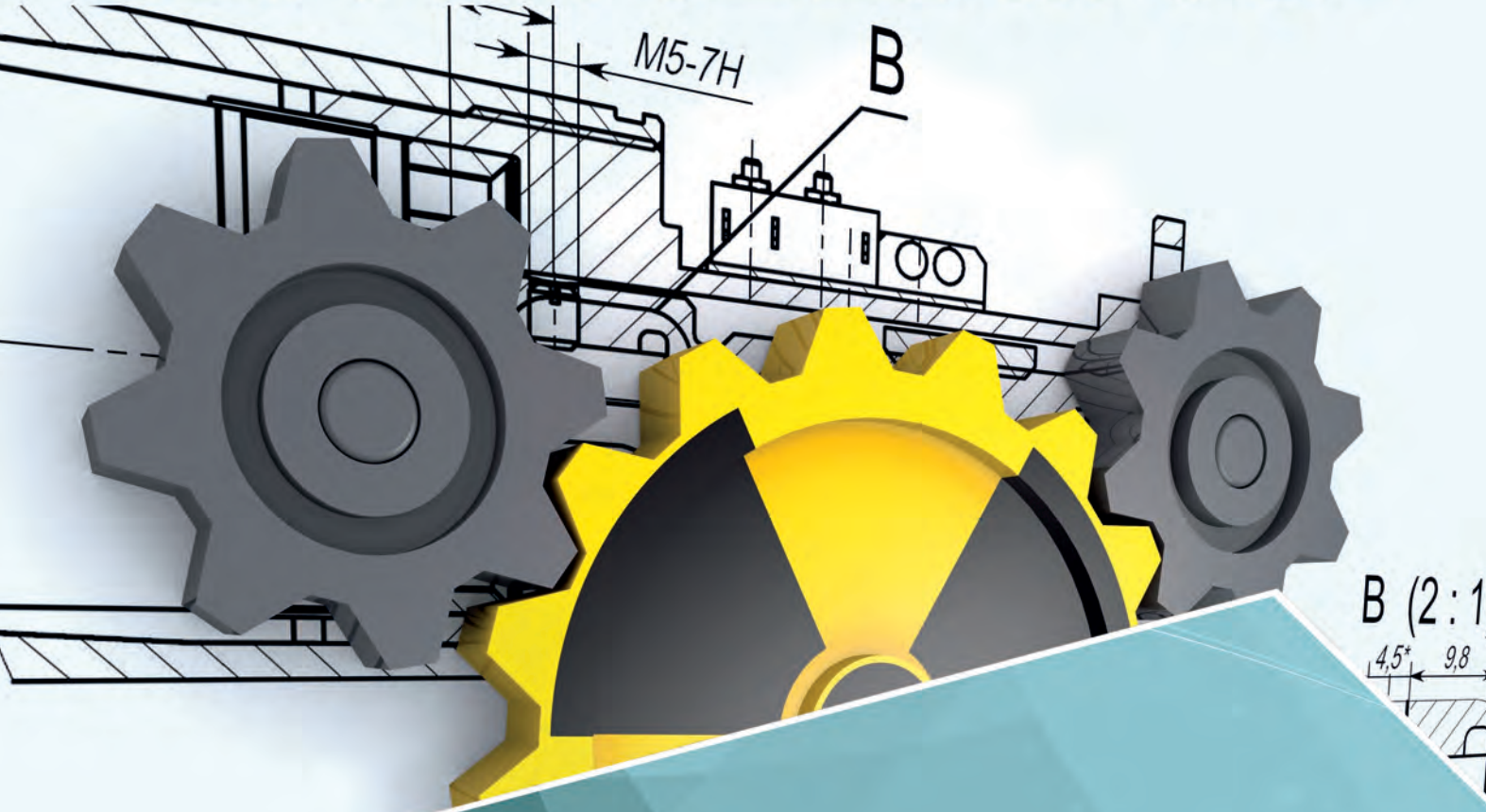
CAREER PATHS

Virginia Evans
Jenny Dooley
Anil Prinja, PhD

NUCLEAR ENGINEERING



Express Publishing

CAREER PATHS

NUCLEAR ENGINEERING

Book 1

Virginia Evans
Jenny Dooley
Anil Prinja, PhD

Express Publishing

Scope and Sequence

Unit	Topic	Reading context	Vocabulary	Function
1	The Nuclear Engineer	Magazine article	detection, diagnostic imaging, disposal, dosimetry, nuclear fuel, nuclear power, nuclear proliferation, nuclear reactor, nuclear weapon, radiation therapy	Correcting a misconception
2	Energy	Textbook excerpt	act on, chemical energy, chemical reaction, conserve, energy, force, heat, kinetic energy, light energy, potential energy, radiant energy, sound energy, store, thermal energy, transfer	Correcting yourself
3	Atoms	Encyclopedia entry	atom, atomic number, electron, element, isotope, mass number, neutron, nucleus, proton, subatomic particle	Describing similarities and differences
4	The Periodic Table	Guide	atomic radius, block, electron configuration, element symbol, group, ionization energy, period, periodic table, valence shell, VSEPR theory	Making comparisons
5	Measurements	Conversion chart	Celsius, convert, cubic foot, cubic meter, Fahrenheit, gallon, imperial, kilogram, liter, metric, pound, ton, tonne	Asking for assistance
6	SI Units	Poster	base unit, derived unit, energy, force, joule, Kelvin, newton, pascal, pressure, SI, temperature	Confirming information
7	Numbers and Basic Math	Chart	add, divide by, equal, -hundred, less, minus, multiply by, over, plus, subtract, times	Expressing confusion
