

Lesson #3-Drilling For Oil

With this lesson plan, students will recognize that crude oil must be extracted from the ground before it can be used. They will also examine the processes for extracting crude oil and natural gas.

This lesson plan was developed by The Black Gold Regional Division No. 18 and teachers Margaret Lyall and Kimberly Epp.

Black Gold: the Story of Oil

Section Four

Drilling for Oil

Black Gold: the story of oil

Section 4: Drilling for Oil

Purpose:

- ◆ Students will recognize that crude oil must be extracted from the ground before it can be used.
- ◆ Students will examine the processes for extracting crude oil and natural gas.

Materials:

- ◆ overhead of a drilling rig
- ◆ library books on drilling

Procedure:

1. Drilling an Oil Well: The Play

Select a group of students to act out the play *Interview at a Drilling Site*. Before the play, give everyone else in the class a copy of the questions to accompany the play (Questions for Interview at a Drilling Site). Go through these questions, and as a class, predict what the answers will be. Have a student record these predictions on an overhead copy of the student sheet. Have the students set the sheets aside, and watch the play.

To set the stage for the play, make an overhead transparency of a drilling rig. Project it as a backdrop for the action.

After the play, go back to the questions and update them as to what was learned. Have the students fill in their own copies.

3. Tour a Drill Site

Use the reading *A Tour of a Drilling Rig* to take a tour of a drilling site. Once the reading has been completed, have the students illustrate what they would see from what they read.

Evaluate their work based on the clarity, use of space, and information displayed.

Students can read and answer the *A Tour of a Drilling Rig: Questions*.

Extension:

- ◆ This could also be turned into a slide show by a group of students: have them record the dialogue onto a cassette and illustrate overheads to go with the tape.
- ◆ In pairs, the students could make their own photo album presentation of the reading, using drawn pictures and captions.

4. What Other Workers Can You Find at a Wellsite?

Select a group of students to act out the play *Black Gold at Last: Interview with a Service Rig Crew*.

Have the students complete the reading and written activities *Black Gold at Last*

Language Extension:

Display, on the overhead, the list of people employed by a drilling rig (Employment Overhead¹). Have the students choose three jobs that they think they would enjoy or could do from what they have learned about the jobs from the play, and from their own experience or reading activities. Each student chooses one of the jobs, and describes why he/she could imagine being someday able to do it, and what he/she would have to do in the job. This could also include what sort of things the student could start doing now to prepare for getting that particular job.

¹ This list is taken from *Our Petroleum Challenge*, distributed by the Petroleum Communication Foundation, Calgary.

Drilling an Oil Well

Name _____

A drilling rig has five parts:

The hoisting system

The hoisting system has to lift, hold, and lower heavy pipe. The tall part of a drilling rig is called the **derrick**--this is part of the hoisting system.

Hoisting means lifting--the block-and-tackle on the derrick lift the heavy pipe.

The rotary system

The rotary system must twist the **drill bit**. Some of it works above the rig floor, but the drill bit may be kilometers below the ground.

Rotary means turning--the drill bit turns round and round to grind up the rock.

The circulating system

The circulating system pushes a special mud down the pipe, and pushes it back up again. This mud does three things: (1) It lubricates the drill bit (makes it slippery so it doesn't stick), (2) When the mud comes back up, it brings with it all the little pieces of rock (rock cuttings) that the drill has ground up, and (3) it stops the oil and gas from escaping up the outside of the pipe.

"Circulating" means "moving round and round"--the mud moves down the hole and then comes back up.

The blowout prevention system

A blowout happens when the drill strikes oil or gas or water that is under a lot of pressure. It could blow the mud out of the pipe and shoot oil (or gas, or water) high into the air. No-one wants this to happen. The blowout prevention system (BOP) stops this by sealing off the hole.

The power system

The power system provides the energy that the oilmen need to run the rig. Usually diesel oil is burned to make electricity.

