Hormones
Hormones

Contents

What are hormones?
Fertility and the menstrual cycle
Treating infertility
Blood glucose regulation
Summary activities
We’ve been trying for a baby but I can’t seem to get pregnant.

It could be your hormones.

What are hormones?
Hormones are chemicals that act like messengers. They are secreted by glands and carried in the blood from organ to organ.

Cells in different parts of the body recognize the hormones and respond by making changes.
Where are the major glands of the body?

- thyroid
- adrenal glands
- testes (males)
- pituitary gland
- pancreas
- ovaries (females)
Sex hormones

In males, the testes produce the sex hormone **testosterone**, which makes male secondary sexual characteristics develop.

In females, the ovaries produce the sex hormones **oestrogen** and **progesterone**.

These make female secondary sexual characteristics develop and are involved in fertility and the menstrual cycle.
The pituitary gland is a pea-sized gland at the base of the brain. It releases many hormones and controls several other glands in the body.

The pituitary gland produces two hormones involved in fertility:

- follicle stimulating hormone (FSH)
- luteinizing hormone (LH).
## True or false?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hormones are chemical messengers used to regulate cells and organs.</td>
<td>true</td>
</tr>
<tr>
<td>2. Each hormone only affects one type of cell.</td>
<td>false</td>
</tr>
<tr>
<td>3. Fertility and the menstrual cycle are controlled by hormones.</td>
<td>true</td>
</tr>
<tr>
<td>4. Hormones travel along nerves.</td>
<td>false</td>
</tr>
<tr>
<td>5. Hormones are produced by glands.</td>
<td>true</td>
</tr>
<tr>
<td>6. Men and women produce different types of sex hormone.</td>
<td>true</td>
</tr>
</tbody>
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The menstrual cycle

What happens during the menstrual cycle?

Click "start" to find out.

start
Inside the ovary

What happens in the ovary during the menstrual cycle?

Day 1-13: egg developing inside the growing follicle

Day 14: ovulation – egg released from follicle

Day 15-28: empty follicle turns into corpus luteum (yellow body)

immature eggs
The lining of the uterus becomes thicker with blood vessels and more stable during the menstrual cycle. Why is this important?

A fertilized egg will bury itself (implant) in the uterus lining. The egg needs a plentiful supply of oxygen and nutrients to develop.
Hormone levels during the menstrual cycle
Pregnancy

If the egg is fertilized, the uterus lining must not break down otherwise the fertilized egg will not develop.

**Egg fertilized:**
- Uterus lining maintained
- Egg implanted

**Corpus luteum:**
- Continues to produce progesterone and oestrogen

**Progesterone memo**
- To: Uterus
- From: Corpus luteum
- Maintain uterus lining.

**Oestrrogen memo**
- To: Pituitary
- From: Corpus luteum
- Don’t send FSH.
How does the contraceptive pill work?

Contraceptive pills contain progesterone and need to be taken every day. How do they work?

**progesterone memo**

To: pituitary  
From: contraceptive pill  
Stop sending FSH.

no FSH received:  
no egg maturing

Contraceptive pills mimic pregnancy, which means that the ovaries do not produce any eggs.
Hormonal changes

What is the sequence of changes in the menstrual cycle?

1. Oestrogen causes the uterus lining to thicken
2. LH stimulates egg release
3. Oestrogen switches FSH off and stimulates LH release
4. The pituitary gland releases LH
5. FSH stimulates egg maturation and oestrogen release
6. The pituitary gland releases FSH
7. The ovaries release oestrogen
8. The egg is unfertilized – period occurs
What hormones are involved in the menstrual cycle?

click the brain to start
What is infertility?

Some couples are unable to conceive naturally. This is called **infertility**. What might be some of the causes of infertility?