8	Large Numbers	Employee manual	cubed, exponent, hundredth, leading zero, order of magnitude, rounding error, scientific notation, significant figure, squared, tenth, thousandth, to the nth power, trailing zero	Making a realization
9	Analyzing Quantities	Textbook excerpt	convert, decimal number, denominator, fraction, numerator, -out of -, percent, percentage, point, reduce	Correcting an error
10	Describing Change	Journal article	decline, decrease, double, expand, fluctuate, increase, rise, stabilize, steady, trend	Describing change
11	Radioactivity	Textbook chapter	activity , alpha particle, beta particle, decay law, disintegration, gamma ray, half-life, neutrino, radioactive decay, radioactivity	Asking for clarification
12	Nuclear Processes	Course description	bombardment, cross section, elastic scattering, induce, inelastic scattering, neutron migration, nuclear reaction, particle attenuation, spontaneously, transmutation	Making a polite request
13	Materials and Radiation	Textbook excerpt	charged, excitation, ionization, particle, photon, radiation, range, stopping power, target, uncharged, X-ray	Asking about a process
14	Fission	Poster	absorption, byproduct, chain reaction, delayed neutron, fissile, fission, fission fragment, fission product, prompt neutron, split	Describing order of events
15	Fusion	Magazine article	constraint, D-D fusion reaction, deuterium, electrostatic repulsion, fuse, fusion, inertial confinement, magnetic confinement, plasma, radiation loss, thermonuclear	Giving news