Match these terms:

- | | |
|------------------------------------|---|
| 1. Hoisting system _____ | A. Moves mud down the hole and back up again. |
| 2. Rotary system _____ | B. Provides the power |
| 3. Circulating system _____ | C. Lifts and hold heavy pipe |
| 4. Blowout prevention system _____ | D. Twists the drill bit round and round |
| 5. Power system _____ | E. Seals the hole to stop a blowout |

Interview at a drilling site

Speaking roles: Reporter, Toolpush, Driller, Mudman

Non-speaking roles: Derrickman (stands on a chair), Motorman, 2 Roughnecks

Setting: A drilling rig. Show the overhead of the drilling rig as a backdrop to the play.

Reporter: This is (student name) from DRIL News. As part of the celebrations of the anniversary of Leduc #1, I'm bringing you a special edition background report on what actually happens when you drill for oil.

Right now I'm standing on a freezing cold platform about 45 km from (community name). Let's talk to the man in charge of this whole operation. This is Tony Toolpush. Tony, can you tell us about your role here on the platform?

Toolpush: First, (student name) I'd like to thank you for taking the time to do this interview to show what happens on the rigs. This is where it all starts, before the cars, the plastic, the paint, and the lipstick.

Reporter: Lipstick?

Toolpush: Yes, lipstick is one of the many, many products that come from oil. Anyway, back to your question. As a toolpush, I'm in charge of the drilling rig. Sometimes I'm called the rig manager. My job is to make decisions about how far to drill, when to pack up, and when to move on. I hire the workers you see behind me here on the platform, and sometimes have to fire them. The well is operating 24 hours a day, 7 days a week.

Reporter: Don't the men have any days off?

Toolpush: Sure: Like most rigs, our men work for two weeks, 12 hours a day, then they have a week off. Let me introduce you to them. Hey, Doug. This is Doug Driller.

(The Driller comes forward)

Reporter: Hello Doug, what is your job here on the rig?

Driller: I'm in charge of this shift. I have four men working for me. The guy you see way up there on the derrick is my derrickman. *(Points to the student on the chair, who points to the derrick on the overhead)* He can't be afraid of heights, because where you see him is where he spends most of his time.

Reporter: Isn't it cold and dangerous up there?

Driller: It sure can be cold, especially during an Alberta winter. He does wear a safety harness, in case he should fall.

Next, over there, is my motorman. *(Points to the motorman, who points to the motors on the overhead.)* He is in charge of running the motors that power this whole rig.

You see the two guys over there? *(Points to the roughnecks, who point to the oil platform on the overhead)* They're the floorhands--we call them roughnecks. They do the heavy work.

Excuse me, I have to go now, because we're working on a round trip. That's one of the busiest times on a drilling rig.

Reporter: See you later, Doug. Tony, I can see the men are very busy. What's a round trip?

Toolpush: I'd better explain about drilling first, because a round trip is just part of it. The drilling is done by a steel bit which weighs as much as a small man. This bit is attached to one end of a ten meter long, hollow, steel drill pipe. The drill pipe turns, and the bit at the end grinds into the rock. When the bit has cut through 10 meters of rock, one length of pipe almost disappears into the ground. Then we have to add another length.

(Roughnecks and driller act out pulling out lengths of pipe. Derrickman pretends to hold the top of each pipe.)

Reporter: Is that what the men are doing right now?

Toolpush: No, right now they're changing a bit. This is what we call a round trip, because all the pipes come out and go back in. Usually, when we're drilling, we don't pull the pipes out--we just keep adding lengths of pipe as they are needed. We've been using this drill bit for several days, and it's become dull, so we have to put a new one in.

Reporter: How can you change a drill that's a kilometer below the ground?

Toolpush: Right now the men are pulling up the pipe, and unscrewing it at every third joint. If you look over there, you can see the groups of 30-meter long pipes standing in the derrick. When they pull out the last one, they'll take off the dulled bit, and replace it with a bright new sharp one.

Reporter: Let me guess...then they'll have to put all the pipe back, right?

