope and a daughter isotope.*

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CHAIN OF DECAY

• Your student will build off their understanding of parent and daughter isotopes to learn about nuclear decay chains, which are especially important in nuclear reactors.
• The vocabulary term nuclear decay chain is defined.
• A quick aside about alchemy is included; it is a pseudoscience that was popular during a time just before the beginning of modern science.
  - It also has connections to nuclear reactions because people who studied it believed they could "transmute" elements into other elements, a feat only performed by nuclear reactions.

THINK ABOUT IT!

Question 1: Why do you think nuclear power plants use chain reactions, in terms of efficiency and resources? Explain.
Answer: The more a power plant can reduce the initial cost of fuel and the cost of disposing of waste, the better.
How to Help: *Starting with one material and getting as much energy out of it as possible makes sense for financial and environmental reasons. In addition, safety is improved if workers do not have to interact with the reactor as much.*

Question 2: How long do you think nuclear decay takes? Explain.
Answer: Answers will vary.
How to Help: *Nuclear decay times vary from fractions of a second to billions of years or more, depending on the half-life of the radioactive material (which is further explained in the next section).*

NOTES: