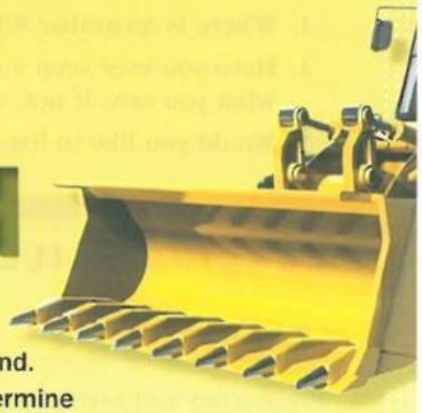
UNIT 1

Going Underground



In this unit, you will

- read about the benefits of living and working underground.
- learn how one metropolitan city uses technology to determine what exists underneath it.
- increase your understanding of the target academic words for this unit.

READING SKILLS Previewing and Predicting

Self-Assessment

Think about how well you know each target word, and check (✓) the appropriate column. I have...

TARGET WORDS	never seen the word before	seen the word but am not sure what it means	seen the word and understand what it means	used the word, but am not sure if correctly	used the word confidently in *either* speaking *or* writing	used the word confidently in *both* speaking *and* writing
AWL						
assume						
create						
emerge						
environment						
ethnic						
immigrate						
liberal						
locate						
notwithstanding						
predict						
similar						
structure						
technique						
unique						

Oxford 3000™ keywords

Outside the Reading What do you know about engineering?
Watch the video on the student website to find out more.

LIVEWORKSHEETS

READING 1

Before You Read

Read these questions. Discuss your answers in a small group.

1. Where is Australia? What do you know about its weather and its landscape?
2. Have you ever seen a movie or a photograph showing a mine? If so, describe what you saw. If not, what do you think conditions in a mine are like?
3. Would you like to live in an underground house? Why or why not?

READING SKILL Previewing and Predicting

LEARN

Previewing and *predicting* are strategies you can use before you read a text. A quick preview of the key elements of a text can help you predict what it might be about. This will help prepare you to take in the information as you read.

To preview a text:

- Read the title and any headings.
- Look at any photographs, illustrations, or graphics.

Then, based on your preview, predict some ideas and information you expect to find in the text.

APPLY

Take one minute to preview Reading 1. In the first column of the chart, write five words or phrases that caught your attention during your preview. In the middle column, use each word or phrase to create a prediction about the reading.

Word or phrase	Prediction	Accurate?
1. Down under	*The reading will be about Australia.*	

After you read, write *Y* (yes) next to each accurate prediction and *N* (no) next to each inaccurate prediction in the last column of the chart. Write a question mark (?) if you are not sure. Discuss your results with the class.

LIVEWORKSHEETS

Read

This online travel magazine article is about a town in Australia's outback, or isolated rural areas, where underground homes are common.

Coober Pedy: Really Down Under



Coober Pedy, a dusty town in South Australia, sits atop the world's greatest known deposits of opal—a milky white gem with stripes and flecks of color. In hopes of getting rich, gemstone miners endure the harsh outback **environment**. They suffer through dust storms, flies, and midsummer temperatures higher than 120° Fahrenheit (about 50° Celsius). To escape the heat and the flies, the people of Coober Pedy go underground. They carve homes—called "dug-outs"—into the hills overlooking the town. Subterranean[1] living has become normal in Coober Pedy. There are shops, hotels, meeting halls, and restaurants underground.

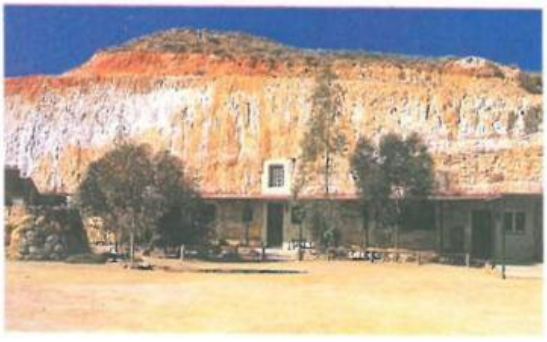
THE MINERS ARRIVE

The first opals in Coober Pedy were discovered by a 14-year-old boy, Willie Hutchinson, who was looking for gold with his father in 1915. Many soldiers returning from World War I came to the area and dug the first underground residences. A settlement took shape, which Aborigines (the original inhabitants of the area) called *Kupa Piti*, meaning "White Man's Burrow."