Toolpush: Right. Excuse me, they're about to pull out the drill bit. I have to go and make sure they cover the hole while they change the bit. If I leave it off, someone might drop a tool down the hole. Then the men would have to fish it out, using a magnet. If we can't get it out, we'd have to somehow drill around it. That tool could wreck the bit if we didn't take it out.

(Toolpush leaves)

Reporter: (to the audience) It's taken this crew nearly seven hours to change all this pipe. I heard of a rig near here where they changed the bit 30 times before they actually struck oil.

(Mudman enters) Oh, here comes someone now....Hi there. I'm (student name) from DRIL News. Could you tell us what your job is here on the rig?

Mudman: Hi. Sure. I'm the mudman. I'm in charge of the mud for three different rigs around here. I've just come by to complete my regular check that the mud is the right combination of clay, chemicals, and water. The derrickman on each shift keeps track of it for me, and follows my instructions if anything needs to be changed.

Reporter: What on earth is mud? No pun intended. What do you use it for?

Mudman: It's really called circulating fluid, but we always call it mud. The crew sends it down the inside of the pipe, and it comes up the outside, bringing with it the rock chips. It also lubricates and cools the drill bit, and it maintains well control. We shake out the rock chips, and send the mud back down again. It circulates, like the blood in your body.

Reporter: Well, that's it, folks. We've had a look at the drilling process. The crew is much too busy to talk to me right now, because, as you know, they're in the middle of a round trip. I'd like to go on a round trip right now--to somewhere warm! This is (student name) from DRIL News signing off.

These are the answers to the questions that the rest of the class must answer:

1. Who is in charge of the rig? *The Toolpush*
2. How many hours a day is the rig running? *24 hours*
3. Who is in charge of a shift? *The Driller*
4. What is the name of the man who works up in the derrick? *The Derrickman*
5. What is another name for a roughneck? *Floorhand*
6. What does the motorman do? *He runs the motors that power the rig.*
7. What is attached to the end of the drill pipe? *The drill bit*
What does it do? It grinds up the rock
8. Why is it so hard to change the drill bit? *All the lengths of pipe must be pulled out, taken apart, and stored. When the drill has been replaced, all the lengths of pipe must be put back one at a time.*
9. What do oilmen call the circulating fluid? *Mud*
10. What is this circulating fluid used for? *It goes down the pipe, lubricates and cools the drill bit, and brings up the rock chips.*

Questions for *Interview at a Drilling Site*

After you've seen the play *Interview at a Drilling Site*, answer these questions. You can ask the actors if you're not sure of the answers:

1. Who is in charge of the rig? _____
2. How many hours a day is the rig running? _____
3. Who is in charge of a shift? _____
4. What is the name of the man who works up in the derrick? _____
5. What is another name for a roughneck? _____
6. What does the motorman do? _____
7. What is attached to the end of the drill pipe? _____
What does it do? _____
8. Why is it so hard to change the drill bit? _____

9. What do oilmen call the circulating fluid? _____
10. What is this circulating fluid used for? _____

A Tour of a Drilling Rig

Name _____

Pretend you've visited a drilling rig and taken photographs of the different parts of the rig. Draw "photographs" in the boxes. You may use library books to help get the pictures right.