<table>
<thead>
<tr>
<th>Women</th>
<th>Men</th>
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<tbody>
<tr>
<td>ovaries not releasing eggs</td>
<td>low sperm count</td>
</tr>
<tr>
<td>blocked fallopian tubes</td>
<td>poor quality sperm</td>
</tr>
<tr>
<td>(carry eggs from the ovaries to the uterus)</td>
<td></td>
</tr>
<tr>
<td>problems with the uterus lining</td>
<td>blocked or damaged tubes that carry sperm</td>
</tr>
<tr>
<td>hormonal problems</td>
<td>hormonal problems</td>
</tr>
</tbody>
</table>
How do fertility drugs work?

Fertility drugs are used to help women who do not produce an egg every month.

There are many different types of fertility drug but they all work by tricking the body into producing more eggs.

Some fertility drugs contain FSH. How do these work?

FSH memo

To: ovary
From: fertility drug
Get another egg ready and start making oestrogen.
What is IVF?

Sometimes, women have problems becoming pregnant even after using fertility drugs. When this happens, they can try in vitro fertilization, or IVF.

*In vitro* is Latin for ‘in glass’ so IVF means fertilization that takes place outside of the body and in laboratory glassware.

Babies born by IVF are sometimes called ‘test-tube’ babies. However, fertilization doesn’t take place in test-tubes but in a special dish.
How does IVF treat infertility?

Who can have IVF?
IVF is suitable for cases of unexplained infertility, blocked fallopian tubes and for older women.

Click "start" to find out how it works.
Why does IVF increase the chances of multiple births?
Multiple births and the risks of IVF

Multiple births are more likely with IVF because more than one embryo is implanted into the uterus to increase the chance of a successful pregnancy.

Around 20% of IVF births are twins (compared with 1.25% of normal births), and 0.5% are triplets. The number of triplets was much higher 15-20 years ago because more embryos were implanted at the same time.

Multiple births are the biggest risk of IVF for both the mother and babies. They are more likely to result in premature births, miscarriages, and long-term disability and ill health.
The cost of IVF

IVF is expensive – around £3,000 for the treatment itself, plus extra costs for consultation with doctors, drugs and tests. Freezing embryos for further attempts at IVF also costs extra.

Couples may need to try IVF several times (each attempt is called a cycle) before it is successful.

About 25% of IVF treatments are funded by the NHS. Women aged between 23 and 39 years can get one free IVF cycle on the NHS.
Do you agree or disagree with these opinions on whether the NHS should pay for IVF?

Sarah (College student)
"Yes! IVF costs thousands of pounds for each attempt. It isn’t fair if only rich people can have children."

disagree  not sure  agree
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Diabetes

Do you want to have children one day?

Yes, but I have to be careful because I’m diabetic.

Do you have to give yourself injections?

It’s not so bad. The jabs contain insulin. It’s a hormone that controls blood glucose.
Glucose is a type of sugar used by the body to provide energy.

Sometimes there is too much glucose in the blood, and sometimes there is not enough. What affects the level of blood glucose?

- eating causes blood glucose levels to rise
- vigorous exercise causes blood glucose levels to fall

The amount of blood glucose therefore needs to be regulated. How does the body do this?
The hormones of the pancreas

Blood glucose levels are monitored by the pancreas.

If blood glucose levels are too high, the pancreas releases the hormone **insulin**. This tells the liver to convert glucose into glycogen, which is stored in the liver and muscles.

If blood glucose levels are too low, the pancreas releases the hormone **glucagon**. This tells the liver to convert glycogen into glucose, and release it into the blood.
Blood glucose rises just after eating, but quickly returns to normal. Where does the sugar go? Why is it not left in the blood?

![Blood glucose levels graph](image)
Maintaining a safe blood glucose level

How does the body control blood glucose levels?

Click "start" to find out how the body controls the level of blood glucose.
What is diabetes?

Some people are unable to regulate their blood glucose levels because their pancreas doesn’t produce enough insulin. This is called diabetes.

The lack of insulin means that blood glucose levels can rise dangerously high after eating, which can cause cell damage.

