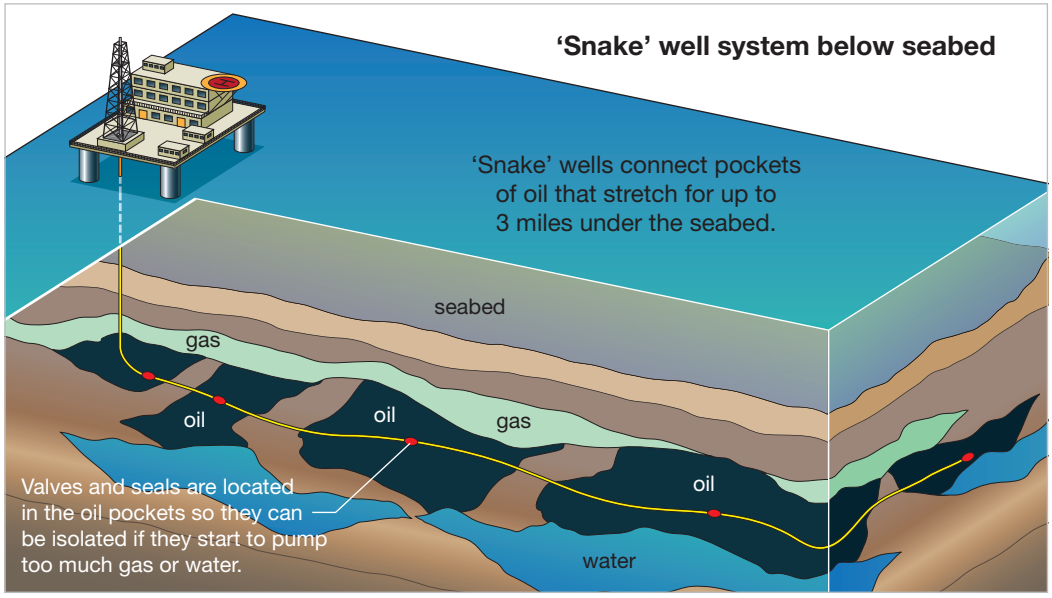
2 Smart wells

Start here

1 Work in pairs. Discuss these questions about the illustration below. Make notes.

1 What are the advantages of this method of oil extraction compared with vertical wells?
2 How do you think computers are used in this method?



Reading

2 Read this article and check the notes you made in 1.

SMART OIL FIELDS

If an oil company discovers a large single reservoir of oil and gas, the solution is simple: drill a vertical well down to the reservoir and bring up the oil. But what can be done when an oilfield consists of hundreds or even thousands of small, **isolated** pockets of oil? It would be too expensive to drill hundreds of vertical wells to reach all the small pockets.

The innovative solution to this problem is the 'snake well'. Unlike the **conventional** vertical well, this is a horizontal well that weaves **laterally** back and forth across a number of oil-containing zones. Guided by smart technology, a single snake well can access multiple pockets of oil and achieve output **equivalent** to several individual wells, which has the **dual** advantage of reducing cost and ensuring that no oil is overlooked.

A snake well uses **steerable** drills that can be positioned with great accuracy. Special imaging software generates detailed computer models of underground geology and reservoirs. This enables drills to hit a target far underground that is less than two metres across.

Located 90 km off the coast of Brunei, the Champion West oilfield is Shell's flagship project using Smart Fields technology. For 30 years, Champion West lay dormant, its rich oil reserves **locked** 2,000 to 4,000 m beneath the seabed in a **complex** web of small reservoirs (see illustration above).

In the past, these small pockets of oil were too expensive to develop. But now Champion West has been changed into one of the world's most advanced oil and gas fields by means of Smart Fields technology and new drilling techniques.

Buried deep beneath Champion West's seabed, sensors relay digital information about temperature, pressure and other factors to control centres on land by means of a network of fibre-optic cables.

This enables continuous monitoring of production, and engineers can make speedy decisions on how best to extract the maximum amount of oil, monitor its movement within the reservoir and instantly notice production problems, such as blockages.

They can take action to solve problems, for example by the remote electronic activation of hydraulic well valves. If gas or water threatens to break into the well, for example, the valve for that section can be closed down using a remote control. **Swellable** seals are used to isolate the zones from one another, and prevent fluid from one zone from flowing into another **adjacent** zone.

3 Answer these questions about the article.

1 What are the two main economic reasons for drilling a snake well?
2 How accurate is the drill of a snake well when it is guided remotely?
3 For how long was the Champion West oilfield left unused following the discovery of oil there? Why was it left unused?
4 How is data about conditions inside the snake well transmitted to the surface?
5 How do engineers stop the oil in the well being contaminated with water or gas?