<p>The first thing we saw was the derrick--it's the part that sticks up so high. It has to be high so the workers can lift long pieces of pipe. We saw the workers using a block and tackle to raise a length of pipe and fasten it to the pipe already in the ground. This might happen every hour, but if the rock is really hard, it might be as much as eight hours before they must attach another length of pipe.</p> <p>The derrick is part of the hoisting system. <i>Hoisting</i> means <i>lifting</i>: the hoisting system has to lift, hold, and lower heavy pipe. There is a block-and-tackle on the derrick to help with the lifting.</p>	
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	<p>We were lucky: we were able to see the drill. Most of the time, it's far under the ground. The drill is attached to a length of pipe, and the rotary system twists it so that the drill chews up the rock into rock chips. As it chews up the rock, it moves deeper into the ground, until the length of pipe nearly disappears. Then the workers must attach another length of pipe.</p> <p>We saw it because every now and again, a drill wears out. Then the workers must pull out all the pipe, one length at a time, until they've pulled out the drill. Then they replace the drill, and put all the pipe back down into the ground, one length at a time. This is called a round trip.</p>
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<p>We wondered about the big tanks beside the rig. They are the mud tanks. The drilling fluid is a very special mixture that the workers call <i>mud</i>. Mud pumps move the mud through the circulating system, down the well to the drillbit and back up again.</p> <p>As the mud comes back up, it's full of rock cuttings. These rock cuttings are shaken out of the mud and wind up in a big pile near the rig.</p> <p>The mud has three jobs: (1) it brings up these rock cuttings; (2) it lubricates the drill bit (makes it slippery so it doesn't stick); & (3) it stops oil and gas from escaping up the outside of the pipe.</p>	
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	<p>We had to look closely to see the BOP (blowout prevention system), because it's underneath the drill floor. A blowout happens when the drill strikes oil or gas or water that is under a lot of pressure. It could blow the mud out of the pipe and shoot oil (or gas, or water) high into the air. No one wants this to happen. The BOP stops this by sealing off the hole around the drill pipe!</p>
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<p>We saw the diesel engines that provide the power. The power system provides the energy that the oilmen need to run the rig. Usually diesel oil is burned to make electricity.</p>	
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A tour of a drilling rig: Questions

Name _____

A. Match these terms:

- | | |
|------------------------------------|---|
| 1. Hoisting system _____ | A. Moves mud down the hole & back up again. |
| 2. Rotary system _____ | B. Provides the power |
| 3. Circulating system _____ | C. Lifts and holds heavy pipe |
| 4. Blowout prevention system _____ | D. Twists the drill bit round and round |
| 5. Power system _____ | E. Seals the hole to stop a blowout |

- 2.
1. The derrick sticks up high because:
 - a. the oil might shoot out of the ground really high
 - b. the workers need to lift long lengths of pipe
 - c. the derrickman needs to climb it for his shift
 - d. the mud needs to go up high

 2. When oilmen talk about a *round trip*, they mean:
 - a. a round-the-world cruise
 - b. the mud goes down the hole and back up again
 - c. all the pipe must be pulled out so that the drill can be replaced
 - d. the diesel engines run everything

 3. What do the oilmen usually call the special drilling fluid?
 - a. oil
 - b. asphalt
 - c. diesel
 - d. mud

Petro point:

In the oil industry, a rig is not called an *oil rig* unless it actually finds oil. Until then, it's called a *drilling rig*.

Petro point:

The mudman--the man in charge of the circulating fluid, or mud--probably doesn't work for the same company as the drilling crew. He might travel around to two or three different wells.

Black Gold at Last: Interview with a Service Rig Crew

Speaking characters: Reporter, Company representative, Toolpush, Perforating engineer

Nonspeaking characters: Driller, 2 Roughnecks, Derrickman,

Setting: an oil well

A driller and 2 roughnecks are at work in the background. The derrickman stands on a chair or table to show he's high up in the derrick.

The reporter and the company representative face the audience.

Reporter: This is (student name) from DRIL News. Last month we interviewed a drilling crew here at this site. Today we have the company representative with good news. Hello, Dan.

Company rep: Hello (student name) Last week my company got terrific news: the drilling crew had struck oil!

Reporter: That's great, but didn't you expect that to happen?

Company rep: No, this was a wildcat well. When you don't know if an area has oil or not, but you drill anyway to find out, you're drilling a wildcat well. Nine out of every ten wildcat wells turns out to be a dry hole. Did you know that Imperial Oil drilled 133 of them before they found oil in 1947 at the Leduc #1 site? The toolpush on that rig, Vern Hunter, was called "Dry Hole Hunter" because of his bad luck until that day.

Reporter: Last month we spoke to Tony Toolpush. Is he here today?

Company rep: No, he and his crew have packed up and gone. They packed up the whole rig a few days ago, and moved it two kilometres away. They're drilling another well there now.

