Understanding Cancer

A SERIES OF SIMPLE EDUCATIONAL VIDEOS FOR THE GENERAL PUBLIC

By Dr Hafsa Waseela Abbas

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Understanding Cancer

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Part 13: Diagnosis - PET scan

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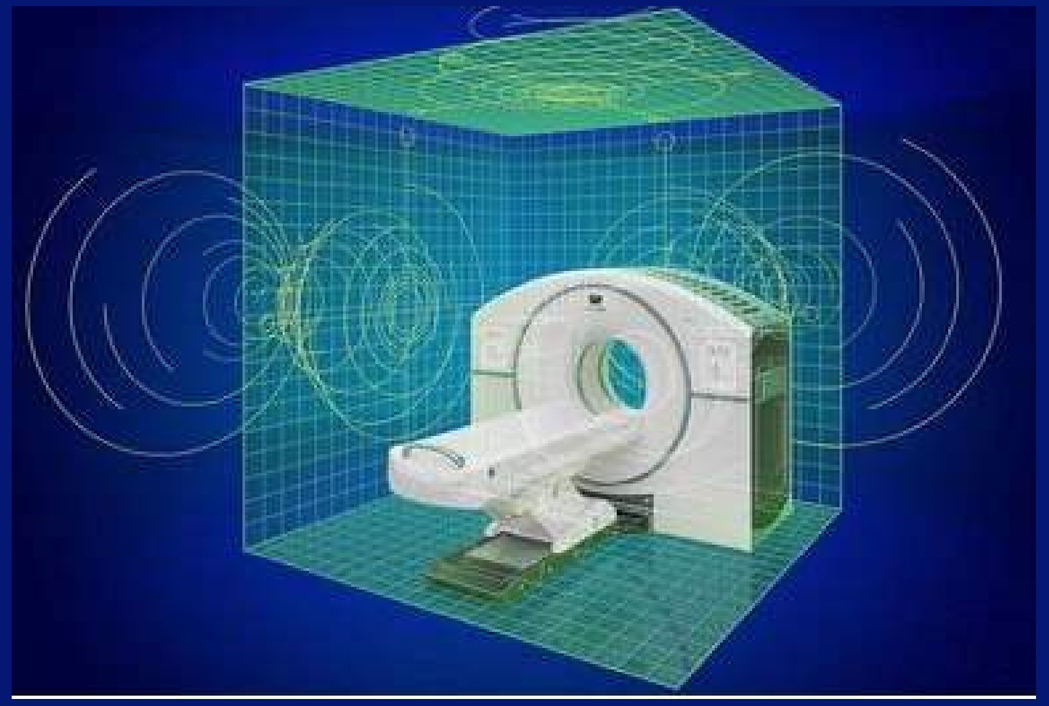
What is an PET scan?

What is an PET scan?

Positron emission tomography (PET) scans creates 3-dimensional (3D) images of the inside of the body with great detail.



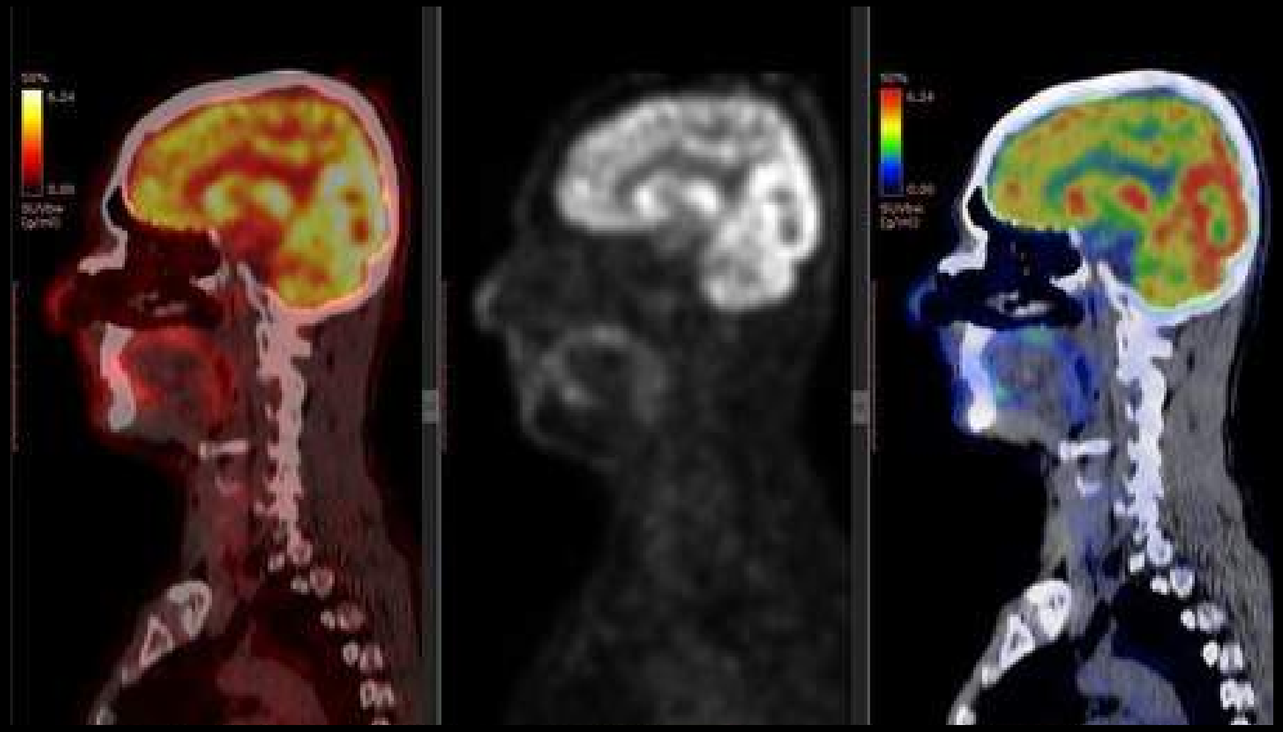
What is an PET scan?

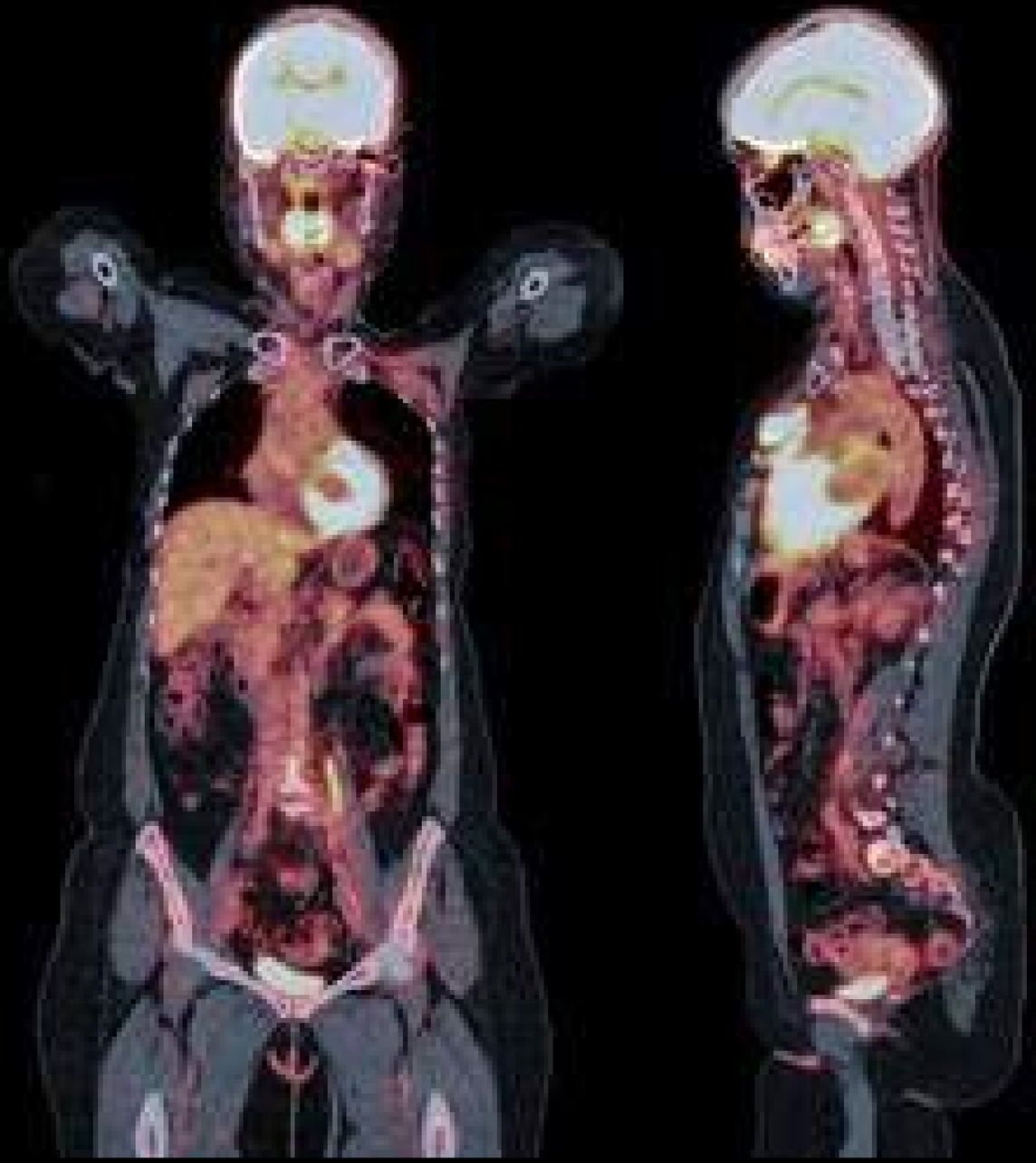
This allows to see any areas that are not normal and find out how well the body is working.

POSITRON EMISSION TOMOGRAPHY

PET-CT scan

PET-CT scan can be joined with CT scan to make very detailed images!





PET-MRI scan

Similar case with MRI!

Who invented the PET scan?

Dr Gordon Brownell is a physicist who heard about a patient case - a 7-year-old girl travelled from Rhode Island to Boston in 1953 where doctors were unable to know as to why she was unable to read nor see properly.

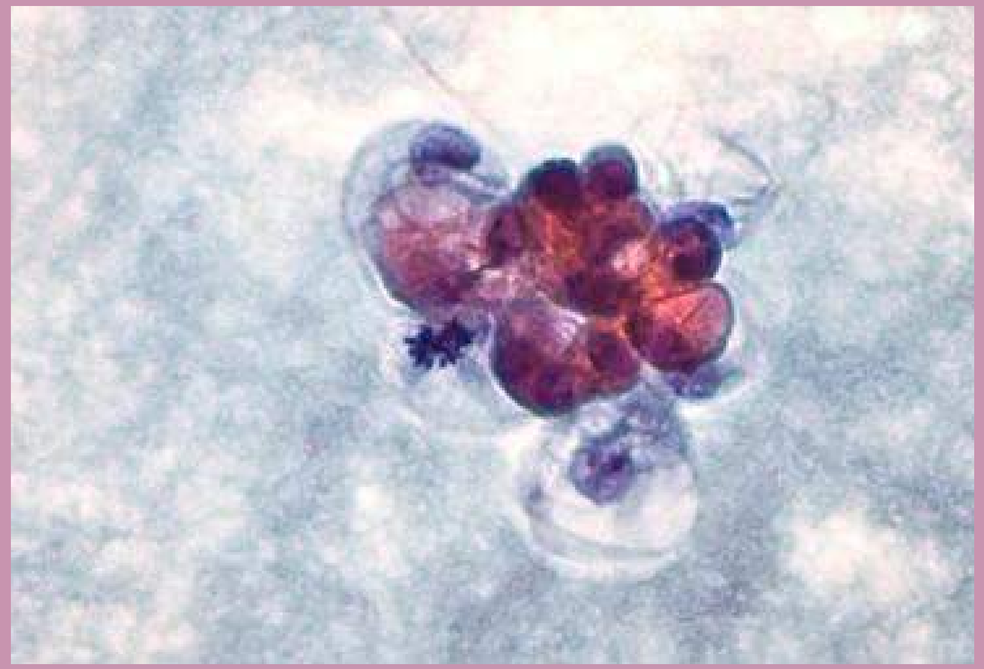
Source: Archive.Boston.com

Who invented the PET scan?

He developed the PET machine that detected the tumour in her brain which was removed by surgery.

Source: Archive.Boston.com

What can PET scans be used for?



CANCER!

What can PET scans be used for?

Identify primary tumours

What can PET scans be used for?

Identify advanced cancers or metastases

What can PET scans be used for?

Size of the cancer?

What can PET scans be used for?

FEATURES!

lump?
Swollen lymph nodes?

What can PET scans be used for?

