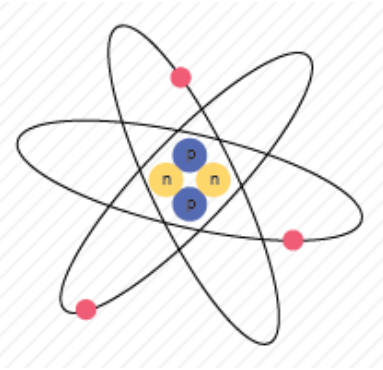
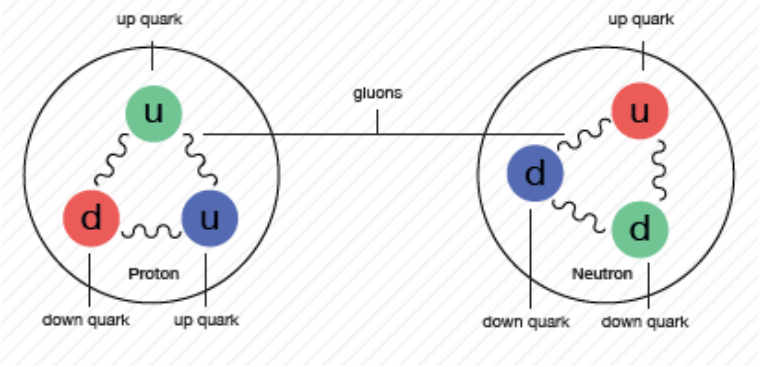
# Protons at the LHC

1. The LHC collides protons.

2. Protons exist inside the atom along with neutrons. Electrons whizz around the outside.



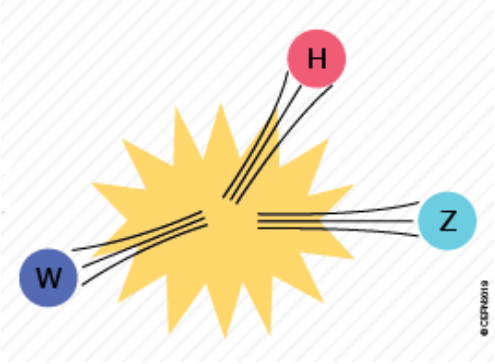

3. Protons and neutrons are made of quarks and gluons. Quarks come in three colours (red, green, blue) and two types (up, down). Gluons bind the quarks together.




3a. The proton has two up quarks and one down quark.

3b. The neutron has one up quark and two down quarks.

4. When protons hit each other at very high speeds, their mass gets turned into energy, and then back into mass in the form of new particles.




5. Similar processes happened in the moments after the Big Bang.

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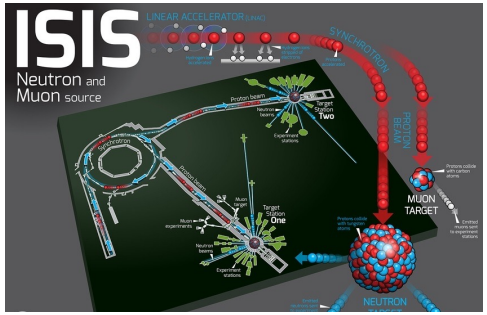
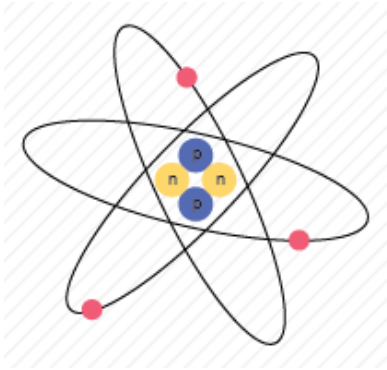
CERN