4 Match the reference words 1–6 from the article with the correct words or ideas a–j that they refer to.

1 this (line 12)	a) increased output from many oil zones
2 which (line 18)	b) conventional vertical well
3 that (line 21)	c) engineers
4 This (line 25)	d) snake well
5 This (line 47)	e) blockages
6 They (line 54)	f) transmission of data
	g) computer model generation
	h) underground reservoir
	i) steerable drills
	j) network of cables

Vocabulary

5 Match these words or phrases with their synonyms (in bold) in the article in 2.

1 capable of being expanded	6 having two parts
2 complicated	7 trapped
3 capable of being guided	8 separated from one another
4 neighbouring	9 horizontally sideways
5 normal	10 equal in value

Language

Linking (past participial phrase)

The **past participle alone** can sometimes replace **subject + passive verb**. It makes the text more concise.

- *The Champion West oilfield, **located** 90 km off the coast of Brunei, is Shell's flagship project …* (= *The Champion West oilfield, **which is located** …*)

The past participle can also be placed at the beginning of a sentence. Find these examples in the text in 2:

- ***Located** 90 km off the coast of Brunei*, the Champion West oilfield is Shell's flagship project …
- ***Guided** by smart technology*, a single snake well can access pockets of oil …
- ***Buried** deep beneath Champion West's seabed*, sensors relay digital information …

Note that the participle must have the same subject as the verb in the main clause.

6 Join the information in each note into a single sentence in a similar way. Begin each sentence with the past participle in italics.

Example: *1 Isolated in small pockets, the oil can't be extracted using vertical wells.*

1 the oil is *isolated* in small pockets + it can't be extracted using vertical wells
2 the sensors are *connected* by fibre-optic cable + they collect data from inside the snake well
3 the drills are *guided* by remote controllers + they can hit a target only 2 m wide
4 the oil is *locked* 4,000 m beneath the seabed + it couldn't be extracted for 30 years
5 the sensors are *attached* to the drill bit + they allow controllers to guide the drill
6 the software was *developed* by GeoSolutions + it generates computer models of the geology

Answer key

UNIT 1.2 – SMART WELLS

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1 A single oil platform can access many small pockets of oil (and achieve output equivalent to several individual wells).
2 Imaging software generates detailed computer models of underground geology; sensors steer the drill; sensors allow engineers to control valves and seals.

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ex 3

1 It reduces cost because you only need to build one drilling platform for many oil pockets; it increases production, because no oil is overlooked.
2 Very accurate: it can hit a target far underground that is less than two metres wide.
3 For 30 years; because the oilfield consists of many small reservoirs, and the snake drill did not yet exist.
4 by means of (a) sensors (b) fibre-optic cables
5 by closing valves via remote control

ex 4

1 d 2 a 3 i 4 g 5 f 6 c

ex 5

1 swellable (line 60)
2 complex (line 33)
3 steerable (line 21)
4 adjacent (line 63)
5 conventional (line 11)
6 dual (line 18)
7 locked (line 32)
8 isolated (line 7)
9 laterally (line 13)
10 equivalent (line 17)

ex 6

1 Isolated in small pockets, the oil can't be extracted using vertical wells.
2 Connected by fibre-optic cable, the sensors collect data from inside the snake well.
3 Guided by remote controllers, the drills can hit a target only 2 m wide.
4 Locked 4,000 m beneath the seabed, the oil couldn't be extracted for 30 years.
5 Attached to the drill bit, the sensors allow the controllers to guide the drill.
6 Developed by GeoSolutions, the software generates computer models of the geology.

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Model answer

Model answer:

Here is a brief outline of how a laser works:

First of all, the high-voltage power source, located below the ruby crystal, makes the tube flash on and off rapidly. These flashes inject particles of light, known as *photons*, into the ruby crystal.

Next, the energy emitted by the light tube is absorbed by an atom, shown as a large green circle at point 3 in the diagram. Excited for a short time, the atom then returns to its normal state and emits a new photon. The photons emitted from the atoms then move up and down inside the ruby crystal at the speed of light.

If a photon hits another atom stimulated by the energy from the tube, the second atom gives off two photons of light instead of one. The light created by this process doubles and doubles millions of times.

The photons are reflected up and down the inside of the crystal by the two mirrors, located at the two ends of the crystal and shown as grey discs on the diagram. One of these mirrors is partial.

The partial mirror, positioned at one end of the tube, reflects about 99% of the photons back into the crystal, but allows the other 1% to escape from the machine.

The photons allowed to escape by the partial mirror form a very concentrated beam of light, called a laser beam.