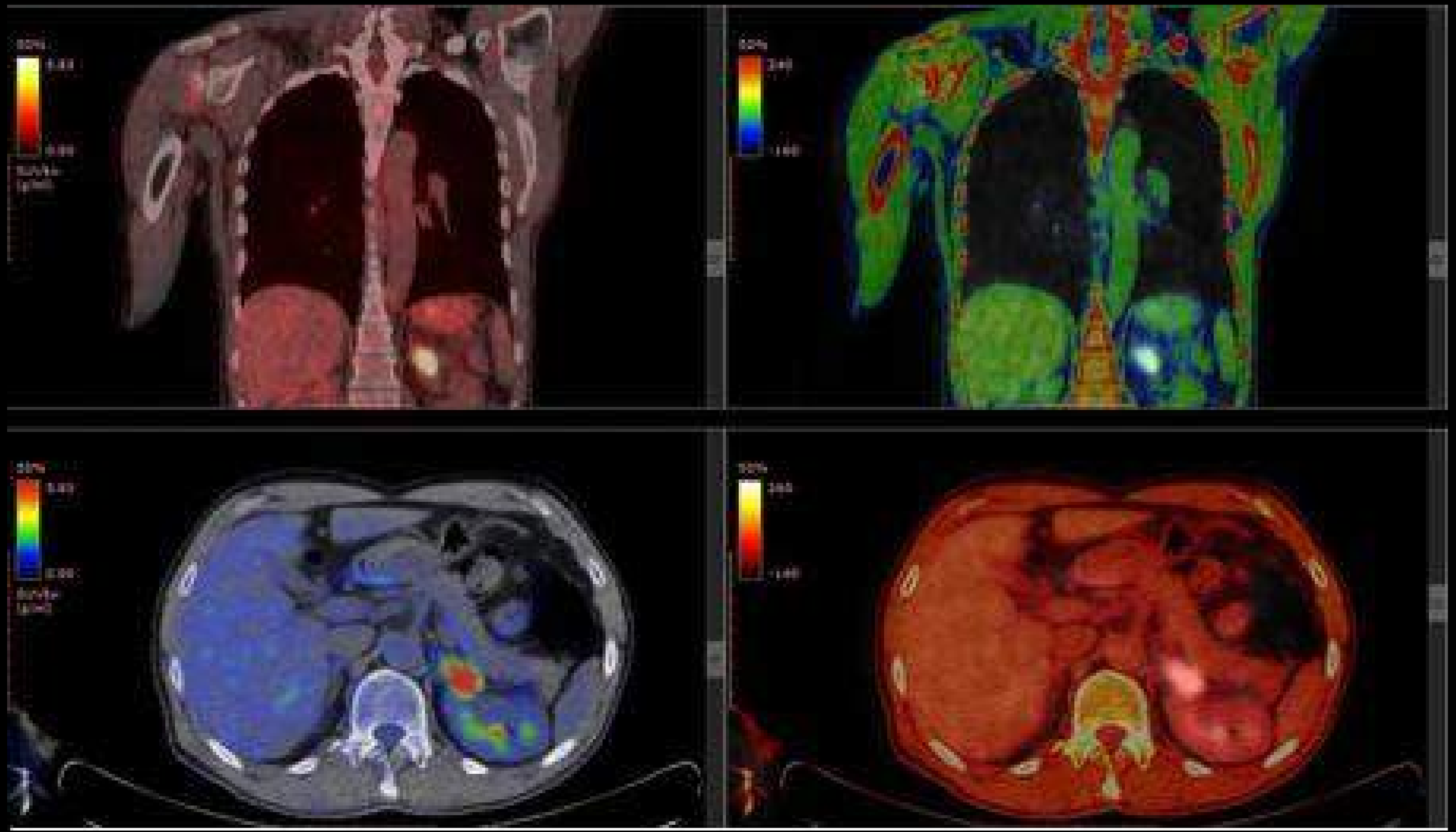
How active is the tumour?

What can PET scans be used for?

How fast does the cells turnover?

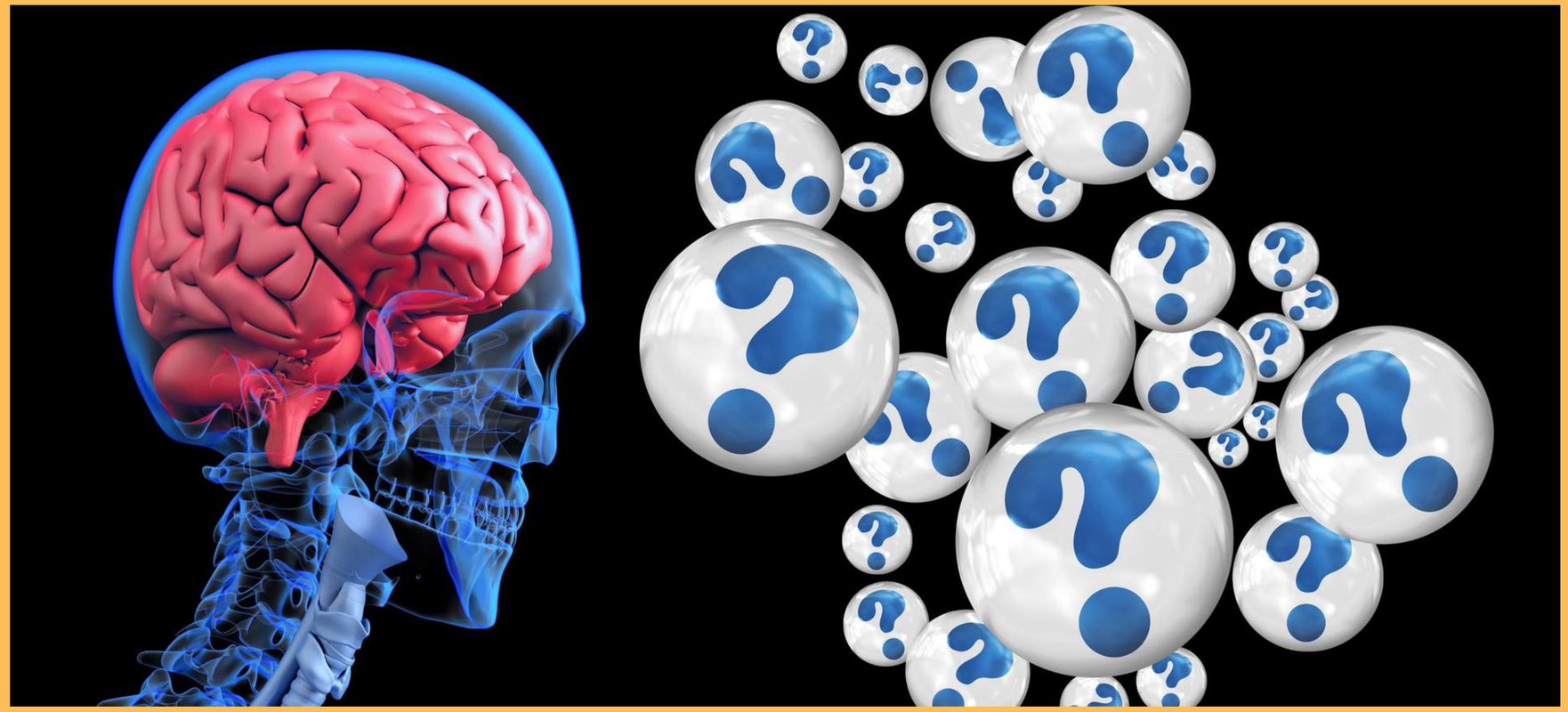
What can PET scans be used for?

What is the response to therapy?
e.g. chemotherapy or radiotherapy?
Is it working well?



Other uses of PET scan

Conditions e.g. Dementia or Alzheimer's disease.

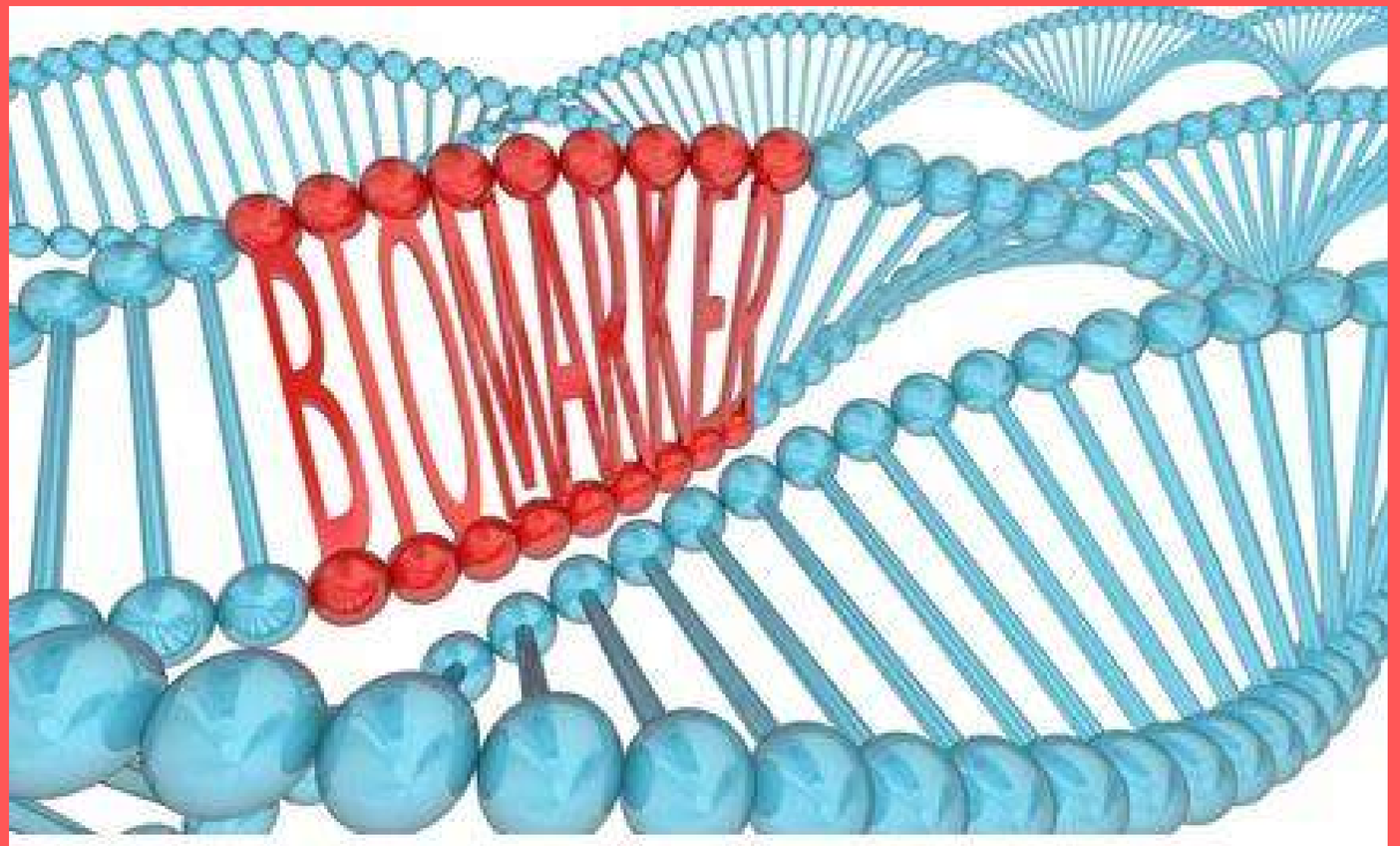


Other uses of PET scan

Guide in operations involving the heart and the brain.

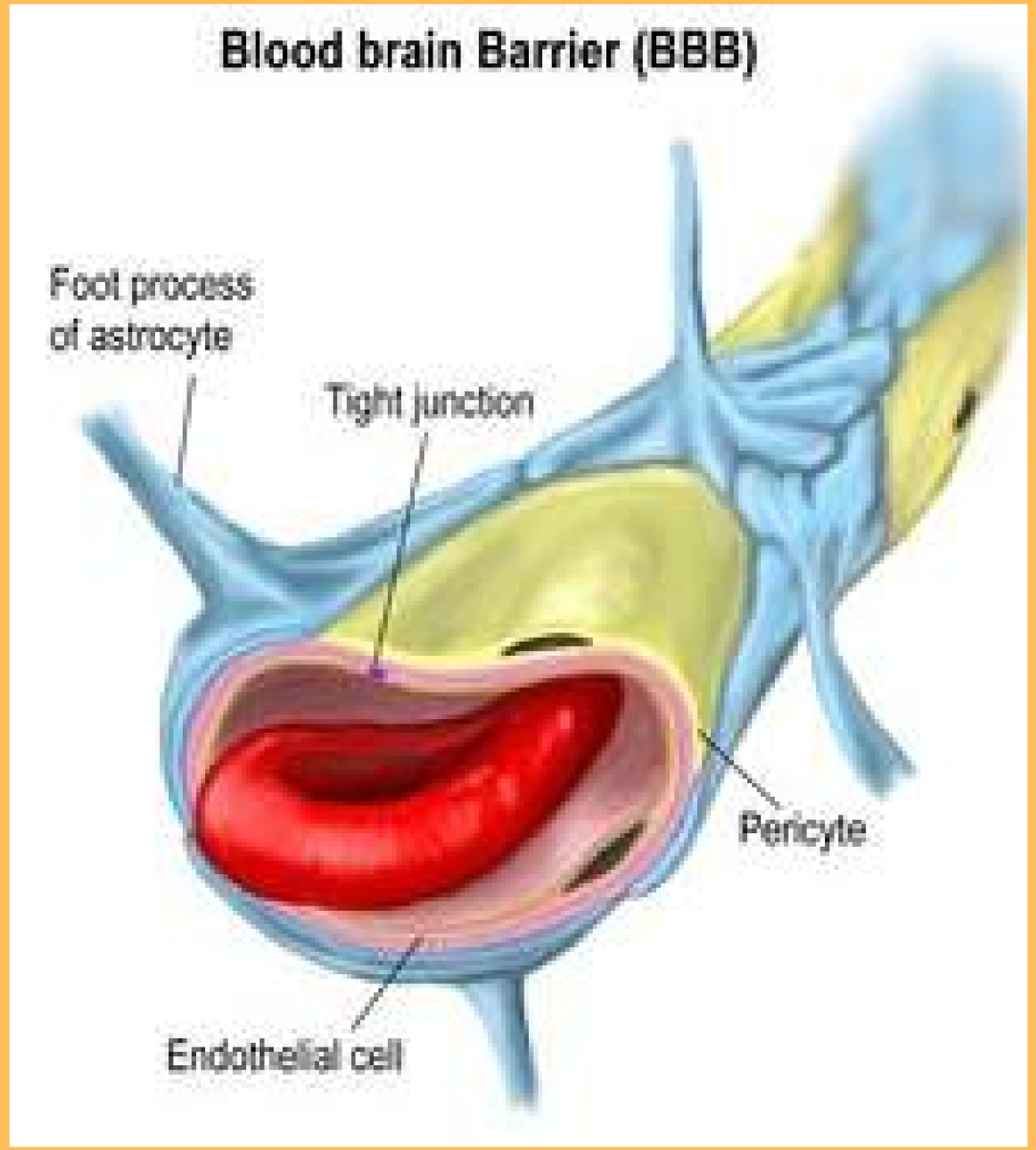
Other uses of PET scan

PET imaging probes can be used as early biomarkers to see the outcome before taking therapy.