Reporter: Another wildcat well?

Company rep: No. Now we know that oil is around here, the new well won't be a wildcat.

Reporter: You said that they took the drilling rig away--but I can see a rig right here.

Company rep: If you look closely, you'll see this is a smaller rig. There's the toolpush over there--hey, Ted. *(Ted Toolpush comes over.)* Ted, can you explain about your crew? I have to make a phone call. *(Company rep. leaves.)*

Toolpush: Sure. We're a service rig crew. We don't work directly for the big oil companies. When one of their drilling rigs strikes oil, they pay us to come in and get the well ready.

Reporter: What do you have to do?

Toolpush: Before the drilling crew left, they took out the original drill pipe, and put in a wider, thinner pipe that we call *casing*. Then they poured cement down the casing so that it came out the bottom of the casing and up the outside for hundreds of metres. After they put the wellhead on, they left, and we came in. Then it's our turn. We ran tubing down the inside of the casing, and we prepared the well for perforating. Here comes the perforating crew now.

(Sound of a truck driving up. The perforating engineer comes to join them.)

Reporter: Hi--can you tell us what a perforating crew does?

Perforating engineer: Sure. You know the drilling crew poured cement around the bottom of casing before they left?

Reporter: Yes, the toolpush was just explaining that.

Perforating engineer: Our job is to shoot bullets at the bottom of the well to make holes so the oil and gas can get into the casing.

Reporter: Real bullets?

Perforating engineer: Not any more. I remember when we set off real explosions at the bottom of the wells. Those were the days--these young fellows don't remember. Today we use jets that send chemical "bullets" that eat holes in the casing and the cement and the rocks.

Reporter: Yikes! I wouldn't want any of those chemicals on me!

Perforating engineer: Neither would I. Excuse me, I'd better go and see to it. That's what the oil company is paying me for! *(Perforating engineer leaves)*

Toolpush: Our job will soon be done. Our next contract is with another oil company, they have a well 55 km from here that needs a service crew.

Reporter: What will happen next at this site?

Toolpush: After we've run the bottom hole pump rod, we'll leave, and an oilfield construction crew will install the pump jack.

Reporter: Yes, I've seen those nodding in the fields. They look like hungry horses. Well, folks, this has been (student name) from DRIL News, coming to you from an oilfield.

Answers to questions the rest of the class might ask you:

1. What is a wildcat well? --*A well that is drilled in an area where oil has not yet been found.*
2. What does the drilling crew pour around the outside of the casing? --*Cement*
3. What does the service rig crew do? --*They run tubing down inside the casing, and prepare the well for perforating.*
4. What does the perforating crew do? --*They shoot chemical bullets through the casing and cement in the bottom part of the oil well. Also they run the pump and rods.*
5. Who installs the pump jack? --*The oilfield construction crew.*

Black Gold at Last

Name _____

What is black gold?

It's another name for oil. For centuries, people searched for gold, hoping to become rich. Today, more people search for oil instead of gold--so we sometimes call it "black gold".

Once a **drilling crew** has found oil, a lot of things happen:

- ◆ They take out the drill bit
- ◆ They take out the pipe

A **logging crew** comes in. They don't have anything to do with the lumber industry!

- ◆ They send a *logging tool* down the well. It's a steel tool, 7 or 8 centimetres in diameter, up to five metres long. It has gadgets that read things in the rock.
- ◆ They read the gadgets, and they *log* the results--that means they write things down in a book.

The logging crew go away, but they might come back one more time.

The **drilling crew** gets back to work:

- ◆ They put in a casing, which is a kind of pipe that is not as heavy as the drilling pipe. It's wider than the original pipe, but slightly smaller than the hole (the drill bit always drills a hole that's wider than the pipe).
- ◆ They pour cement down to the bottom of the pipe, so it spreads up around the outside of the casing for hundreds of metres at the bottom. This stops oil and gas from shooting up the pipe (well, okay, you do want it to come up eventually, but you want to be able to control it.)
- ◆ They put the well head on--it goes on top of the casing, and has so many valves that it's sometimes called a *Christmas tree!*

The drilling crew pack up the drilling rig, and drive away, to drill another well somewhere else.