Most miners arrived in the 1960s and 1970s, **immigrating** to Australia and Coober Pedy from around the globe. The current population of 3,500 includes members of more than 40 **ethnic** or national groups, including Greeks, Poles, Germans, Italians, Serbs, and Croats. They live together in relative harmony, producing 80 percent of the world's opals. Dealers from Hong Kong buy the opals directly from the miners because large companies cannot mine here. Mining permits are sold only to individuals or small groups.

ROUGH EDGES

Like many mining communities, Coober Pedy is a rough and rugged town. Trucks with "Explosives" signs on their sides clatter[2] around the streets. A sign outside the drive-in movie theater politely asks patrons not to bring in any dynamite. The miners may enjoy a rough kind of fun—including occasional fights—but the community takes a **liberal** attitude toward this behavior.



A dug-out home

[1] *subterranean:* underground, from the Latin sub, meaning "under," and terra, meaning "land"
[2] *clatter:* make noise, such as when metal pieces repeatedly hit each other

LIVEWORKSHEETS

Its rough edges **notwithstanding**, Coober Pedy has a warmth and raw charm. Many residents claim that long ago they stopped off only for gasoline and never left. Some fell in love with the **unique** (though sometimes scary) scenery. Just outside town are colorful rocky areas, used as the **location** for numerous films, including *Red Planet* and *Mad Max Beyond Thunderdome*. All around, the dry land forms a moonscape[3] cut through by fencing, which keeps wild dogs out of the sheep-farming country to the south and east.

Tourism is flourishing, and unlucky miners have opened opal shops, cafés, and underground motels. Still, this is a working town, and tourists had better watch their step. Peter Rowe, formerly the head of the Mine Rescue Squad, pulled plenty of badly injured people out of mine shafts[4] during his career. The dirt tracks that cross the opal fields have many signs warning walkers to watch their step. Tourists have died after carelessly walking backwards while taking photographs.

HOME IS WHERE THE DIRT IS

To **create** a typical dug-out, you need a hill and a drill. Most home-diggers tunnel into a hillside, which is a lot easier than digging straight down. If the hill doesn't have a side of exposed rock, bulldozers push sand and loose soil away until a sandstone face **emerges**. Dug-outs in the 1980s, before Coober Pedy established a town government, were usually blasted into a hillside, not actually dug. Drilling, with huge machines meant to dig tunnels through mountains, is now the **technique** of choice.

The homes are essentially artificial caves, but don't **assume** there is anything primitive about them. Three-bedroom plans are common, and having your cave drilled out costs about the same as building a new above-ground home of **similar** size. Needless to say, the **structure** is solid, which **creates** some challenges. Electrical wiring has to be placed in grooves in the rock and then plastered over. Plumbing is set in **similar** grooves.



Interior of a dug-out home

The hills inside the town limits were all claimed soon after the comforts of dug-out living became well known. Coober Pedy had to expand, not because it needed more space but because it needed more hills. Some town planners **predict** that Coober Pedy will sprawl out to great distances as more miners seek a place to dig. Some paved roads have been laid, most of them running along the faces of the hills and out to mine shafts. A lot more will be needed if homeowners head to the faraway hills.

One comfortable dug-out illustrates the advantages of underground living. Outside, it is pushing 104° Fahrenheit (40° Celsius). This is relatively mild for January in Coober Pedy, but hot nonetheless. Inside, it is wonderfully cool. The low ceiling and honey-colored stone walls give a feeling of safety and refuge. Area rugs and comfortable furniture soften the interior. Appliances are set into custom-carved spaces. Hole sweet hole.

[3] *moonscape:* a view of the surface of the moon
[4] *shaft:* vertical tunnel or deep hole

LIVEWORKSHEETS

Reading Comprehension

Mark each sentence as *T* (true) or *F* (false) according to the information in Reading 1. Use the dictionary to help you understand new words.

___ 1. Underground homes are considered normal in Coober Pedy.
___ 2. The first underground homes in Coober Pedy were built by Aborigines.
___ 3. All the opals located in and near Coober Pedy belong to one trading company.
___ 4. Coober Pedy has liberal attitudes toward miners' behavior.
___ 5. The environment around Coober Pedy is dry and rocky.
___ 6. Some tourists have died from falling into holes in the town.
___ 7. Most underground structures in Coober Pedy were originally opal mines.
___ 8. The cost of creating an underground home is similar to the cost of building a home on the surface.
___ 9. It is easier to dig an underground home into a hillside than into the ground.
___10. So far, only one underground home in Coober Pedy has water service.