The brain and the PET scan

Getting a substance into the brain is difficult due to the blood brain barrier.

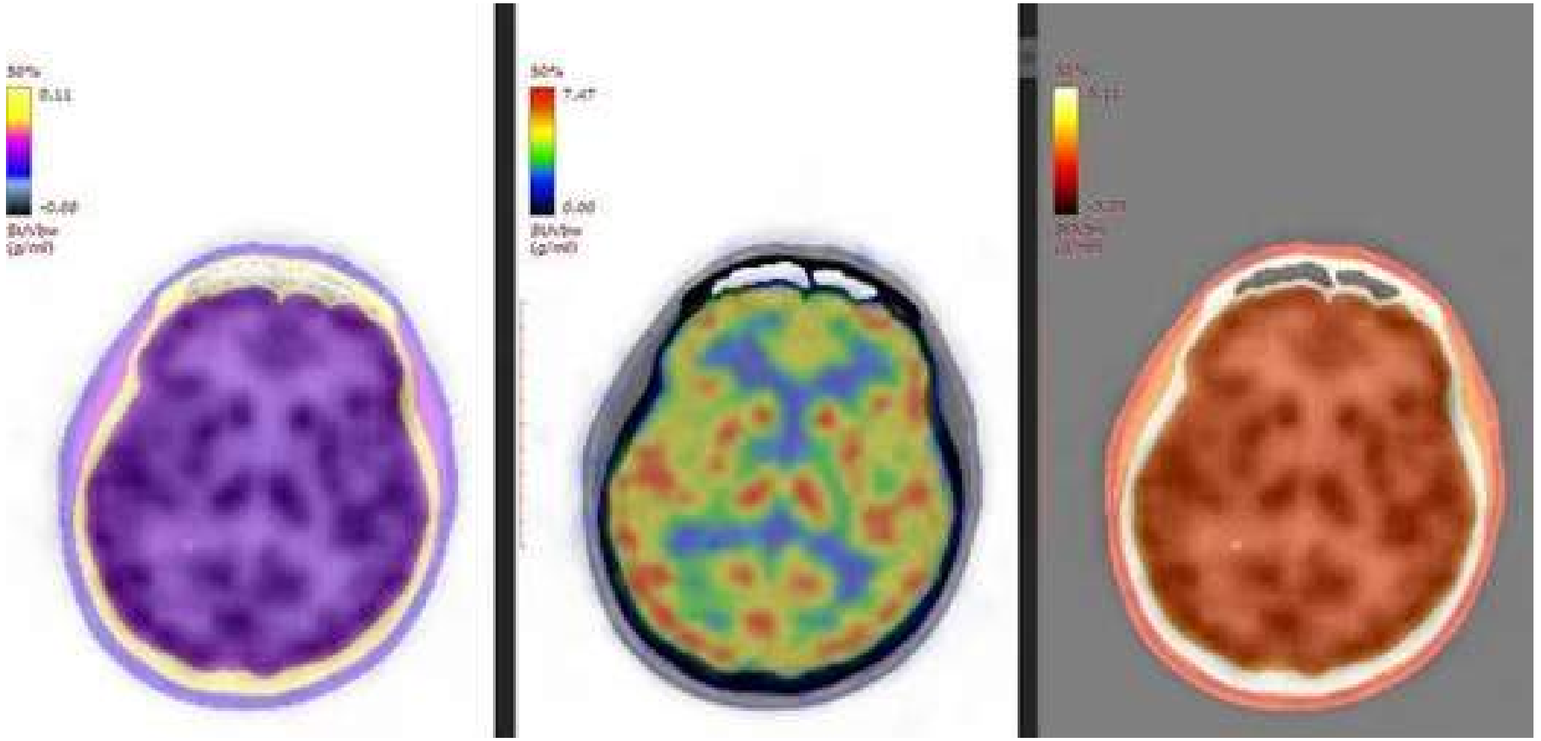


The brain and the PET scan

The flourine isotope 18F is an radioactive emitter that can join with glucose to help it pass through the barrier.

The brain and the PET scan

This helps detect activity in the brain!



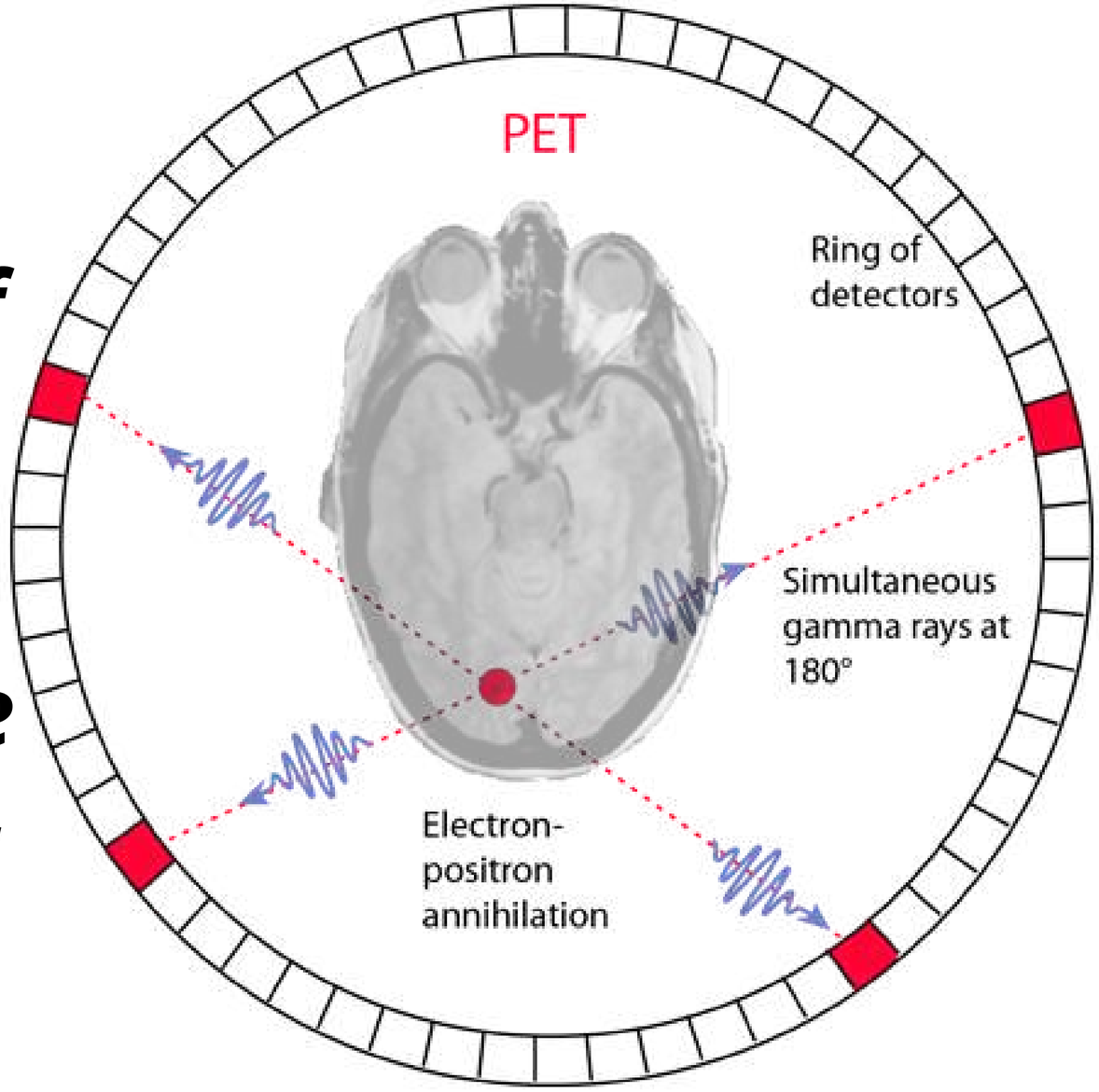
How do PET scans work?

1) A substance called a radiotracer is injected into the arm through a small plastic tube called a canulla.

How do PET scans work?

2) This allows it to go round different areas of the body.

Radiotracers can also be inhaled (breathed in) or swallowed.

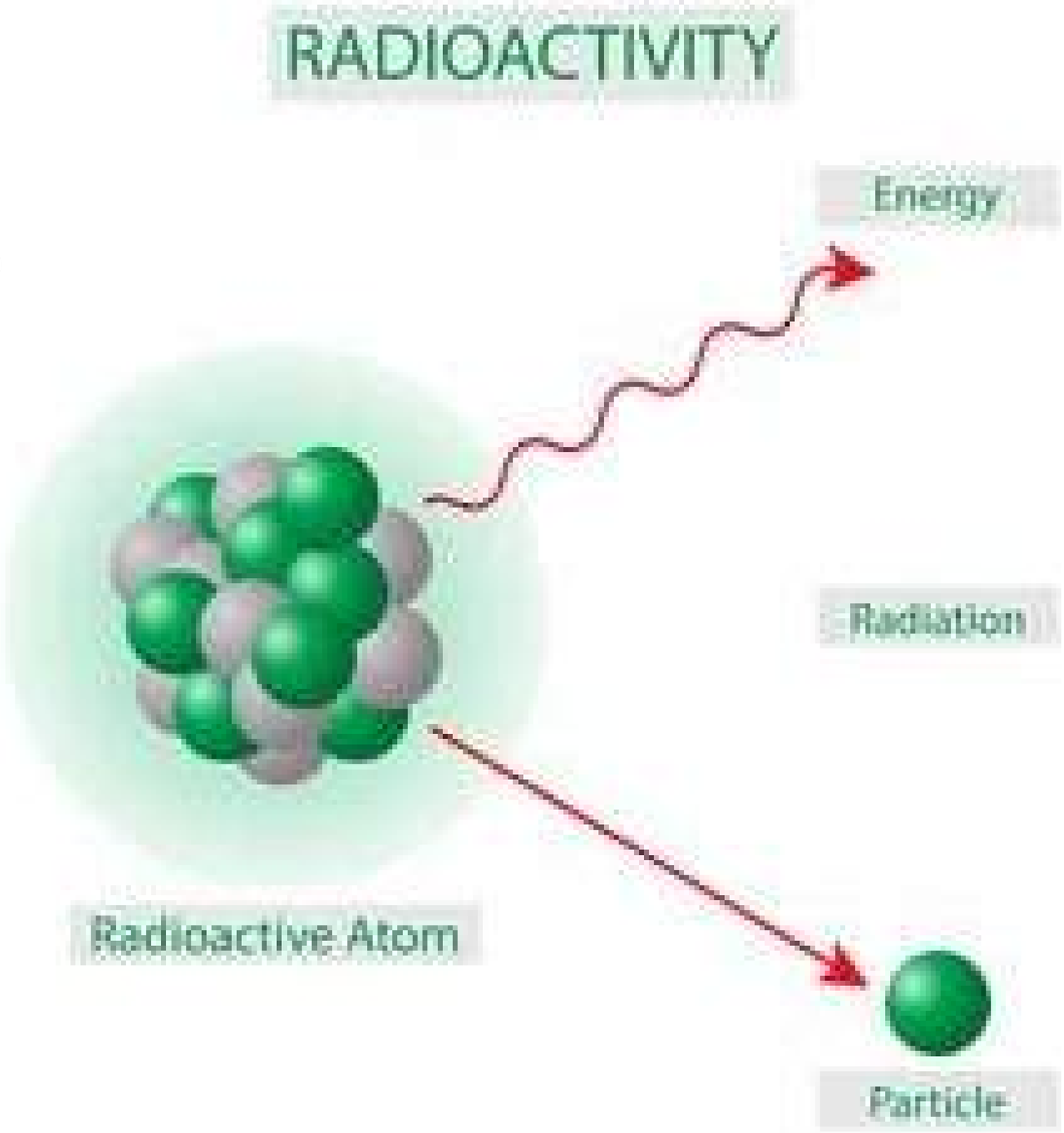


How do PET scans work?

3) A PET scanner is doughnut-shaped and detects the radiation given off by the radiotracer.

What is a radiotracer?

They are chemicals that have a radioactive isotope to help find out and observe the behaviour of different processes.