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CAREER PATHS

NUCLEAR ENGINEERING

Book 2

Virginia Evans
Jenny Dooley
Anil Prinja, PhD

Express Publishing

Scope and Sequence

Unit	Topic	Reading context	Vocabulary	Function
1	Education	Webpage	bachelor's degree, calculus, computer science, doctoral, engineering, master's degree, PhD, physics, postgraduate, radiochemistry, thermal hydraulics, undergraduate	Giving advice
2	Radioactive Materials	Article	Americium 241, becquerel, curie, krypton 85, plutonium, polonium, potassium 40, radium, thorium, tritium, uranium	Asking for an explanation
3	The Scientific Method	Textbook excerpt	conclusion, control group, evaluate, experiment, experimental group, hypothesis, independent variable, observation, problem, result, scientific method, testable	Describing an experiment
4	Rate Processes	Employee manual	diameter, driving force, flow rate, flux, inlet, outlet, pressure, rate, rate process, resistance, viscosity	Asking for information
5	Accounting	Textbook excerpt	closed system, consumption, extensive quantity, final, generation, initial, input, intensive quantity, open system, output, system, universal accounting equation	Expressing confusion
6	Particle Accelerators	Textbook excerpt	betatron, Cockroft-Walton generator, collider, cyclotron, electromagnetic field, electrostatic generator, linear accelerator, orbit, particle accelerator, spallation, synchrotron, Van de Graaff accelerator, voltage multiplier	Providing an explanation
7	Isotope Separators	Letter	AVLIS, cascade, centrifugal force, cryogenic distillation, gas centrifuge, gaseous diffusion, isotope separator, laser, mass spectrometry, membrane, MLIS, SWU	Agreeing/ Disagreeing
8	Neutron Chain Reactions	Textbook excerpt	balance, critical, critical mass, critical volume, effective neutron multiplication factor (k), explosion, leakage, reactivity (ρ), self-sustaining, subcritical, supercritical, volatile	Clarifying information
9	Nuclear Heat Energy	Webpage	condenser, conduction, convection, cooling agent, cooling tower, heat exchanger, heat transmission, radiation, steam, temperature gradient, turbine, waste heat	Describing results
10	PPE	Webpage	anti-contamination, anti-static, bootie, coverall, exit portal monitor, flame resistant, glove, hood, laundry, oversuit, PPE, respirator, scrubs	Providing reassurance
11	Thermal Reactors	Editorial	BWR, containment building, coolant, fuel rod, HTGR, LWR, moderator, PHWR, PWR, radiation shielding, reactor vessel, thermal reactor	Asking about differences
12	Breeder Reactors	Textbook excerpt	breeder reactor, breeding gain, breeding ratio, conversion ratio, doubling time, fast reactor, generate, IFR, LMFBR, loop system, pot system, thermal breeder reactor	Describing benefits
13	Fusion Reactors	Article	D-T reaction, fusion reactor, ICF machine, ignition temperature, ITER, MCF machine, neutral particle injection, ohmic heating, RF generator, tokamak, vacuum vessel	Expressing interest
14	Reactor Safety	Webpage	containment system, containment ventilation, control rod, control room ventilation, core catcher, diesel generator, ECCS, ESWS, fuel cladding, RPS, safety injection, SBGT	Clarifying information
15	Reactor Accidents	Abstract	Chernobyl, core melt accident, criticality accident, decay heat, equipment failure, failsafe, Fukushima Daiichi, human error, LOCA, meltdown, redundancy, sarcophagus, Three Mile Island	Discussing risk