Vocabulary Activities STEP I: Word Level

A. Read these excerpts from another article on underground homes. For each excerpt, cross out the one word or phrase in parentheses with a different meaning from the other three choices. Compare answers with a partner.

1. Unlike most homes, underground homes can be (*located / built / ~~structured~~ / positioned*) on steep surfaces. They take up very little surface space.
2. Underground building (*methods / houses / techniques / processes*) mostly use materials already available at the home site.
3. A typical above-ground house makes (*careful / heavy / extensive / liberal*) use of energy, mostly for heating and cooling. An underground home needs little or no heating or cooling, because underground temperatures remain stable. Consequently, it uses only about 20% of the energy used in a conventional home.
4. Underground (*environments / settings / surroundings / creations*) provide excellent noise insulation. Underground homes are exceptionally quiet places to live.
5. Finally, underground houses have a (*special / well-known / unique / one-of-a-kind*) ability to blend in with nature. This not only looks nice but also preserves habitat for wildlife.

LIVEWORKSHEETS

The word *notwithstanding* means "not being prevented by." It can come before a noun or noun phrase (*Notwithstanding* the rain, the players finished the game) or after one (The rain *notwithstanding*, the players finished the game).

CORPUS

B. Read each pair of sentences. Check (✓) the ones that can be made into one sentence using *notwithstanding*, and then write the sentences in your notebook. Compare answers in a small group. Discuss what connectors (*because, therefore, yet*, etc.) you could use for the other sentences.

✓ 1. Daytime temperatures can be extreme. Some people still walk around above ground.

*The extreme daytime heat **nothwithstanding**, some people still walk around above ground.*

___ 2. Coober Pedy is known for its uncomfortable heat and dryness. People like living there.

___ 3. Building a dug-out is a great challenge. More and more miners want underground homes.

___ 4. A system of roads out to the hills is under development. Many people are planning to build underground homes there.

___ 5. Tourism is flourishing in Coober Pedy. There are many shops, cafés, and motels.

___ 6. Tourists sometimes have accidents in Coober Pedy. Signs tell them to be careful.

___ 7. The people of Coober Pedy come from more than 40 ethnic groups. They work together very well.

Vocabulary Activities STEP II: Sentence Level

Word Form Chart			
Noun	**Verb**	**Adjective**	**Adverb**
prediction	predict	predictable predicted	predictably

To *predict* something means "to say something is likely to happen in the future."

*Town planners **predict** that in the next few years, more people will want underground homes.*

Predict is also often used to talk about weather.

*Forecasters are **predicting** another hot day tomorrow.*

CORPUS

LIVEWORKSHEETS

C. **Answer these questions in your notebook. Use the form of *predict* in parentheses. Compare sentences with a partner. Refer to Reading 1 for information.**

1. You want to buy 100 opals. What can you guess about their origins? (*predict*)

   *I can **predict** that about 80 of them will be from Coober Pedy.*

2. Why do people in Coober Pedy not get upset about fights and other rough behavior? (*predictable*)
3. What would the weather service normally say about tomorrow's weather in Coober Pedy? (*predict*)
4. Someone is planning to construct an underground home in Coober Pedy. What tools will he or she probably use? (*prediction*)
5. Imagine that people do not build a large number of homes in the hills far from town. In that case, what could you say about the development of Coober Pedy's road system? (*predicted*)

Word Form Chart

Noun	Verb	Adjective	Adverb
assumption	assume	assumed	_____
creation creator creativity	create	creative	creatively
emergence	emerge	emergent	_____
similarity	_____	similar	similarly
structure	structure	structural	structurally

D. **Read these sentences about underground structures. Then restate each of the sentences in your notebook, using the words in parentheses. Do not change the meanings of the sentences. Be prepared to read aloud or discuss your sentences in class.**

1. Underground homes may or may not be safe. Anyone who is planning to live in one should check it carefully. (*assume*)

   *Anyone planning to live in an underground home should not just **assume** it is safe but should check it carefully.*

2. The roof of a dug-out could collapse if there are not enough walls in the underground space to support it. (*structure, structural,* or *structurally*)
3. A harmful gas called radon is naturally present in most soil, and it slowly makes its way into underground spaces. (*emergence* or *emerge*)
4. Since rainwater naturally flows downward from the ground, people who live underground have to expect water problems. (*assumption* or *assume*)
5. When designing an air-circulation system for a home underground, a builder has to think flexibly and imaginatively. (*creative*)
6. Too much moisture and not enough fresh air can make an underground home moldy, like a pile of wet clothes. (*similarly* or *similar*)

LIVEWORKSHEETS

READING 2

Before You Read

Read these questions. Discuss your answers in a small group.