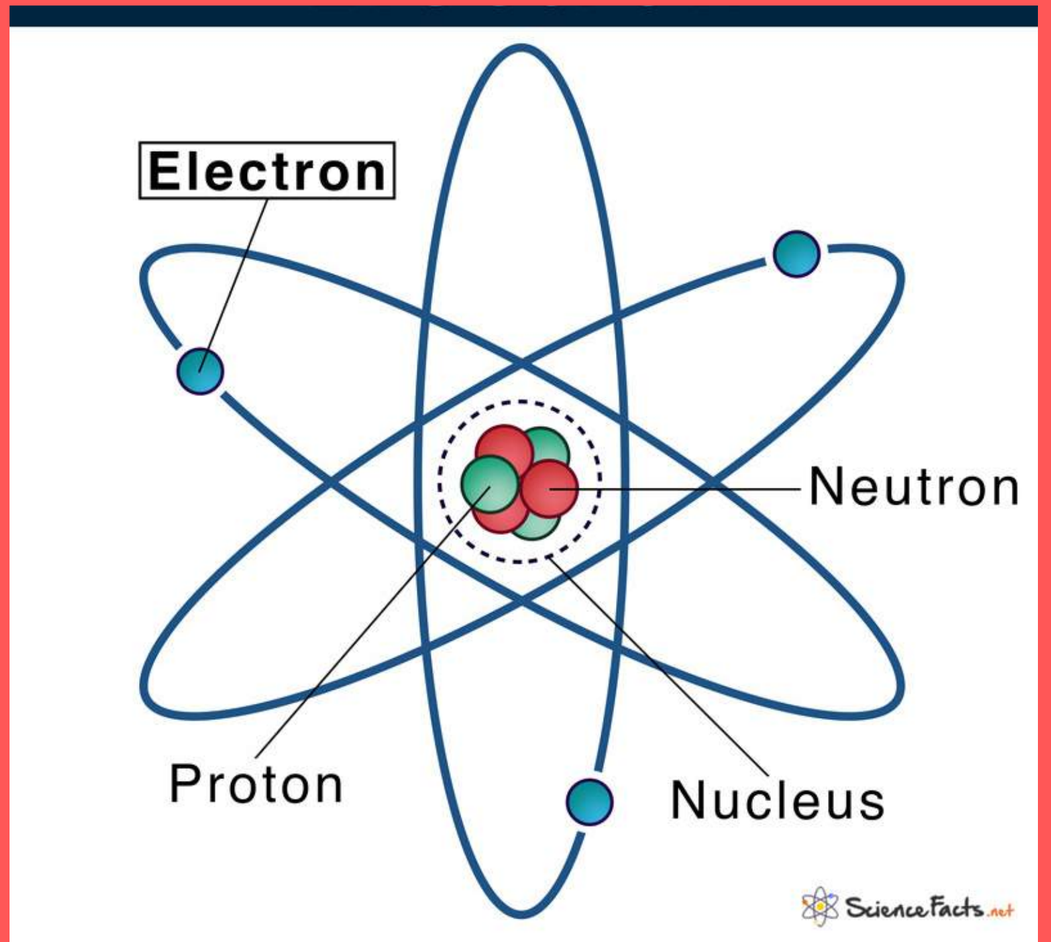


What is a radioactive isotope?

It is an atom with a few neutrons in its nucleus.

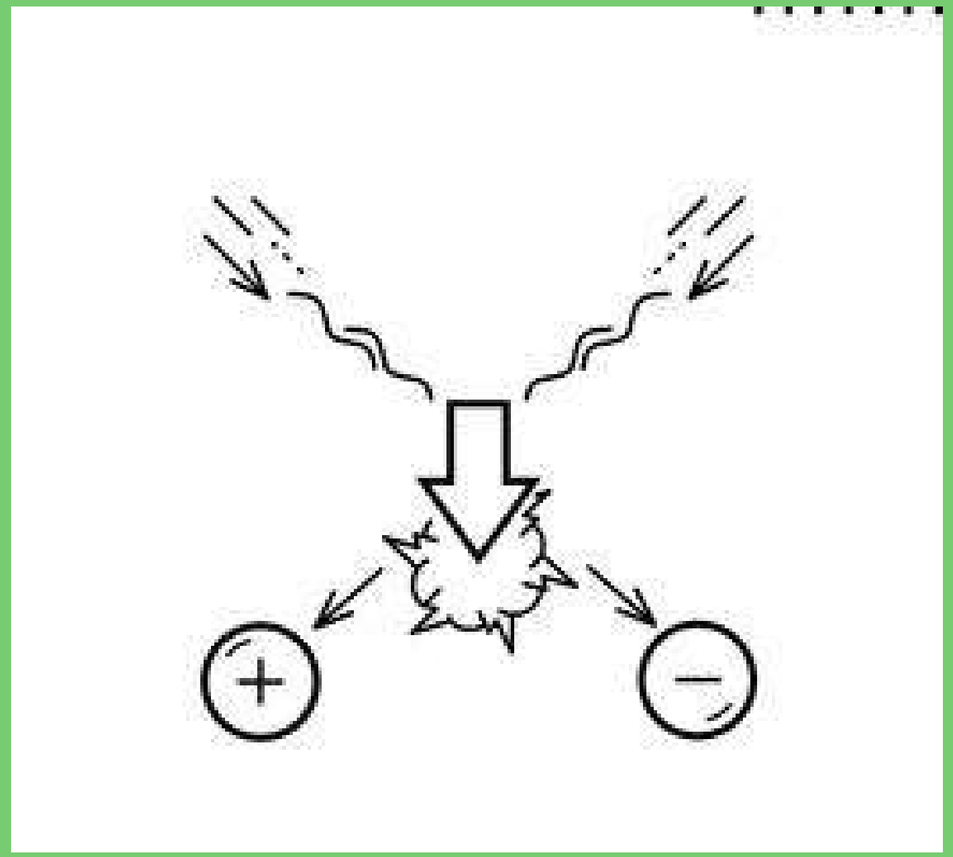
This makes them unstable.

Neutrons have no charge.



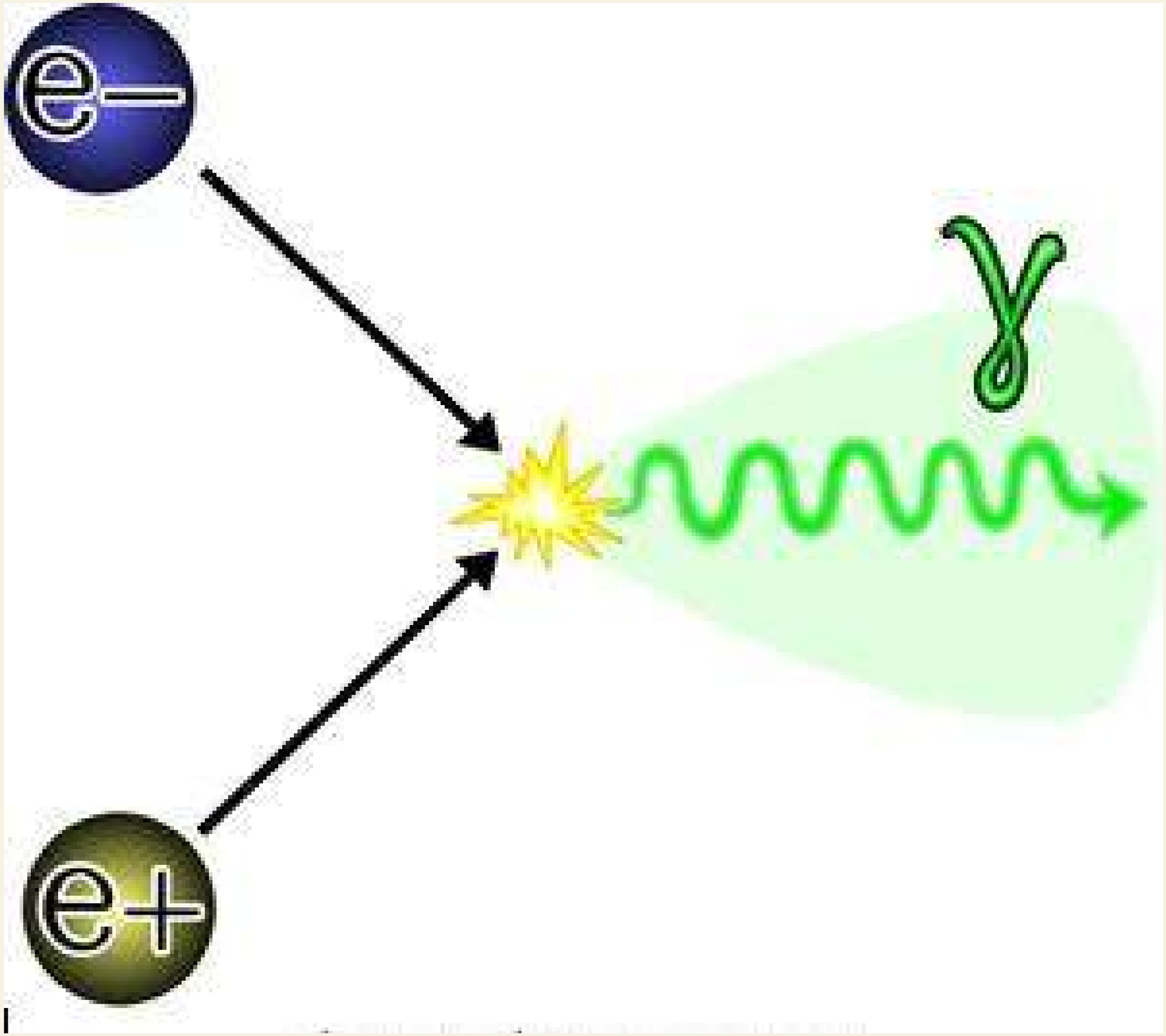
What is a radioactive isotope?

The nucleus splits and this releases positively charged electrons called a positron!



What is a radioactive isotope?

POSITIVE + ELECTRON → POSITRON


e−
e+
γ

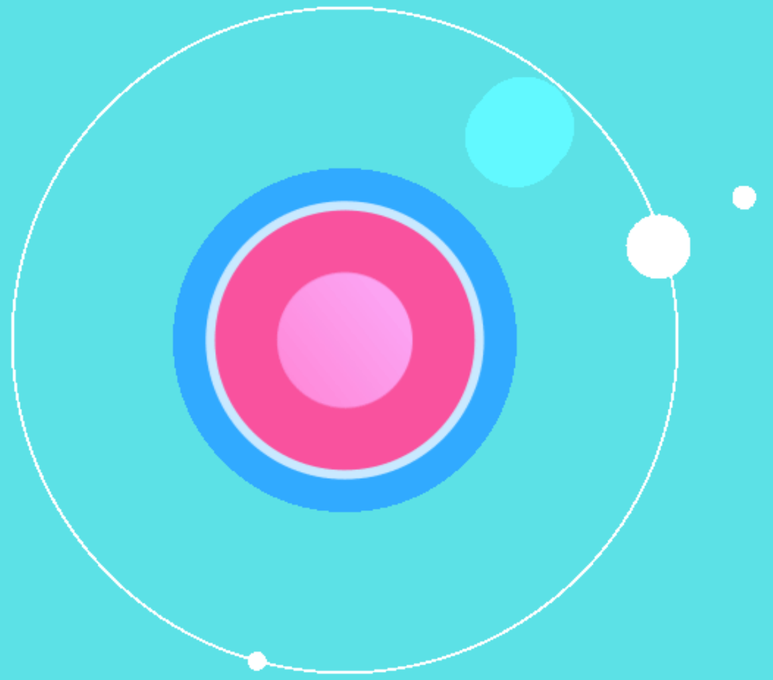
How do PET scans work?

4) Radioactive isotope attaches to certain molecules before being injected into the body:

- *Glucose*
- *Oxygen*
- *Ammonia*
- *Water*

How do PET scans work?

5) These molecules track and help to check if a disease is present.

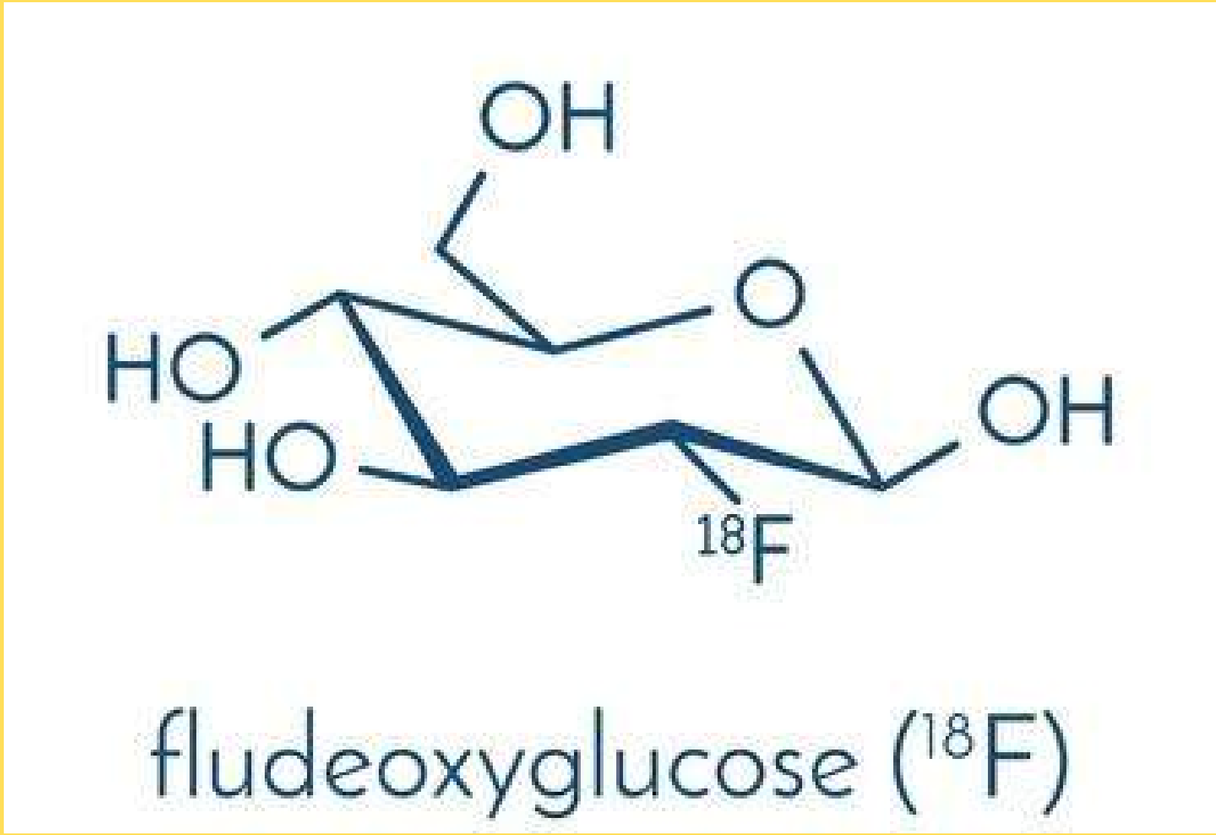


Finding out where the radiotracer goes and builds up shows how well the body is working.