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CAREER PATHS

NUCLEAR ENGINEERING

Book 3

Virginia Evans
Jenny Dooley
Anil Prinja, PhD

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Scope and Sequence

Unit	Topic	Reading context		Function
1	Uses of Isotopes	Article	carbon-14, CT scan, dating, medical imaging, neutron activation analysis, PET scan, radiography, radioimmunoassay, radioisotope, radiopharmaceutical, SPECT scan, tracer	Describing differences
2	Effects of Radiation	Textbook excerpt	acute, background radiation, biological, cancer, chronic, effective dose, exposure, genetic, hazard, mutation, organism, radiation poisoning, rem, sievert, somatic	Giving reassurance
3	Risk Assessment	Course description	consequences, core damage, event tree, failure, fault tree, frequency, immediate, intersection, latent, mitigation, probabilistic risk analysis, risk, undesired, union, Venn diagram	Agreeing with a suggestion
4	Radiation Detectors	Product listing	accuracy, Cerenkov counter, dead time, detector, gas counter, Geiger-Müller counter, nuclear emulsion track detector, proportional counter, pulse height analysis, purpose, solid state detector, trace	Expressing necessity
5	Uses of Radiation	Article	brachytherapy, crop mutation, dose fractionation, food preservation, insect, irradiation, pathogen reduction, radiation therapy, SIT, spoilage, sterilization, suppress, tumor	Asking for an explanation
6	International Use of Nuclear Power	Report	consolidation, deregulation, distribution, globalization, in development, mothball, MWe, operate, per capita, phase out, privatization, shut down, state-owned	Reacting to bad news
7	International Bodies and Regulations	Online encyclopedia entry	commission, IAEA, INRA, INSAG, INSC, member, NEA, OECD, peaceful, promote, safeguard, standard, UNAEC	Expressing preferences
8	Security	Report	adequate, aircraft attack, attack, background check, breach, DBT, hack, IT, physical barrier, protection, release, security, security officer, surveillance, terrorism	Discussing goals
9	Nuclear Propulsion	Article	aircraft carrier, commercial, compact, DIPS, interplanetary, lunar, merchant ship, naval, propulsion, refuel, RTG, service life, spacecraft, submarine	Politely disagreeing
10	Waste Disposal 1	Textbook excerpt	burial, fuel fabrication, high-level waste, low-level waste, nuclear fuel cycle, once-through, ore, radioactive waste, reprocess, spent fuel, store, tailings, transuranic waste, yellowcake	Checking understanding
11	Waste Disposal 2	Webpage	backfill, canister, compaction, consolidate, drill, filter, immobilize, incineration, ion exchange, leaching, packing, shaft, storage, subsidence, transportation	Discussing plans/ intentions
12	Waste Disposal 3	Letter	aboveground vault disposal, belowground vault disposal, cap, depth, double, drainage channel, earth-mounded concrete bunker disposal, erosion, intermediate-depth disposal, mined-cavity disposal, modular concrete canister disposal, runoff, shaft disposal	Discussing pros and cons
13	Nuclear Weapons	Webpage	atom bomb, fallout, fission explosive, hydrogen bomb, ICBM, missile shield, mutually assured destruction, New START, nonproliferation, nuclear winter, reduction, SORT, START I, START II, thermonuclear explosive, weapons-grade	Making an assumption
14	Future of Nuclear Energy	Journal article	consumption, desalination, eliminate, global warming, greenhouse gases, lead-cooled fast reactor, multi-effect distillation, multistage flash distillation, population growth, production, R&D, reverse osmosis, sodium-cooled fast reactor	Asking for information
15	Career Options	Webpage	advisor, aerospace, defense agency, developer, government, medical industry, military, plant design, power industry, professor, research, test engineer, utility company	Discussing qualifications

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1 The Nuclear Engineer

Get ready!

1 Before you read the passage, talk about these questions.

1 What jobs are available for nuclear engineers?

2 What are some different uses for nuclear technology?

Reading

2 Read the magazine article. Then, choose the correct answers.

1 What is the main idea of the article?

A recent advancements in nuclear engineering

B areas of employment in the nuclear industry

C how nuclear weapons are detected

D pursuing an education in nuclear engineering

2 Which career option is NOT mentioned in the article?

A monitoring medical diagnostic systems.

B aiding in the development of imaging equipment

C detecting nuclear material

D training new engineers to maintain nuclear energy output

3 What is true of dosimetry?

A It is used to detect nuclear weapons.

B It measures the amount of nuclear power being generated.

C It is important when making medical diagnoses.

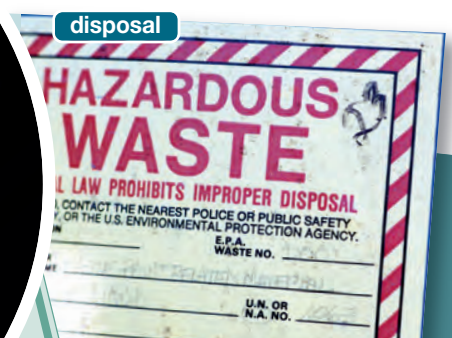
D It is used to sustain a nuclear reaction.

JOBS TODAY

Nuclear Engineers

Nuclear engineers have career options in many fascinating areas. A popular field is the generation of **nuclear power**. This process takes place in a **nuclear reactor**. Engineers also develop **nuclear fuel**. This is what sustains nuclear reactions. Another option is working with **nuclear weapons**. **Nuclear proliferation** is an increasing international concern. Engineers develop systems for the **detection** of nuclear waste. Then, they ensure safe **disposal**.

Many engineers also work in the medical world. Nuclear engineers monitor **radiation therapy** and **diagnostic imaging**. Accurate **dosimetry** ensures that these treatments are safe. Manufacturers need nuclear engineers to develop, maintain, and improve these systems.



Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ nuclear power
2 __ nuclear weapon
3 __ nuclear fuel
4 __ dosimetry
5 __ diagnostic imaging
6 __ nuclear reactor
7 __ nuclear proliferation
8 __ radiation therapy

A a machine that controls nuclear reactions for the production of energy
B the material used to generate nuclear energy
C the product of the reaction of nuclear material
D an explosive that gets its power from a nuclear reaction
E the widespread availability of nuclear energy and weapons
F the treatment of disease by exposure to a radioactive substance
G the measurement of the amount of radiation emitted from a source
H the use of nuclear technology to produce internal images of a structure

4 Read the sentence pairs. Choose the sentence that uses the underlined part correctly.

1 **A** Nuclear engineers must prevent <u>detection</u>.
B There are many steps in the safe <u>disposal</u> of nuclear weapons.

2 **A** Scientists are often asked to monitor <u>nuclear proliferation</u>.
B <u>Nuclear fuel</u> is commonly used to power cars.

5 Listen and read the magazine article again. What is nuclear fuel used for?

Listening

6 Listen to a conversation between an intern and an engineer. Mark the following statements as true (T) or false (F).

1 __ The man works in nuclear power production.
2 __ The woman assumed that the man worked in the medical field.
3 __ The man studied radiation therapy as an intern.

7 Listen again and complete the conversation.

Intern: So you're a **1** _____ _____. What do you do?
Engineer: I develop **2** _____ systems for nuclear weapons.
Intern: So you don't produce **3** _____ _____?
Engineer: Most people think that! But that is a common **4** _____.
Intern: What other jobs are there for engineers?
Engineer: Some engineers work in **5** _____ _____ _____.
Intern: I didn't think of that. What kind of work do they do there?
Engineer: As an intern, I worked on **6** _____ _____. It's a good career path.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

What do you do?
I thought ...
It's a common misconception ...

Student A: You are an intern. Talk to Student B about:

- his or her job as a nuclear engineer
- what types of jobs are available for nuclear engineers

Student B: You are a nuclear engineer. Talk to Student A about jobs for nuclear engineers.

Writing

9 Use the magazine article and the conversation from Task 8 to fill out a letter of interest to a potential employer.

TO WHOM IT MAY CONCERN

Thank you for considering my application. As you can see, I am a qualified nuclear engineer. I currently monitor _____

_____.

_____

_____.

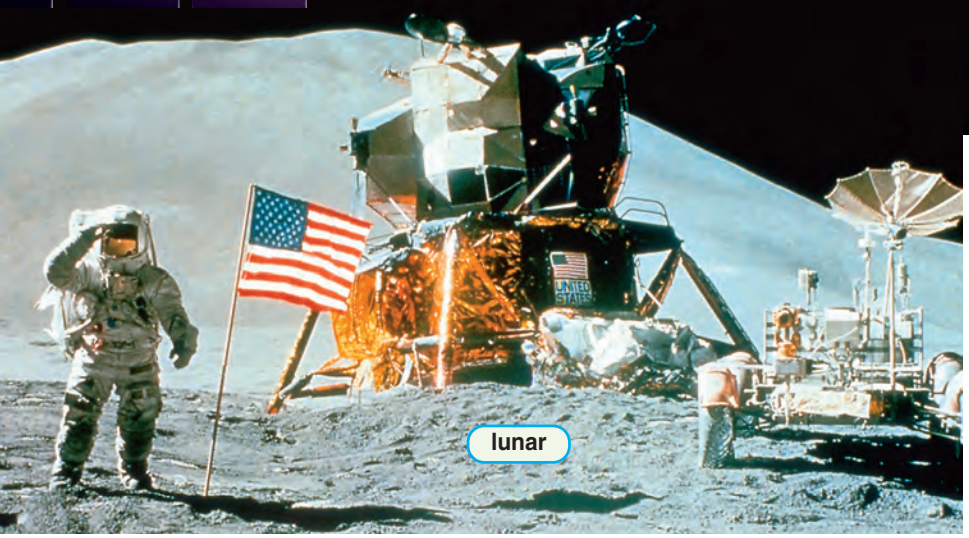
_____

_____.

I hope to hear from you soon.