# Neutrons at the ISIS Neutron and Muon Source

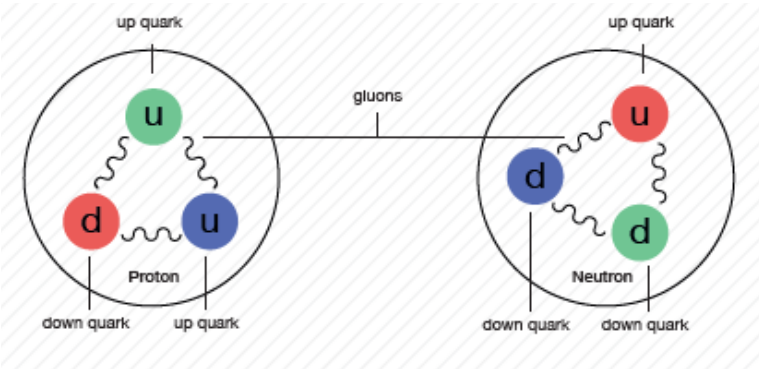
1. The ISIS Neutron and Muon Source smashes protons into a tungsten target to produce neutrons.




2. Neutrons exist inside the nucleus of an atom along with protons. Electrons whizz around the nucleus.




3. Protons and neutrons are made of quarks and gluons. Quarks come in three colours (red, green, blue) and two types (up, down). Gluons bind the quarks together.



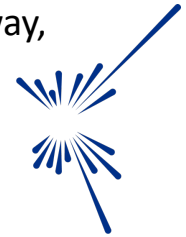

3a. The proton has two up quarks and one down quark.

3b. The neutron has one up quark and two down quarks.

4. When a beam of protons strikes the tungsten target, neutrons are released from the tungsten atoms. These neutrons are guided down to the instruments.

Image: Rose in a lead jar. Neutrons can pass through lead to allow us to see the rose inside.

5. Neutrons allow scientists to study lots of different materials. They can penetrate deep into materials and allow us to see where atoms are and what they are doing. In this way, ISIS is like a super-microscope.



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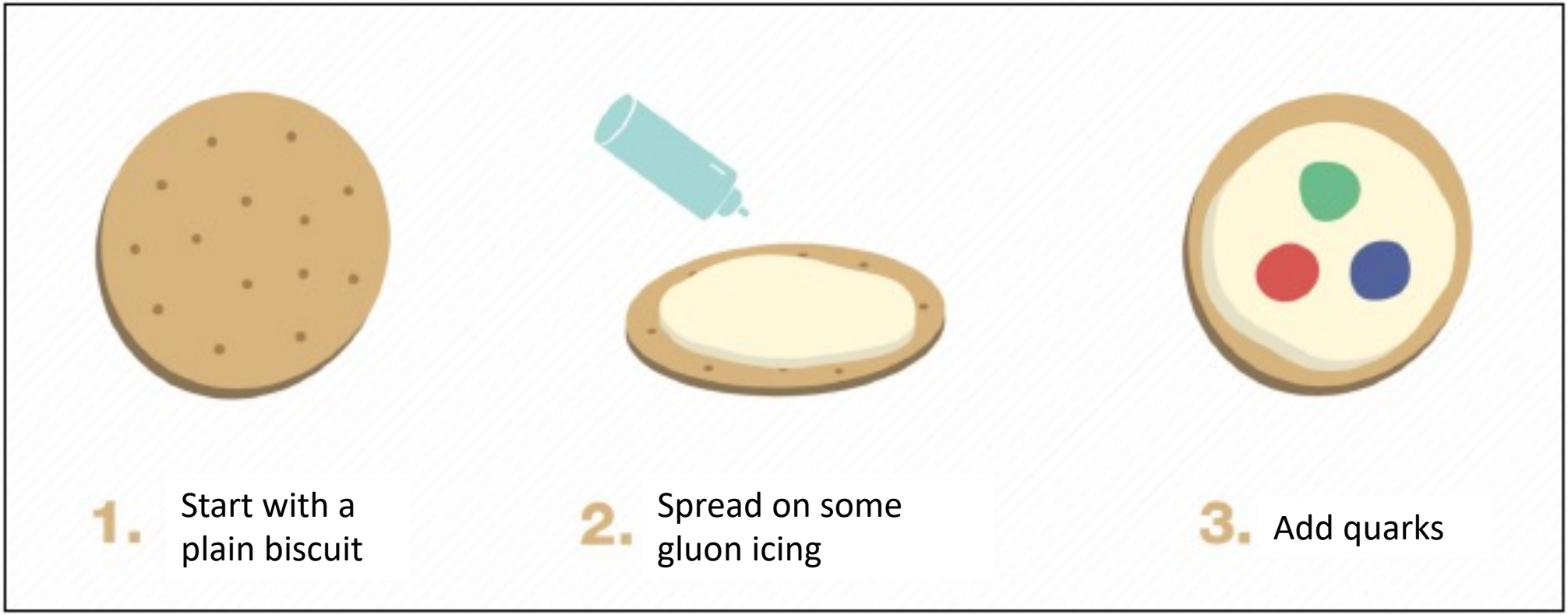
# Build your own Proton/Neutron Cookie!