FDG

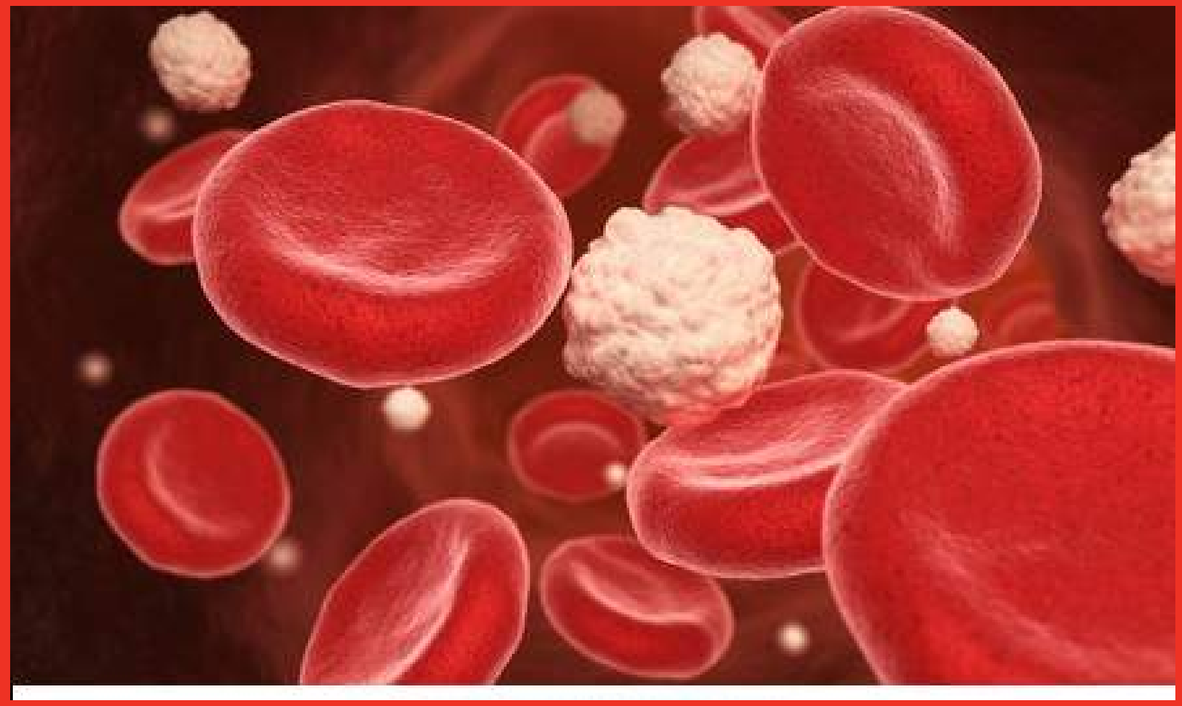
Fluorodeoxyglucose (FDG) is the most common radiotracer used.

It is similar to the natural sugar glucose needed for energy!



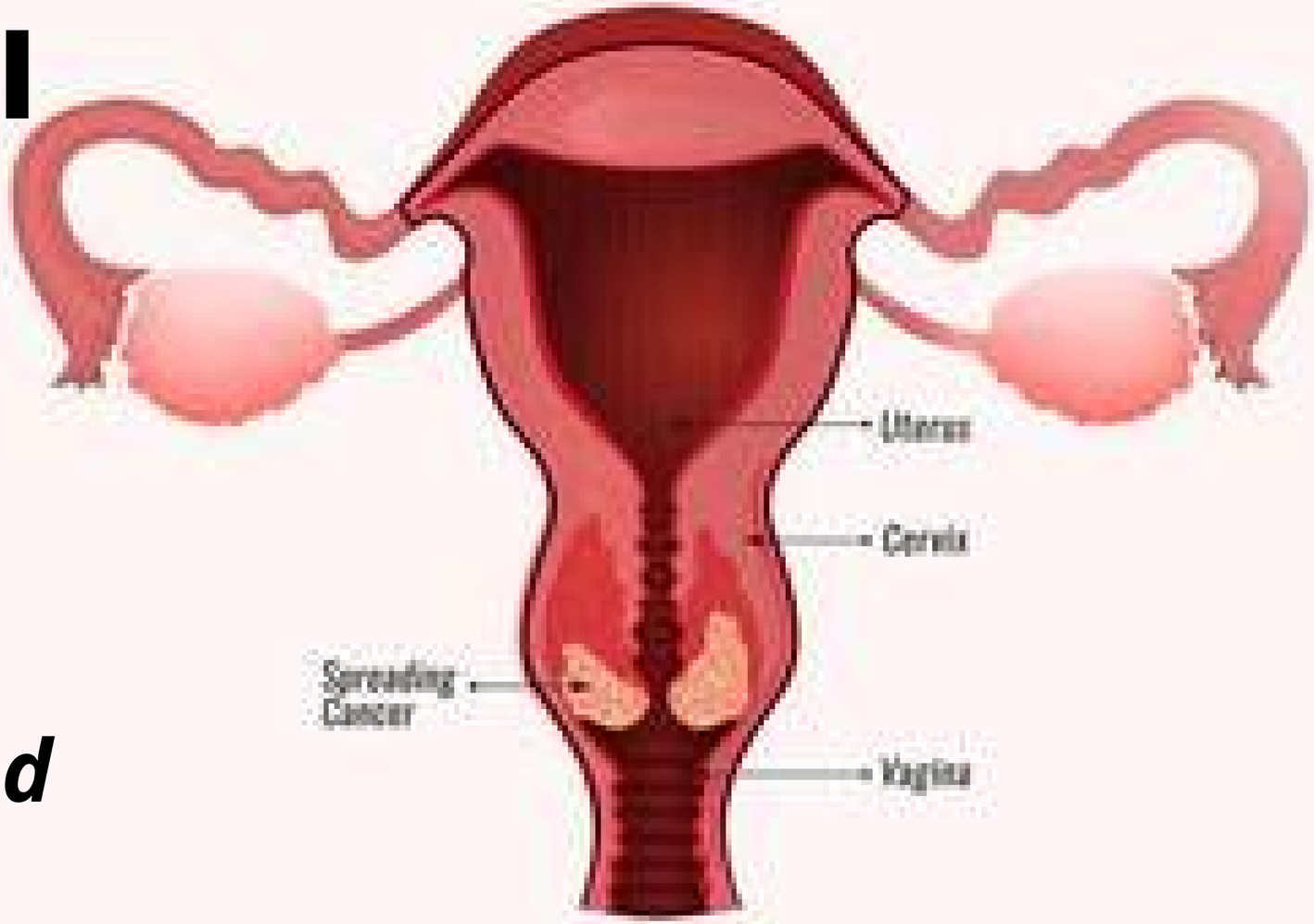
Cancer cells use glucose faster than normal cells for growth which helps to identify cancer!

It shows a brighter area on the image!



FDG and cervical cancer

18F-FDG PET provides sensitivity and specificity for cervical cancer more than CT and other types of scans.



Source: Mirpour, S., Mhlanga, J., Logeswaran, P., Russo, G., Mercier, G., Subramaniam, R. (2013) The role of PET/CT in the management of cervical cancer. Americal Journal of Roentgenology 201 (2) W192-W205.

The Role of PET/CT in the Management of Cervical Cancer

Sahar Mirpour[1], Joyce C. Mhlanga[1], Prashanti Logeswaran[2], Gregory Russo[3], Gustavo Mercier[2] and Rathan M. Subramaniam[12]

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[1] Russell H. Morgan Department of Radiology and Radiologic Science, Johns Hopkins University, JHOC 3235, 601 N Caroline St, Baltimore MD 21287.

[2] Department of Radiology, Boston University School of Medicine, Boston, MA.

[3] Department of Radiation Oncology, Boston University School of Medicine, Boston, MA.

Radioactive isotope improved diagnosis for prostate cancer!

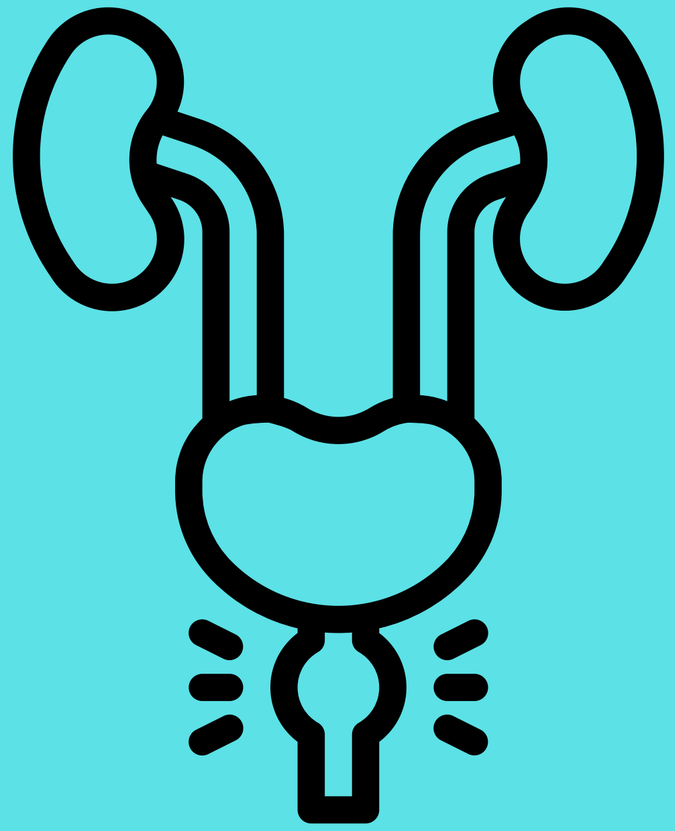
The radioactive tracer 18F-DCFPyL PET has improved the diagnosis and management of patients with recurrent prostate cancer!

The isotope targets PSA (prostate-specific antigen).

Source: Sharma, R. and Aboagye, E. (2011) Comprehensive Cancer Imaging. British Journal of Pharmacology. 163 (8): 1565-1585.

Radioactive isotope improved diagnosis for prostate cancer!

The CONDOR clinical trial involved patients with high PSA levels after therapy!

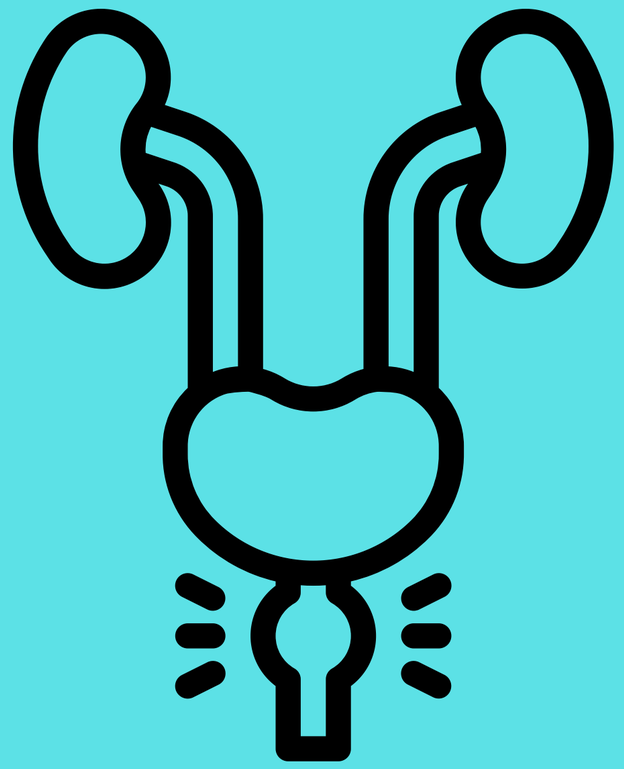


They were given a dose of 333 MBq of the tracer and had PET-SCT scan 1 - 2 hours later!

Source: Sharma, R. and Aboagye, E. (2011) Comprehensive Cancer Imaging. British Journal of Pharmacology. 163 (8): 1565-1585.

Radioactive isotope improved diagnosis for prostate cancer!

The PET-CT scan images were seen by three readers and compared with other tests: pathology, imaging and PSA to calculate the correct localisation rate (CLR).



Source: Sharma, R. and Aboagye, E. (2011) Comprehensive Cancer Imaging. British Journal of Pharmacology. 163 (8): 1565-1585.

Radioactive isotope improved diagnosis for prostate cancer!

The disease detection rate across three readers was 59.1 to 65.9% while the CLR was 84.8 - 87%

Source: Sharma, R. and Aboagye, E. (2011) Comprehensive Cancer Imaging. British Journal of Pharmacology. 163 (8): 1565-1585.