Sincerely,
Joseph Milton

9 Nuclear Propulsion



Propulsion into the Future:
USING NUCLEAR POWER

by Amanda Lindt

Engineers continually make breakthroughs in nuclear **propulsion**. This technology is already commonly used in **submarines**, **aircraft carriers**, and other **naval** vessels. It provides vehicles with the power they need without expensive fuel costs.

Nuclear propulsion is becoming popular for **commercial** use as well. Manufacturers are finding more and more viable ways to use these systems. A few **merchant ships** now rely on nuclear power for propulsion.

And sea travel isn't the only application for nuclear propulsion. Scientists are developing devices for space travel, too. Nuclear propulsion devices are **compact** and have long **service lives**. This makes them ideal for **spacecraft**. Additionally, crews rarely need to **refuel** these types of power sources. Nuclear propulsion for spacecraft is still in experimental stages. But nuclear technology is still used onboard. Low-power **RTG** (radioisotope thermoelectric generators) and **DIPS** (dynamic isotope power systems) provide heating and electricity for many spacecraft.

In the future, nuclear propulsion could lead to even more advanced space travel. **Interplanetary** travel requires a small power source that can operate for many years. It also requires a source that does not need to be refueled. A **lunar** base would have similar requirements. Advancements in nuclear power and propulsion make these applications more practical every day.

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some nautical uses for nuclear propulsion?

2 How can nuclear propulsion be used for space travel?

Reading

2 Read the article. Then, mark the following statements as true (T) or false (F).

1 __ The purpose of the article is to discuss the ways that nuclear propulsion is used.

2 __ It is a benefit of nuclear propulsion to provide power without expensive fuel costs.

3 __ Nuclear propulsion is useful for sea travel because it is resistant to hazards at sea.

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1 __ DIPS

2 __ compact

3 __ propulsion

4 __ RTG

5 __ refuel

6 __ service life

A able to fit into a small area

B the time that a machine will continue to run properly

C a low-power nuclear generator

D a power generator that works by heating an organic substance

E the ability to move something forward

F to fill a tank or vessel with fuel

4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **interplanetary / lunar**

A The possibility of building a(n) _____ base is still very far in the future.

B Travel from the earth to other planets is _____ travel.

2 **naval / commercial**

A Military ships are _____ vessels.

B Ships carrying goods or passengers are _____ vessels.

3 **spacecraft / submarine**

A A _____ travels beneath the surface of the water.

B A _____ travels outside of the earth's atmosphere.

4 **merchant ships / aircraft carriers**

A Companies use _____ to transport products.

B The military uses _____ to transport planes.

5 **Listen and read the article again. Why is nuclear propulsion a good option for spacecraft?**

Listening

6 **Listen to a conversation between two nuclear engineers. Mark the following statements as true (T) or false (F).**

1 __ The woman supports the nuclear propulsion development for naval vessels.

2 __ The man and the woman are deciding which development project to start next.

3 __ According to the man, nuclear power should be used more in the communication industry.

7 **Listen again and complete the conversation.**

Eng. 1: Did you read **1** _____ _____ _____ _____ they are developing for satellites?

Eng. 2: Yes. But I'm not sure that's **2** _____ _____ _____ of resources.

Eng. 1: Really? I think it's exciting. It's great to see nuclear **3** _____ _____ _____ for spacecraft.

Eng. 2: I guess so. I'd like to see it put to **4** _____ _____ _____ , though.

Eng. 1: What do you mean?

Eng. 2: I don't see why they're developing new **5** _____ _____ for spacecraft. We should improve the ones we have for use **6** _____ _____ _____ .

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

Did you read about ...?

I'm not sure I agree with you.

I guess that's true.

Student A: You are an engineer. Talk to Student B about:

- new uses for nuclear propulsion
- your opinion about the best applications for new nuclear development
- why you think these applications are practical

Student B: You are an engineer. Talk to Student A about new nuclear developments.

Writing

9 **Use the article and the conversation from Task 8 to write about nuclear propulsion. Include: an application of nuclear propulsion and the benefits of using nuclear propulsion for this purpose.**

Glossary

NEA [ABBREV-U7] The **NEA** (Nuclear Energy Agency) is an agency that focuses on expanding the nuclear energy field through engineering and scientific studies.

neutron activation analysis [N-UNCOUNT-U1] **Neutron activation analysis** is a process in which a material is bombarded with neutrons so that its radioisotopes can be examined and its element concentrations can be identified.