A **service rig crew** comes in. A service rig is a smaller type of portable drilling rig. It handles smaller pipe, and finishes up the work at the well. There are 4 or 5 men on the crew, and they usually work only during daylight hours (not like a drilling rig)

- ◆ They run tubing down inside the casing.
- ◆ They prepare the well for perforating.
- ◆ They run the bottom hole pump and rods.

Petro point:

Most of these crews are not part of the oil company that drilled the well. A **company representative** (he might be an engineer) will be at the site, to tell them what the company wants done. He's the boss--after all, it's his company that is paying all the different crews!

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The **perforating crew** come to the site. This is probably a crew of three--a perforating engineer, his assistant, and the perforating truck driver.

- ◆ They shoot bullets through the casing and the cement at the bottom of the hole, so that the oil and gas will be able to get through the holes, into the pipe.

Petro point:

In the old days, the bullets were real bullets! After the cement dried, oilmen would set off an explosion at the bottom of the well. The bullets would shoot off in all directions, making holes in the cement.

Today, oilmen use “chemical bullets” instead. They use a perforating gun which jets chemicals out to eat holes through the casing and the cement, and into the rocks.

When the service rig crew is finished, an **oilfield construction crew** arrive.

- ◆ They install the **pump jack**.

Petro point:

A derrick looks cool, but you won't see many derricks in an oil field that is producing oil. Once oil is reached, and the casing has been put in and the bullets have blasted their holes, the derricks are taken down and moved somewhere else.

What you will see at a producing well is the **pump jack**.

You have probably seen a pump jack at work in a field. It looks a bit like a horse or a donkey feeding, so the three main parts of a pump jack are:

- ◆ horse's head
- ◆ saddle bearing
- ◆ tail bearing

The head goes up and down (and the tail goes down and up) pumping up crude oil, which may also contain natural gas.

A mixture of natural gas, crude oil, and water go through a **flowline** to a tank battery, where they are separated. An oil field probably has many pump jacks, pumping from many wells, so the tank battery might be several kilometres from some of the wells. What happens next?

- ◆ The natural gas goes through one pipeline to a gas processing plant.
- ◆ The crude oil goes through another pipeline to an oil refinery
- ◆ The water goes through a pipeline, and is pumped back down a well.

Black gold at last: question page

Which Crew Does the Job?

Drilling crew * * * * * **Logging crew * * * * *** **Service rig crew**
Perforating crew * * * * * **Oilfield construction crew**

- _____ 1. Installs the pump jack
- _____ 2. Puts in a casing, and pours cement around the bottom of the casing
- _____ 3. Runs tubing down the casing, prepares the well for perforating, and runs the pump and rods.
- _____ 4. Runs a steel tool down the well to find out about the rocks.
- _____ 5. Shoots chemical bullets at the bottom of the well, to make holes through the casing and cement and into the rocks.

Answer the following questions after watching the play
Black Gold at Last: Interview with a Service Rig Crew:

1. What is a wildcat well? _____

2. What does the drilling crew pour around the outside of the casing?

3. What does the service rig crew do?

4. What does the perforating crew do?

5. Who installs the pump jack? _____

Employment

**One drilling rig gives work to
about 70 people:**

- **16-22 workers on the drilling rigs**
- **2 surveyors**
- **1 well consultant**
- **3 lease-construction workers**
- **8 truckers**
- **3 water haulers**
- **3 fuel dealers**
- **1 bit supplier**
- **2 casing employees**
- **2 mud suppliers**
- **1 welder**
- **2 coring workers**
- **2 logging employees**
- **2 testing employees**
- **4 camp caterers**
- **2 pumping equipment suppliers**
- **3 stimulators & perforators**
- **2 road & site preparation workers**
- **2 operator personnel**
- **2 equipment manufacturing workers**