11-06-2020 | ASCO 2020 | Conference coverage | News

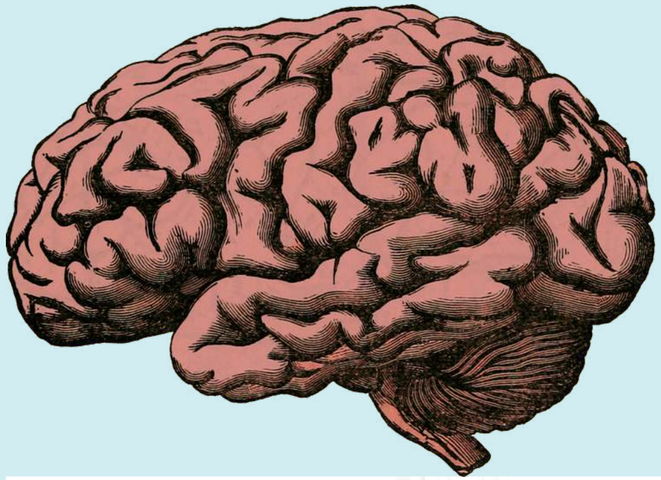
CONDOR: 18F-DCFPyL PET diagnoses biochemically recurrent prostate cancer

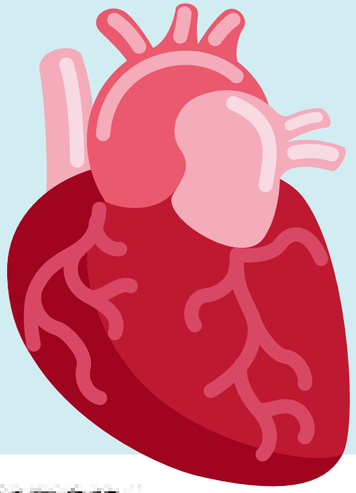
Author: Laura Cowen

medwireNews: Positron-emission tomography (PET) using the novel prostate-specific membrane antigen (PSMA) targeted ^{18}F-DCFPyL tracer shows "excellent diagnostic performance" in men with biochemically recurrent prostate cancer, researchers report.

Speaking at the virtual 2020 ASCO Annual Meeting, Michael Morris, from the Memorial Sloan Kettering Cancer Center in New York, USA, said that ^{18}F-DCFPyL PET "clearly showed superiority to the standard imaging

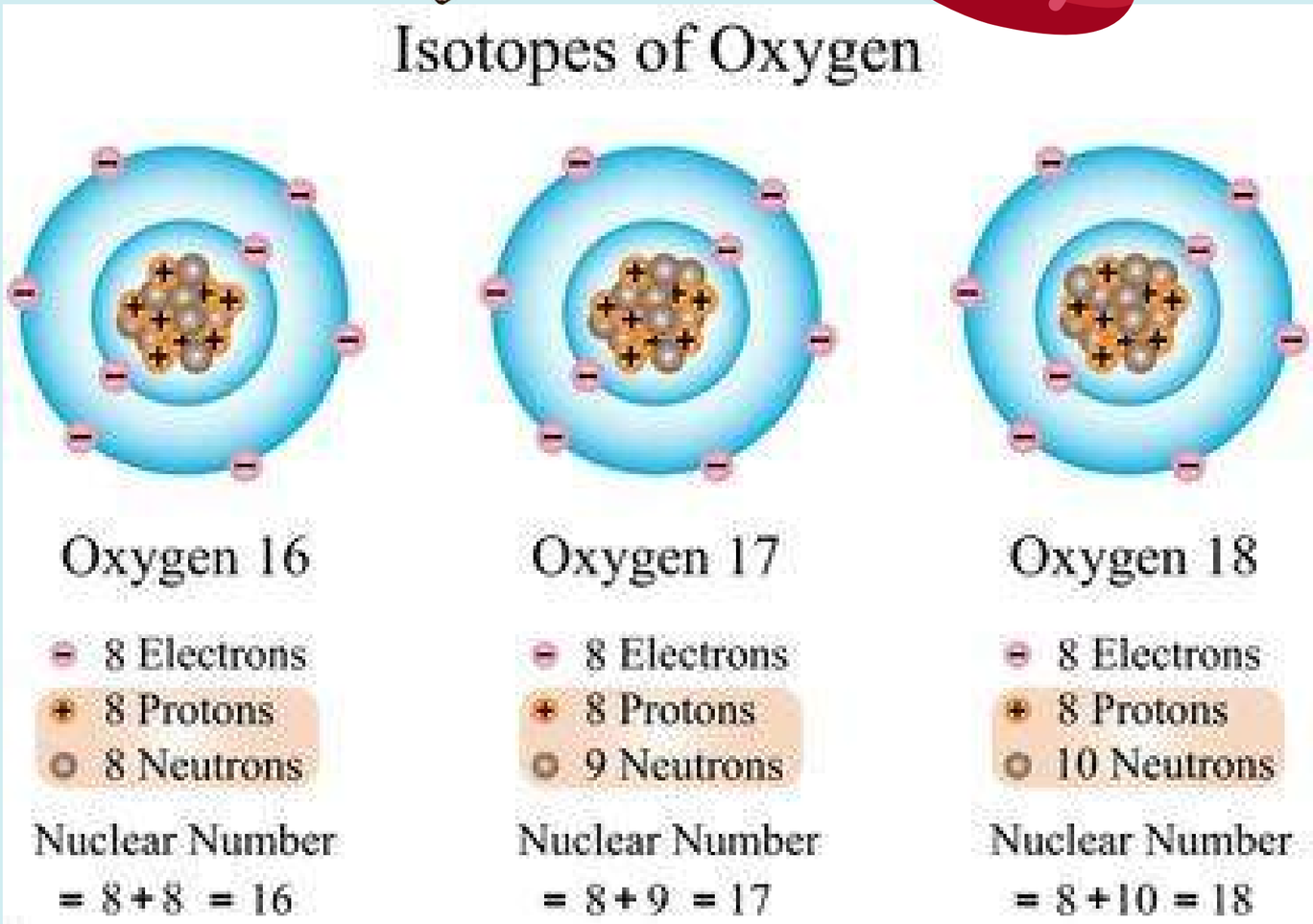
Oxygen





It helps track and detect how well the brain is working!

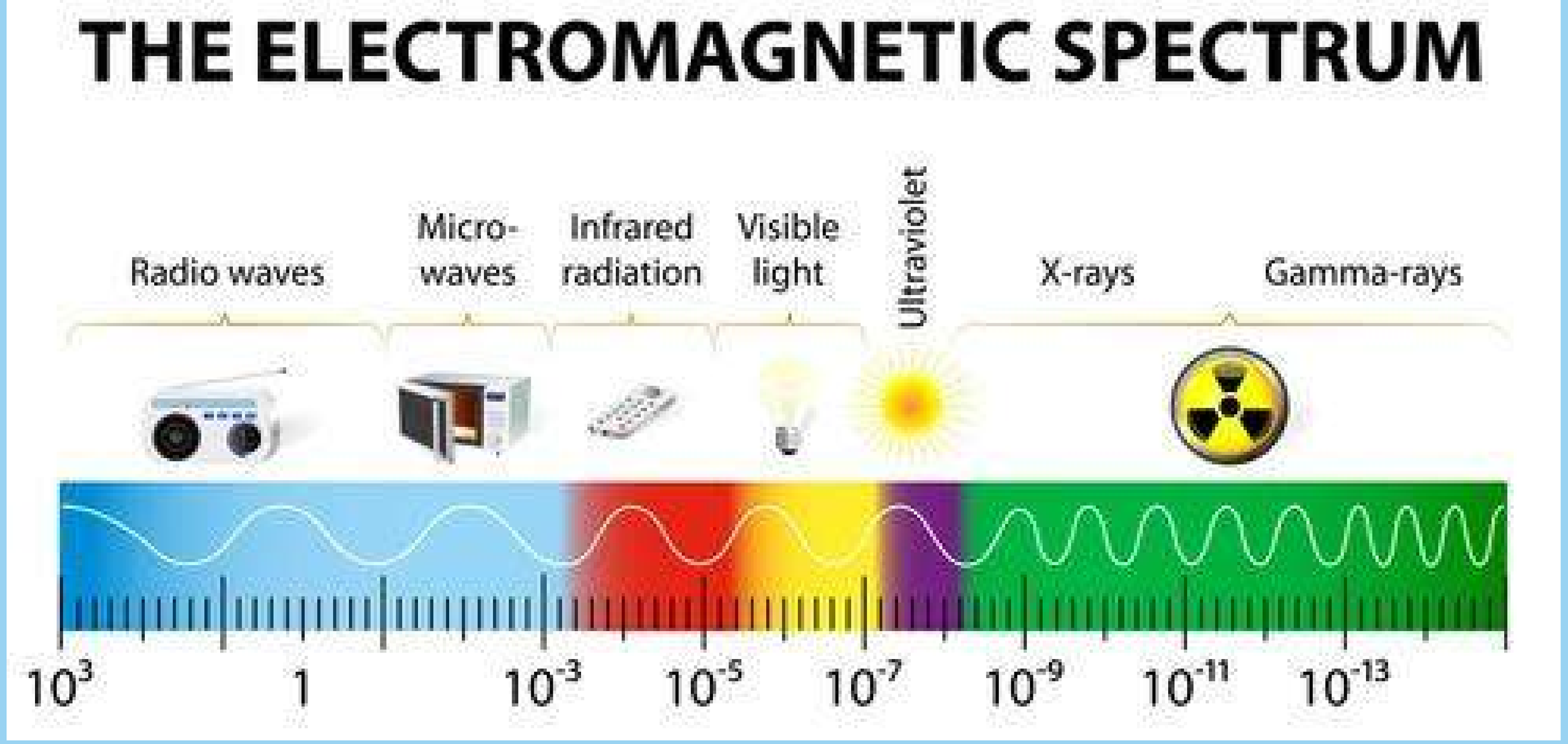
It also helps to detect heart diseases by looking at the blood flow in the heart!



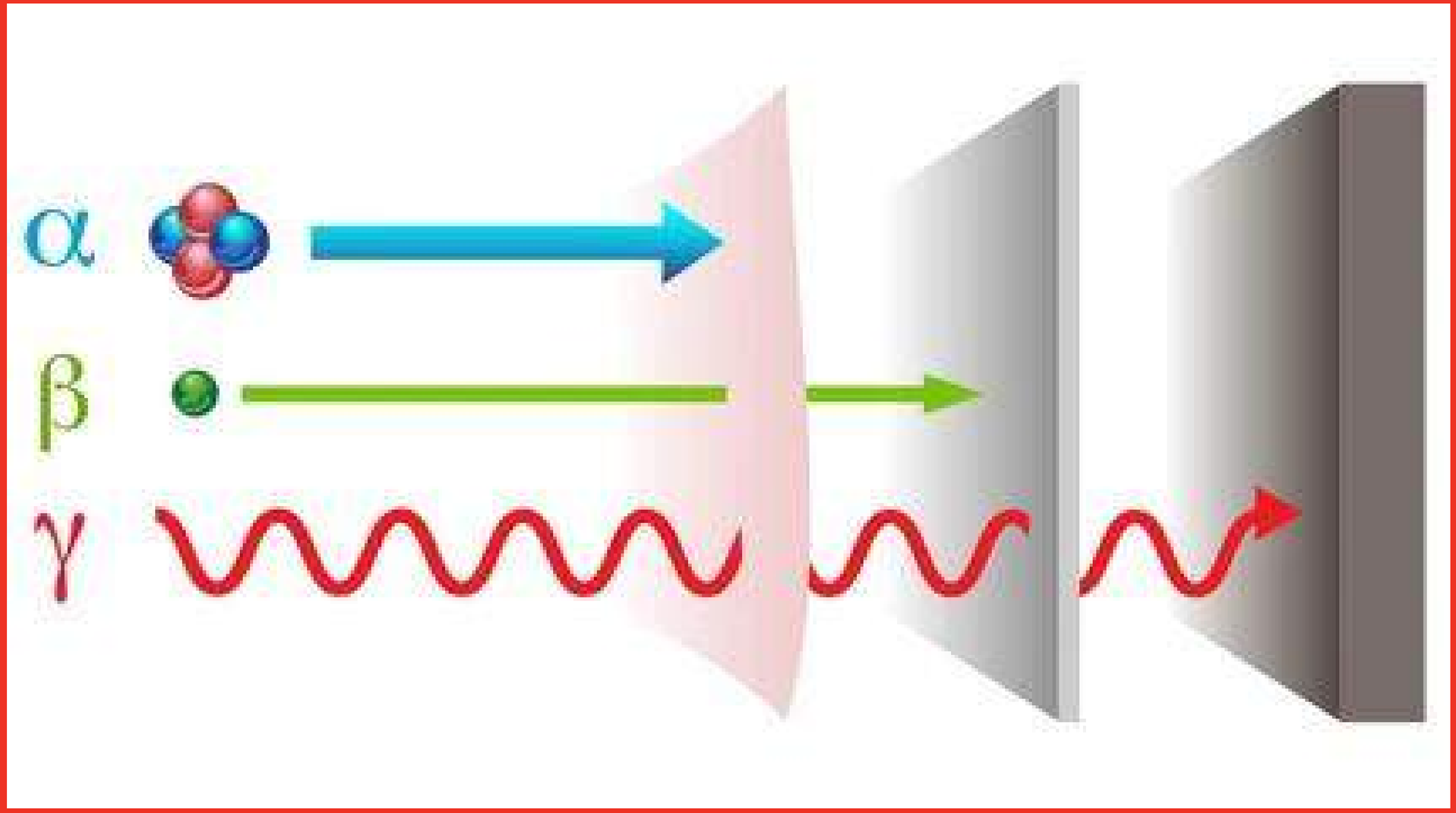
How do PET scans work?

6) When positrons come into contact with electrons (negatively charged particles) in other atoms.

It creates gamma rays!