1. Have you ever been in a tunnel, an underpass, a cave, or some other space underground? Was it uncomfortable or frightening? Why or why not?
2. If you dug a hole in your neighborhood, what do you think you would find at various depths: 6 inches (about 15 centimeters), 2 feet (about 0.6 meter), 10 feet (about 3 meters), and 50 feet (about 15 meters)?
3. Why do cities put water pipes, gas pipes, electric lines, and other utility equipment underground instead of aboveground?

READING SKILL Previewing and Predicting

APPLY

Preview the reading by looking at the title, headings, and photos. Based on your preview, what do you think the reading is about? Write your prediction(s). Then compare them with a partner.

Read

This article from a local magazine in Philadelphia, Pennsylvania (Philly), examines the underground systems on which the city depends.

Understanding Philly's Basement

Philadelphia, a large city on the east coast of the United States, is one of the oldest and most important cities in the country. People walking through the city **assume** they are standing on a rock-solid place. In reality, just below the surface is a vast, dark, and complex **environment**—water pipes, sewers, electrical wires, and television cables. There are also tunnels, abandoned subway stations, graves, hidden waterways, archaeological sites, mines, and more.

Sometimes, one of these underground **structures** fails. A small break in a pipe can eventually **create** a sinkhole that swallows whatever stood above it. One June day, in a **location** not far from Philly, two cars fell 70 feet

LIVEWORKSHEETS



when an enormous sinkhole opened up in a busy highway. That same day, two truckers were killed after their rigs fell into a sinkhole on Interstate 99 in New York State, to the north of Pennsylvania.

AN UNDERGROUND MYSTERY

So just how bad are things down there in lower Philadelphia? The answer is simple and frightening: We don't know.

Philadelphia was carefully planned out by William Penn, who established the city in 1682. The well-organized Mr. Penn obviously had little influence below the surface. The city's underground has been built, **liberally** expanded, and repaired in no particular order for more than 300 years. Some underground work was never documented. For example, in the mid-1800s, anti-slavery groups hid escaped slaves in secret shelters below ground to keep them from being kidnapped and returned to the South. In the past, various **ethnic** groups in the city were sometimes fearful or suspicious of city authorities. They built underground meeting rooms, storehouses, and even treasure vaults for their communities.



A car falls into a sinkhole

Even if records were kept, they may be of no help. Many have been scattered or lost, or were simply inaccurate to begin with. This matters for many reasons. The most important is that new systems are hard to plan unless you know where the old ones are. And then there are sinkholes. Until we figure out exactly what is where, we cannot **predict** where the next man-eating hole might develop.

MAPPING THE DEPTHS

"Philadelphia is an old city," says Lucio Soibelman, an associate professor of civil and **environmental** engineering at Carnegie Mellon University, "so you have old infrastructure[1] and new infrastructure. You have new pipes that are being mapped with GIS (geographic information systems) technology and you have old things that no one knows are there. This is not something that was designed in a perfect way. There's a lot going on, and a lot of research is needed to find out what is underground."

The most common **technique** for finding buried pipes or cables is to use a kind of metal detector. The problem is that many underground utilities aren't metal. Many gas pipes are plastic. The channels of the sewer system are lined with baked clay or plastic. To make it easier for people to find them again, most glass fiber optic cables and many newer nonmetallic pipes contain "tracer wires" that can be picked up by metal detectors. Older pipes, however, remain invisible.

Ground penetrating radar (GPR) is an important new tool. In a way, it is **similar** to the sonar systems used to **locate** objects under water. GPR sends thousands of radar pulses per second into the ground. The signals are then either absorbed or reflected back to a receiver. Software senses how long it takes the GPR signals to bounce back. Differences of even a nanosecond in bounce-back time will be registered. A software-generated image of what lies beneath the surface soon **emerges** on the receiver's screen.

[1] *infrastructure:* the basic **structures** and systems of a city or country, such as roads, sewers, etc.