Symptoms of diabetes develop quickly and can be severe. Initial symptoms include:

- increased thirst, hunger and production of urine
- loss of weight, tiredness and nausea.

Later symptoms include vomiting and abdominal pain. If untreated, diabetes can lead to coma and even death.
How is diabetes treated?

People with diabetes have to inject themselves with insulin before eating to keep their blood glucose at a safe level.

Eating small amounts at regular intervals, and avoiding eating sugar is also important. This helps to reduce the peaks in blood glucose levels.
Comparing blood glucose levels

How do levels of blood glucose compare between diabetics who control their diet and those who don't?

<table>
<thead>
<tr>
<th>Blood glucose (mg/cm³)</th>
<th>Time (mins)</th>
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Insulin treatment was discovered by the Canadian surgeon Frederick Banting and medical student Charles Best. In 1921, they removed the pancreas from dogs so that they became diabetic. The diabetic dogs were then injected with an extract from a healthy dog’s pancreas, and their blood glucose levels returned to normal. One dog, Marjorie, was kept alive for 70 days with regular injections.

What conclusions could they draw from this?
Isolating insulin

Banting and Best worked with biochemist James B Collip to purify a pancreas extract from cattle, finally obtaining a purer form of insulin.

The first human to be treated with insulin was the teenager Leonard Thompson, in 1922. He made a dramatic recovery. Many other patients were treated and their lives were saved.

Insulin was initially obtained from cattle and pigs, but now it is made by genetically-engineered bacteria, which contain the human gene for insulin.
Should animals be used for medical research?

- [ ] yes
- [ ] no
- [ ] unsure
Complete the sentences about insulin

1. Insulin is a _________ secreted by the _________.

2. Insulin makes _________ and muscle cells take in _________, where it is stored as _________.

3. People who cannot produce enough insulin are said to have _________.

Options:
- high
- pancreas
- bacteria
- glucose
- glycogen
- hormone
- liver
- low
- diabetes
- fat

hide solve
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**diabetes** – A disease caused by a lack of insulin, which leads to high levels of blood glucose.

**FSH** – Follicle stimulating hormone: the hormone that makes eggs mature in the ovary, and is used as a fertility drug.

**gland** – An organ in the body that secretes a hormone.

**hormones** – Chemical messengers carried in the blood stream that co-ordinate the actions of different target cells.

**infertility** – An inability to conceive and produce children.

**insulin** – A hormone involved in the control of blood sugar, and which is reduced or absent in people with diabetes.
• **in vitro fertilization** – A treatment for infertility where egg and sperm are brought together outside the body.

• **luteinizing hormone** – The hormone that stimulates egg release from the ovary.

• **oestrogen** – The hormone produced by the ovaries that stops FSH production and causes the uterus lining to thicken.

• **pancreas** – The gland that produces insulin.

• **pituitary** – The gland at the base of the brain that produces FSH and LH, and which controls other glands.

• **progesterone** – The hormone that maintains the uterus lining, inhibits FSH production, and is used in oral contraceptives.
Anagrams

How quickly can you unscramble anagrams of words about hormones?
What’s that gland?

Can you name these glands and their hormones?

1. [Gland 1]
2. [Gland 2]
3. [Gland 3]
4. [Gland 4]
5. [Gland 5]
6. [Gland 6]

thyroid
Complete these sentences about fertility

1. Hormones from the pituitary and _________ prepare the uterus for when an egg is released.

2. FSH causes eggs to mature, and is used in _________ drugs.

3. The ovary releases _________, which causes the _________ lining to thicken.

- egg
- fertility
- FSH
- uterus
- ovaries
- oestrogen
- contraceptive
- progesterone

hide solve
Menstrual hormones

To which hormones do these statements relate?

- oestrogen
- progesterone
- FSH
- LH

maintains uterus lining
Multiple-choice quiz

Can you do ovary well in this quiz on hormones?

start