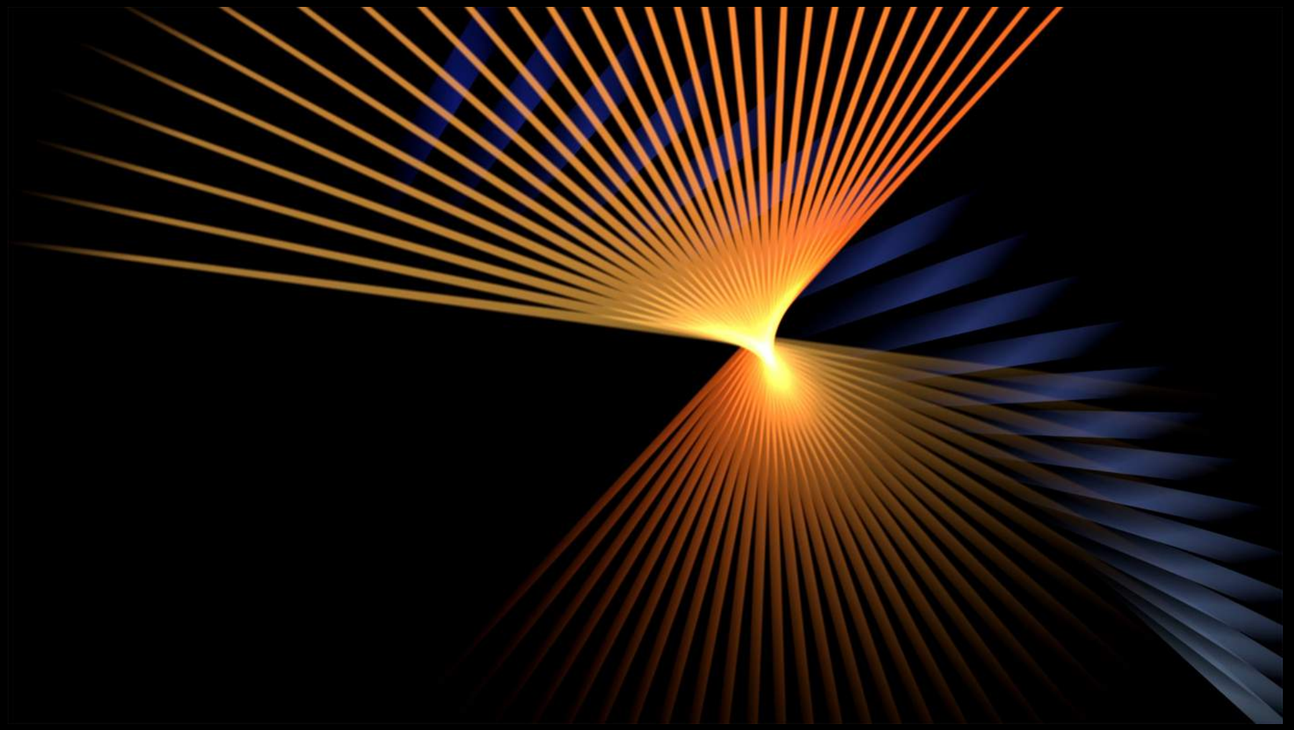
Gamma rays have the smallest wavelengths and the most energy in the electromagnetic spectrum.



Gamma radiation have more energy than other radiations: alpha and beta. It can pass through paper, aluminium and some can pass through even a thick lead!

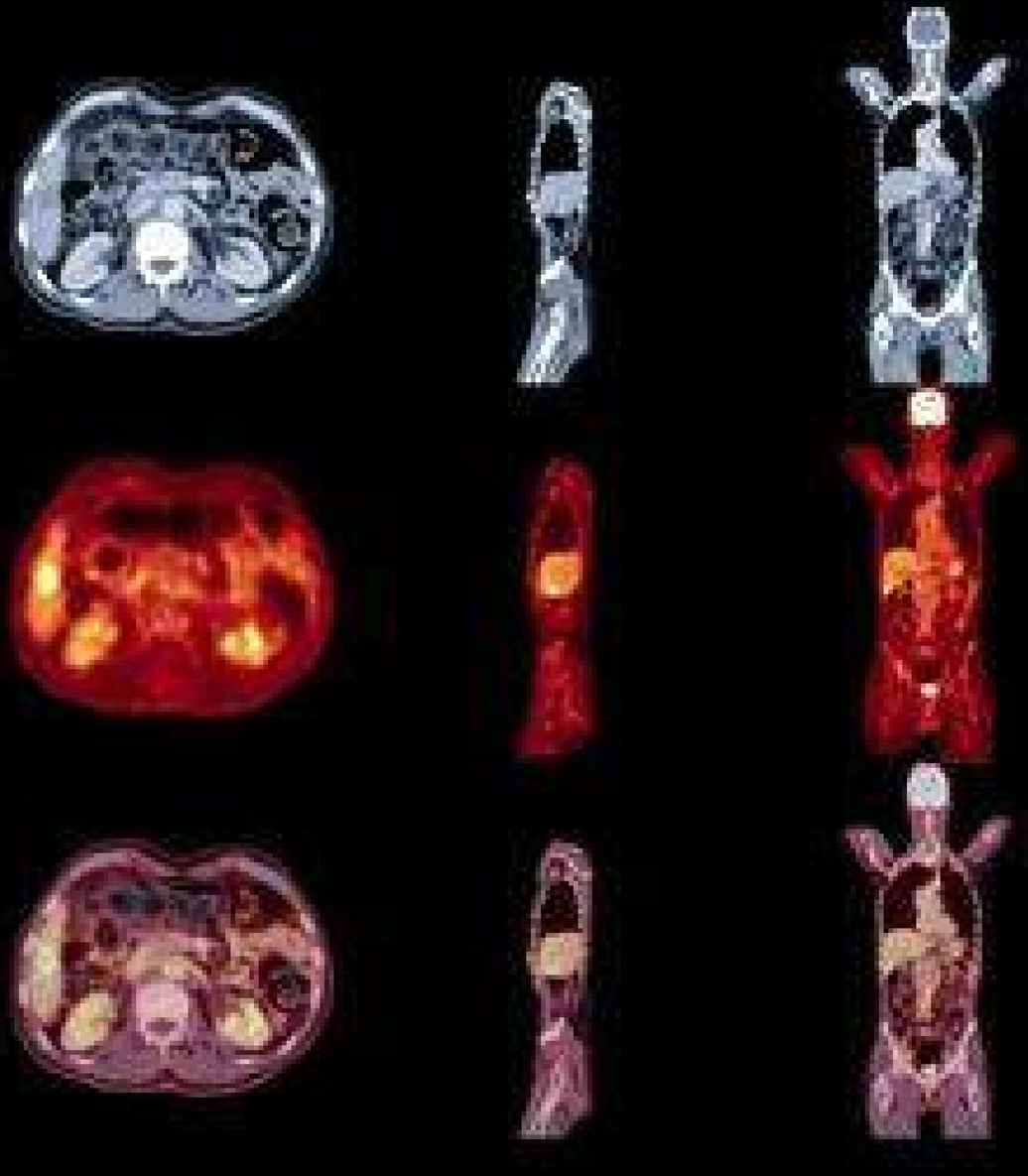
How do PET scans work?

7) Gamma rays are detected by the PET scanner and finds out the location of the tracking molecules!



How do PET scans work?

8) This creates images of different colours and brightness that presents the level or concentration of the tracking molecules changing over time!



How do PET scans work?

9) The activity of the radioisotope lowers with time so it is crucial to get images as soon as the injection has took place!

The process

Before the PET scan.

Please arrive on time (one hour before hand) as the radiotracer works well in a short time!

The process

Before the PET scan.

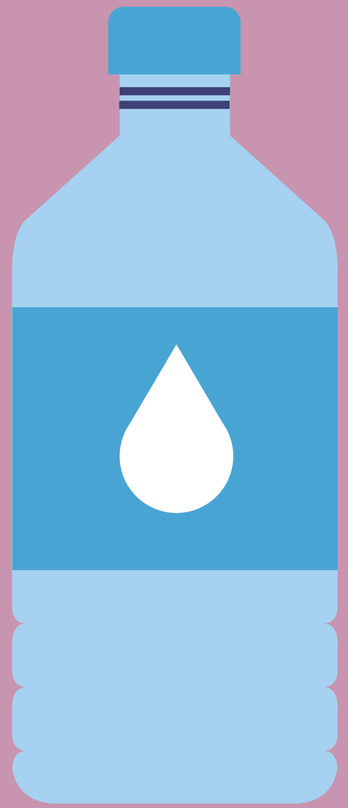
The appointment letter will state any preparation instructions.

The process

Before the PET scan.

Normally, they would advise

- No food 6 hours before appointment.
- Drinking water is possible.
- Avoid heavy exercise a day before the appointment.



The process

Before the PET scan

What do you need to inform the hospital?

Allergies?

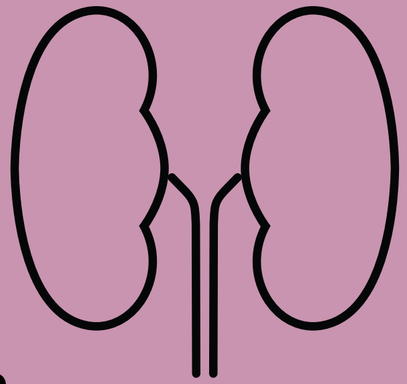
Breastfeeding?

Pregnant?

Kidney problems?

Diabetic?

Do you need sedation?



The process

Before the PET scan

What do you need to inform the hospital?

For diabetic patients, you can alter or adapt diet and the sugar control and the appointment time can be changed!

The process

Before the PET scan

Removal of any metal objects takes place to not interfere with the X-rays e.g.

- Jewellery and piercing.
- Dentures (false teeth)
- Wigs
- Hearing aid

The process

Before the PET scan

The patient may be asked to wear a hospital gown or clothes that has no metal objects e.g.:

- Buttons
- belts
- wired bras
- Zips

The process

Sedatives

It is given to kill pain but it is not normally needed. This must be arranged before the appointment.

If the patient is worried or claustrophobic, it can help keep them relaxed.

The process

What happens during the PET scan?

The radiotracer is injected into a vein in your arm or hand about an hour before the scan.

It takes time to reach the right area in the body!

The process

What happens during the PET scan?

The patient will lie flat on a bed, relax and remain still.

The process

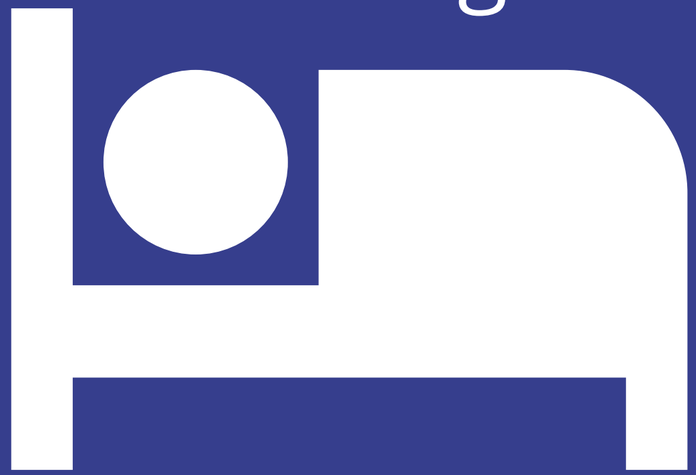
What happens during the PET scan?

Do not talk as it can affect where the radiotracer is going inside your body.

The process

What happens during the PET scan?

The flat bed is moved into the scanner before the scan begins.



The process

What happens during the PET scan?

The radiographer controls the scanner in another room. They can see you on a TV screen.

The process

What happens during the PET scan?

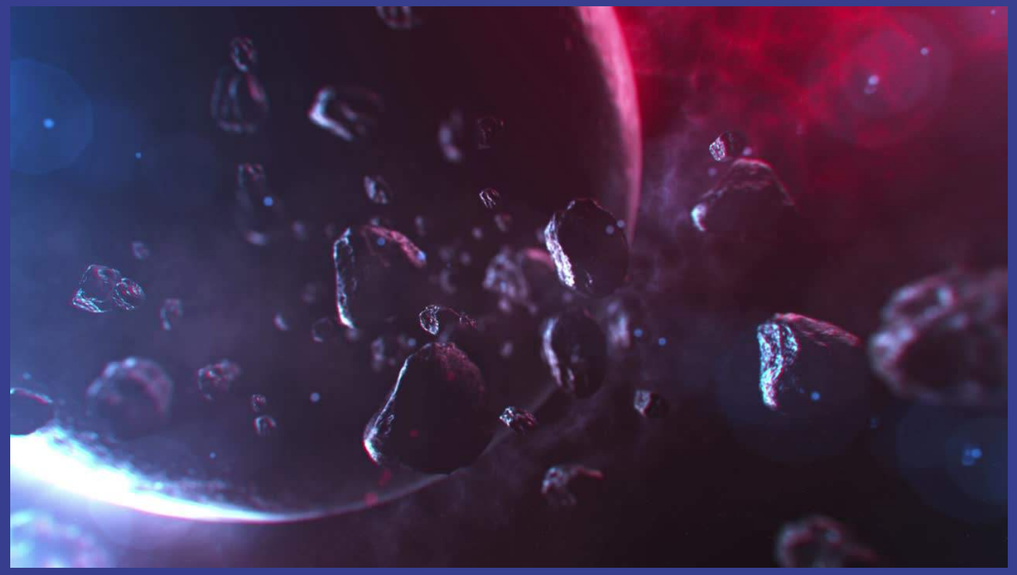
PET is not noisy but there will be some background noise.

You can ask the radiographer to play music before the scan if required.

The process

What happens during the PET scan?

Remain still and quiet whilst the scanner takes images of the body.



The process

What happens during a PET scan?

The scan takes around 30 to 60 minutes.

The process

After the scan

Once the scan is done, the patient is moved outside the scanner.

The patient can resume as normal.

The process

After the scan

The radiographer will remove the cannula from the arm before you go home.

The process

After the scan

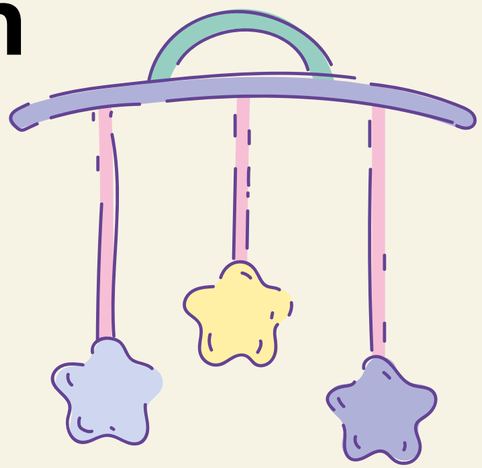
Please drink lots of water to remove the radiotracer naturally.