LIVEWORKSHEETS

An underground mystery **unique** to Philadelphia was finally unraveled in 2005 by using GPR. An escape tunnel under Eastern State Penitentiary (a prison) in the Fairmount neighborhood was used in 1945 by a group of twelve prisoners. Their clever tunneling work **notwithstanding,** they were all easily recaptured in the city. Their muddy footprints showed exactly where they were hiding. Authorities knew where the tunnel started, but they didn't know until the 2005 GPR readings exactly where it went. The detection of other abandoned tunnels is important to law-enforcement authorities. Such underground passageways could be used by persons trying to **immigrate** illegally through Philly's seaport. Smugglers[2] or other criminals could also find them useful. The police want to know where they are, and GPR is a big help.

Robots that can patrol large water systems are another great innovation. They are already used in other cities. In Pittsburgh, for example, a robotic system called Responder travels inside sewers, operated by a remote control, looking for problems in the pipes. Responder is equipped with laser and sonar sensors that scan the insides of pipe walls. The slightest bit of corrosion[3] or the smallest leak will register. Advanced software can then construct extremely detailed 3-D models of the pipe walls.



A tunnel under Philadelphia

OK. NOW WHAT?

Locating problems is important, but it's not enough. Fixing them is the bulk of the job. Fixing and updating underground utilities in a city is very complicated. It's not just a matter of digging a hole, pulling out bad pipes, and installing good ones. The city and its neighborhoods must continue functioning during the many months it takes to put things right.

A company named Insituform has developed technology that can fix a pipe from the inside before it breaks, without any digging. Workers fill a tube with a special kind of resin (a sticky substance) and send it through the pipe. Then they heat the water inside the pipe. The resin expands outward, attaches to the interior surface of the pipe, and then hardens. This **creates** a new pipe inside the old pipe.

The company actually used this **technique** on the sewers under one of the most famous buildings in the United States, the White House, in Washington, D.C. The pipes dated from the mid-1800s and needed extensive repair. For security reasons—and because it would look really ugly—the government decided not to dig up the lawn, but rather to work underground, and under tourists' feet. ■

[2] *smugglers:* people who takes goods in or out of a place illegally and in secret
[3] *corrosion:* weakening or breaking apart because of the action of a chemical

LIVEWORKSHEETS

Reading Comprehension

Mark each sentence as *T* (true) or *F* (false) according to the information in Reading 2. Use the dictionary to help you understand new words.

___ 1. Philadelphia no longer locates pipes or cables underground.

___ 2. The collapse of underground structures sometimes kills people traveling on the surface.

___ 3. William Penn carefully planned Philadelphia's underground environment in the 1680s.

___ 4. Some residents of Philadelphia today use underground structures to hide things from city officials.

___ 5. Old infrastructure is easier to locate than new infrastructure.

___ 6. GPR can detect even non-metal items.

___ 7. By using GPR, the police easily recaptured twelve escaped prisoners.

___ 8. Systems like Responder use radar or sonar to find out where old sewers are.

___ 9. Robots can discover problems by looking at pipes from the inside.

___10. The sewers under the White House were fixed by creating new pipes inside old ones.

Vocabulary Activities STEP I: Word Level

A. Underground exploring (UE) involves traveling through tunnels and other hidden parts of a city. Complete the sentences about UE using the target vocabulary in the box. Use the synonyms in parentheses to help you. (Note: The sentences are not in order.)

assume	environment	notwithstanding	unique
emerge	liberal	similar to	

a. Perhaps because people are fascinated by hidden things, underground spaces have always had a _____ (not found anywhere else) appeal to explorers.

b. Police often arrest UE groups as they _____ (come out) from tunnels and charge them with trespassing.

c. Urban explorers generally take a very _____ (unrestricted) approach to property rights. As long as they aren't damaging anything, they _____ (believe) they have the right to use the property.

d. MIT was only one of several hot spots for UEs. Informal groups _____ (like) the MIT group explored the undergrounds of Paris, Toronto, and Sydney.

LIVEWORKSHEETS

e. Starting in the 1970s, a movement called "urban exploration" (UE) took special notice of rarely visited parts of the underground _____ (space), like tunnels, drains, and abandoned subway stations.

f. Students at the Massachusetts Institute of Technology (MIT) contributed greatly to the UE culture. _____ (despite) the fact that it was illegal, they developed a tradition of exploring the steam tunnels at the university.