New START [N-UNCOUNT-U13] **New START** is an agreement between the United States and Russia, replacing the SORT, in which both parties agreed to reduce the number of nuclear weapons that they possess.

nonproliferation [N-UNCOUNT-U13] **Nonproliferation** is the prevention of an increase in the number of nuclear weapons in the world.

nuclear emulsion track detector [N-COUNT-U4] A **nuclear emulsion track detector** is a photographic plate that records the paths of charged particles passing through it.

nuclear fuel cycle [N-COUNT-U10] The **nuclear fuel cycle** is a process through which material used to create nuclear energy is created, used, and either processed further or discarded.

nuclear winter [N-UNCOUNT-U13] **Nuclear winter** is a predicted period of abnormal darkness and cold caused by the particles in the atmosphere after a nuclear war.

OECD [ABBREV-U7] The **OECD** (Organization for Economic Cooperation and Development) is an organization that supports policies that will improve the economic and social well-being of people worldwide.

once-through [ADJ-U10] If a fuel cycle is **once-through**, it is a system in which fuel is not reused after its initial application.

operate [V-T-U6] To **operate** something is to use it or make it work.

ore [N-COUNT-U10] An **ore** is a rock that has an important element distributed throughout its structure.

organism [N-COUNT-U2] An **organism** is an individual life form such as an animal or plant.

packing [N-UNCOUNT-U11] **Packing** is material that is used to protect a fragile or vulnerable substance when it is stored or transported.

pathogen reduction [N-UNCOUNT-U5] **Pathogen reduction** is the process of using radiation to kill bacteria and sterilize food.

peaceful [ADJ-U7] If something is **peaceful**, it is free from violence.

per capita [ADJ-U6] If something is **per capita**, it measures how much of something exists for each person in a particular area.

PET scan [ABBREV-U1] A **PET** (positron emission tomography) **scan** is a process that uses injections of radiopharmaceuticals to enhance three-dimensional images of a patient's organs.

phase out [V-T-U6] To **phase out** something is to stop using it gradually.

physical barrier [N-COUNT-U8] A **physical barrier** is an object, such as a wall, that prevents people or objects from exiting or entering.

plant design [N-UNCOUNT-U15] **Plant design** is work relating to planning the construction of industrial plants.

population growth [N-UNCOUNT-U14] **Population growth** is the increase in the number of people in an area.

power industry [N-COUNT-U15] The **power industry** is a system of companies and agencies that provide electrical energy.

privatization [N-UNCOUNT-U6] **Privatization** is the process of transferring control of a state-owned operation or facility to a private company instead.

probabilistic risk analysis [N-UNCOUNT-U3] **Probabilistic risk analysis** (PRA) is a formal method for assessing the safety and performance of nuclear reactor systems.

production [N-UNCOUNT-U14] **Production** is the process of creating or manufacturing something out of raw materials.

professor [N-COUNT-U15] A **professor** is a teacher at a university who usually has a doctorate or other advanced degree.

CAREER PATHS

NUCLEAR ENGINEERING

Career Paths: Nuclear Engineering is a new educational resource for nuclear engineering professionals who want to improve their English communication in a work environment. Incorporating career-specific vocabulary and contexts, each unit offers step-by-step instruction that immerses students in the four key language components: reading, listening, speaking, and writing. ***Career Paths: Nuclear Engineering*** addresses topics including materials, nuclear reactors, radioactivity, safety procedures, and career options.

The series is organized into three levels of difficulty and offers a minimum of 400 vocabulary terms and phrases. Every unit includes a test of reading comprehension, vocabulary, and listening skills, and leads students through written and oral production.

Included Features:

- A variety of realistic reading passages
- Career-specific dialogues
- 45 reading and listening comprehension checks
- Over 400 vocabulary terms and phrases
- Guided speaking and writing exercises
- Complete glossary of terms and phrases

The **Teacher's Guide** contains detailed lesson plans, a full answer key and audio scripts.

The **audio CDs** contain all recorded material.

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