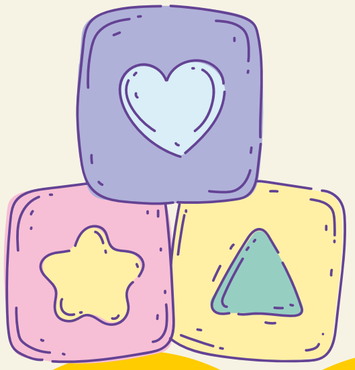
It normally takes a few hours to go.

The process

After the scan

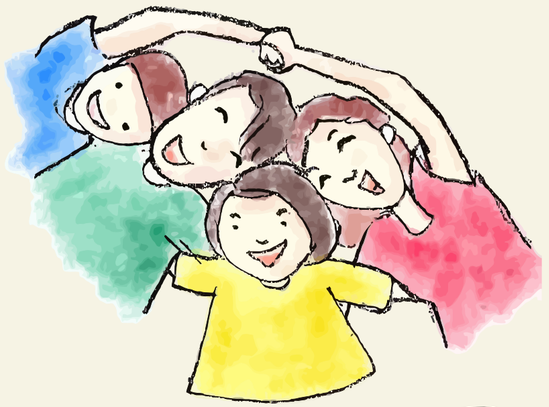
Please avoid pregnant women, children and babies until the radioactive isotope goes naturally.





The process

After the scan



If sedation has been taken, the patient needs to be taken home by a family or friend.

For the next 24 hours, no driving, machinery or alcohol.

The process

After the scan

The radiologist will send results to the doctor who made the referral.

Precautions

It is a painless procedure.

Precautions

The patient may feel uncomfortable due to the length of time lying still.

Precautions

Doses of radiation is small to cause any tissue damage.

Precautions

If the patient is travelling a week after the scan, the airport has radiation sensors which may pick up traces of the radioactive isotope so it is advised to bring the hospital letter.

Precautions

PET-CT scan adds additional radiation but it does not cause any problems.

Precautions

Bruising where needle is inserted.

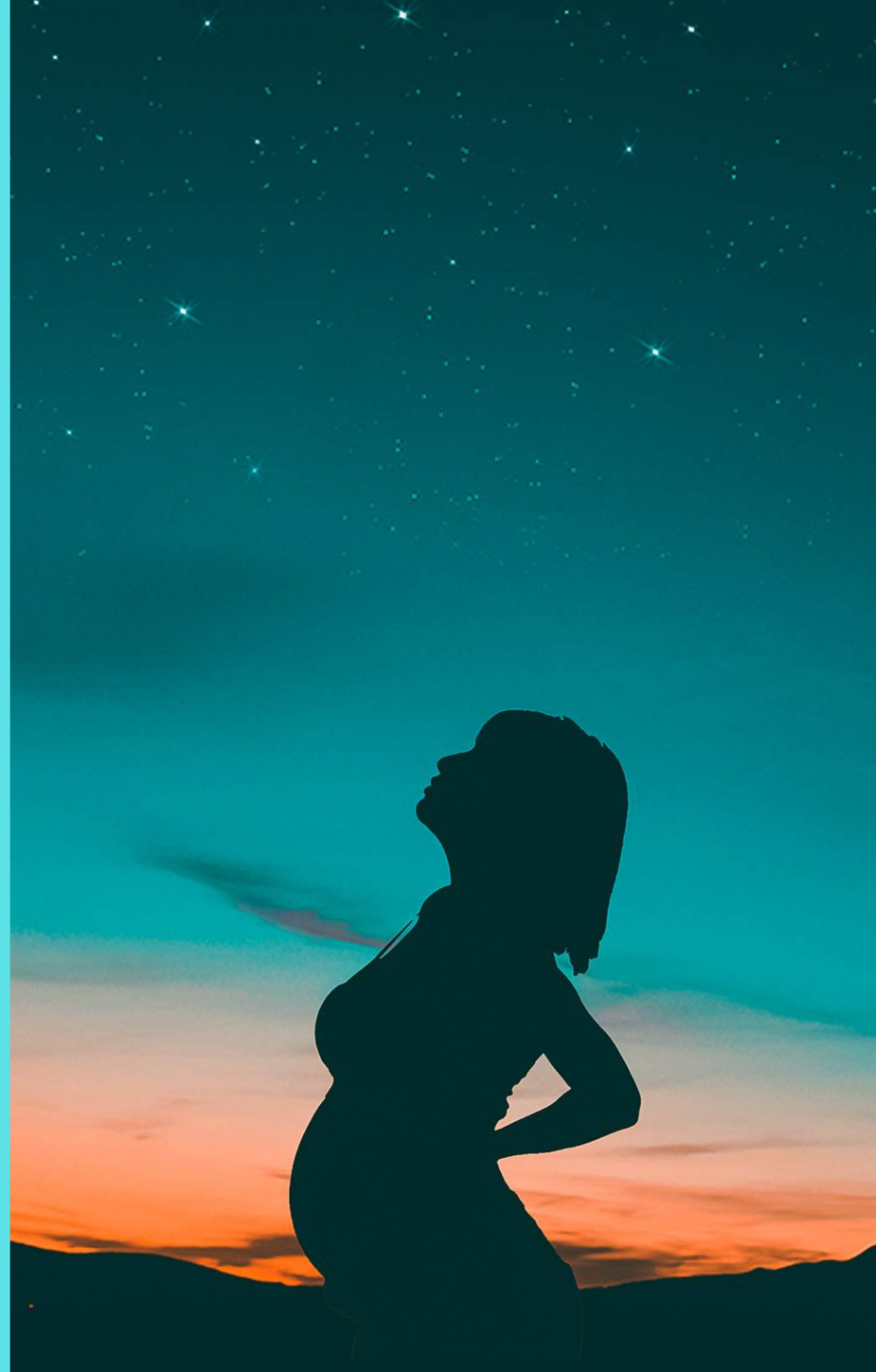
Precautions

Leak of radioactive tracer causes swelling.

Precautions

Emergency scans on pregnant women are done only.

It may cause harm to the baby.



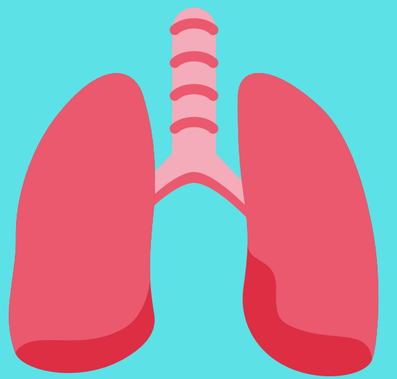
Precautions

Breast feeders will be advised when to stop and start breast-feeding after having the radiotracer.

Precautions

Allergic reaction due to radioactive tracer. Weakness, sweating and difficulty breathing.

Must inform radiographer immediately.



New developments - PET-SCAN detects advanced prostate cancer!

30% of patients had an increase in prostate-specific antigen (PSA) levels after surgical treatment such as radical prostatectomy.

The outcome varies with site and recurrence. PET-CT scan allowed early detection of metastatic cancer.

Source: Fossati, N., Gandaglia, G., Briganti, A. and Montorsi,. F. (2019) The emerging role of PET-CT scan after radical prostatectomy: still a long way to go. The Lancet 20 (9): 1193-1195

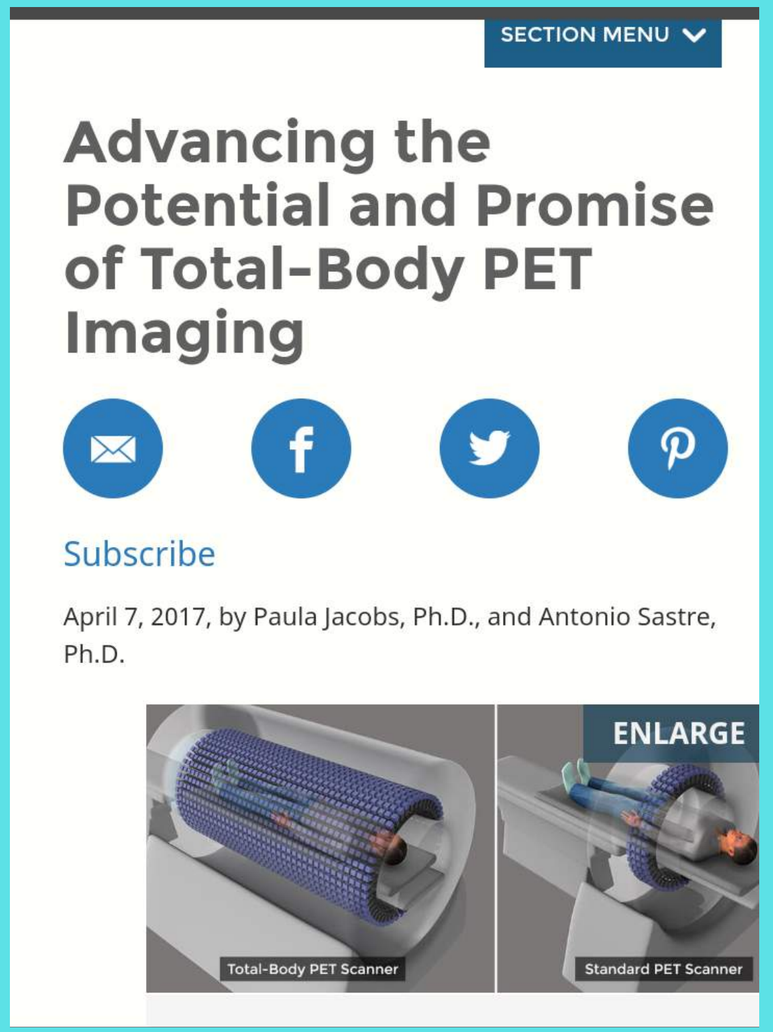
New developments - Total-body PET (TB-PET) scanner in development!

This new device in development can help make a big difference in cancer care!

More signal is released from the radioactive tracers injected into the body.

This high sensitivity means LOW disease of radioisotopes can be used for the scan.

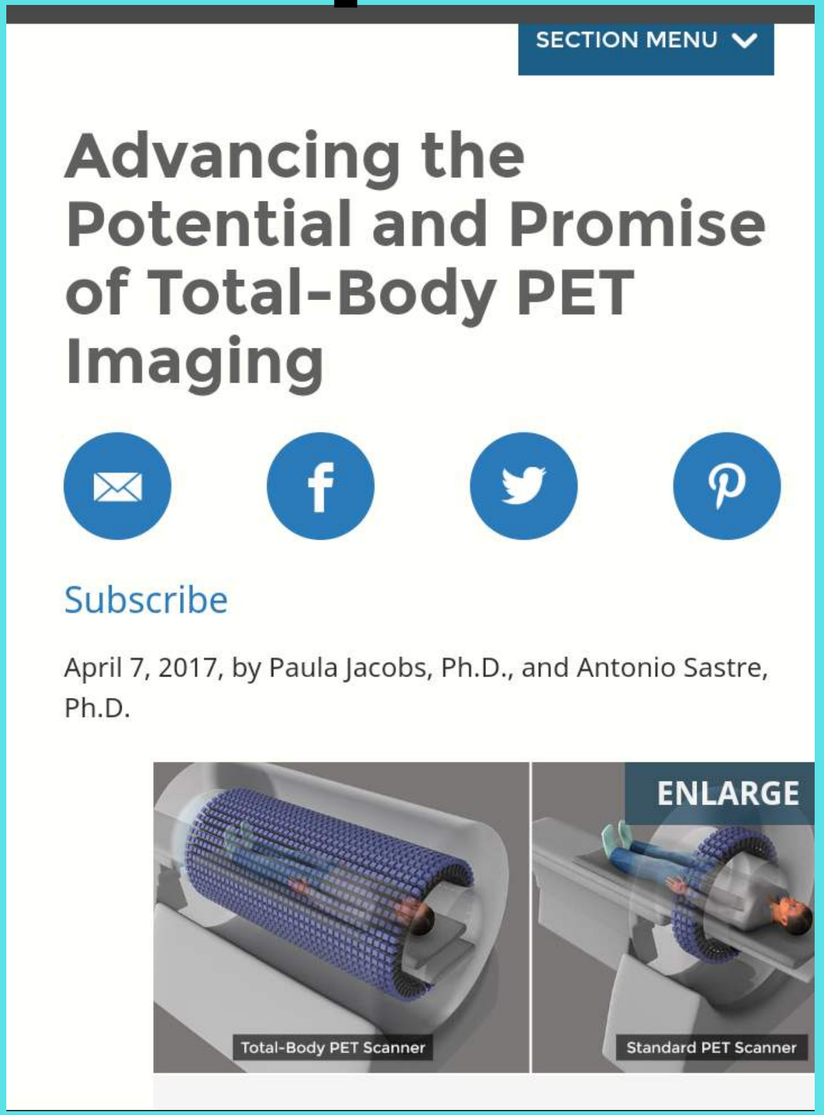
Source: National Cancer Institute



New developments - Total-body PET (TB-PET) scanner in development!

It can also mean that a single dose of the radioactive tracer can help follow-up scans in a patient for days and weeks!

Source: National Cancer Institute



Understanding Cancer

A SERIES OF SIMPLE EDUCATIONAL VIDEOS FOR THE GENERAL PUBLIC

Part 14 : Diagnosis - Biopsy

UPCOMING VIDEO RELEASING SOON!

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Acknowledgements

Oxford Handbook of Oncology
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National Cancer Institute
archive.boston.com

Thank you!