B. **Tell the story of urban exploration by putting the sentences in activity A in order from first (1) to last (6). More than one order may be possible. Then use the target words as you compare stories with a partner.**

1. a
2. ___
3. ___
4. ___
5. ___
6. ___

Many English words have several related meanings. *Locate* is an example. All its meanings refer to "place," but in slightly different ways. A good dictionary will list these meanings for *locate* and its related forms.

CORPUS

C. **Look up *locate* and its forms in your dictionary. Then read these sample sentences and answer the questions that follow. Compare answers with a partner.**

a. On my first day in the new office, I tried to **locate** all the fire exits on my floor.
b. After looking at several cities, Caitlin decided to **relocate** to Chicago.
c. To ensure privacy, it is best to **locate** trees and bushes between your house and your neighbor's house.
d. The university has a beautiful **location** on the shores of Lake Martin.

LIVEWORKSHEETS

1. Check (✓) the word closest in meaning to *locate*. Look up each choice in your dictionary before you answer.

   ___ situate

   ___ move

   ___ inhabit

   ___ clear

2. Sentences a, b, and c in the box above show three slightly different meanings of the verb *locate* and forms related to it. Write the letter of the sentence next to the correct meaning.

   ___ to set up a home or business in a new place

   ___ to search for and find something

   ___ to put something into a place

3. Look at the sample sentences in your dictionary for *locate* and its forms. What is being located in each of those samples?

   _____

   _____

   _____

   _____

4. Check (✓) next to each real meaning of *location*. (Not every item should be checked.) Confirm your choices with your dictionary.

   ___ moving from one place to another

   ___ a place where a movie is filmed

   ___ finding where something is

   ___ a point of view on a political issue

   ___ a site

LIVEWORKSHEETS

Vocabulary Activities STEP II: Sentence Level

To *assume* something is to believe it without checking whether it is true. Our assumptions are reflected in what we do and how we see the world. For example, you probably assume that a person wearing a police uniform is a police officer.

CORPUS

D. **In each of these situations, at least one assumption lies behind the action. Write one assumption for each action in the right column. Be ready to discuss your answers with a partner.**

Action	Assumption
A customer goes to a bank and gives a teller several thousand dollars to deposit.	
A student tells her deepest thoughts and secrets to her best friend.	
A football player walks alone at night through a very rough part of town.	
On the highway, someone drives at speeds slightly over the speed limit.	

E. **Incorrect assumptions can be embarrassing or even dangerous. Rank these (possibly) incorrect assumptions from 1 (most dangerous) to 6 (least dangerous).**

___ If someone mentions a doctor, he or she is referring to a man, not a woman.

___ A manager always does what is best for the company's employees.

___ It doesn't matter what your grades are, as long as you finish school.

___ The groceries I buy have been officially inspected, so they're safe.

___ If I tell someone a secret, he or she won't tell it to other people.

___ Car accidents only happen to other people, not to me.

As a class, make a chart and tally everyone's answers. Which assumption does the class consider most dangerous? Least dangerous? Why do you think this is true?

LIVEWORKSHEETS

F. **Discuss these questions in a small group. Use the dictionary to clarify word meanings, if necessary.**

1. In which environment would an underground house be hardest to build? Why?
   a. a tropical rainforest
   b. New York City
   c. Antarctica
   d. a desert
2. Think about a town or city you know well. Which of these structures or services does it have underground? Who owns them? Why were they put underground?
   a. homes
   b. tunnels
   c. sewers
   d. electrical lines

G. **Look at these arguments for and against urban exploration. Restate each idea in your notebook, using the word in parentheses. Then write a paragraph that expresses your own opinion. Use as many target words as possible in your work. Be prepared to read aloud or discuss your paragraph in class.**

For	Against
Serious urban explorers cause no damage to the structures they explore. Their rule is, "Take only pictures. Leave only footprints." (*assume*)	Not every urban explorer is harmless. Some steal from the places they enter. Others spray graffiti there. (*assume*)
Although some underground spaces are dangerous, urban explorers can prepare themselves well. They are ready for dangers like steam explosions or live electrical wires. (*predict*)	Old tunnels and other underground spaces could contain dozens of dangers, from toxic chemicals to collapsing roofs. No one knows what is there. And explorers can't protect themselves from the most serious ones, like steam explosions. (*predict*)
Any member of the general public has the right to use abandoned property as long as he or she doesn't damage it. (*location*)	Urban explorers do not have any right to enter restricted underground spaces. This is trespassing—being in a place without the permission of its owner—and it is wrong. (*location*)

LIVEWORKSHEETS