Protons have two ‘up’ quarks and one ‘down’ quark.
Neutrons have two ‘down’ quarks and one ‘up’ quark.
Quarks come in different colours. Inside the proton there is always one red, one blue and one green quark.

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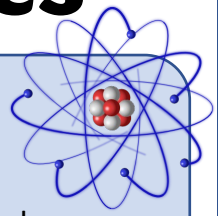
# Proton Cookies



- Protons exist inside the atom, along with neutrons. Electrons whizz around the outside of the atom.
- Protons and neutrons are made of quarks and gluons. Quarks come in three colours (red, green and blue) and two types (up and down). Gluons bind the quarks together.
- A proton has two up quarks and one down quark. One of those quarks is red, one is green and one is blue.

Draw your own proton! Remember to colour in one quark in each colour.

You can make your own proton cookie at home! You will need:

- One cookie
- Some water icing (made of icing sugar and water)
- Some chocolate buttons
- Some writing-icing, in red, green and blue

Use water icing for the gluons, and one chocolate button for each quark. Write the type of each quark on each button: one red, one blue and one green!

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# Proton Cookies

- Protons exist inside the atom, along with neutrons. Electrons whizz around the outside of the atom.
- Protons and neutrons are made of quarks and gluons. Quarks come in three colours (red, green and blue) and two types (up and down). Gluons bind the quarks together.
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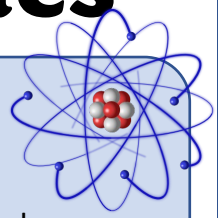
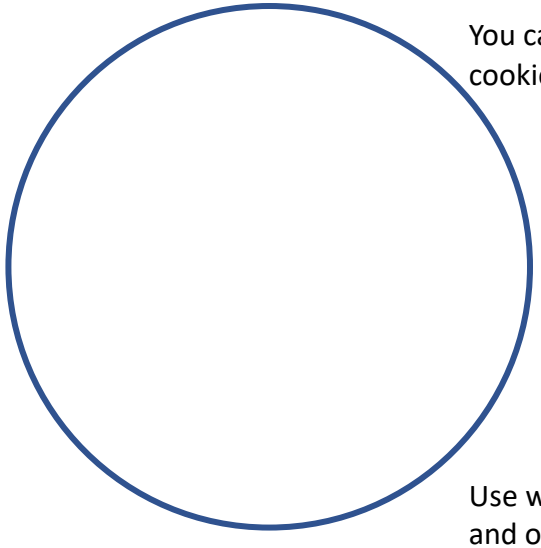
UKRI Science and Technology Facilities Council

# Neutron Cookies



- Neutrons exist inside the nucleus of the atom, along with protons. Electrons whizz around the nucleus.
- Protons and neutrons are made of quarks and gluons. Quarks come in three colours (red, green and blue) and two types (up and down). Gluons bind the quarks together.
- A neutron has two down quarks and one up quark. One of those quarks is red, one is green and one is blue.

Draw your own neutron! Remember to colour in one quark in each colour.



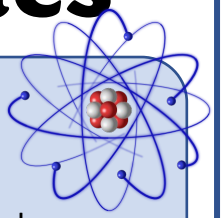
You can make your own neutron cookie at home! You will need:

- One cookie
- Some water icing (made of icing sugar and water)
- Some chocolate buttons
- Some writing-icing, in red, green and blue

Use water icing for the gluons, and one chocolate button for each quark. Write the type of each quark on each button: one red, one blue and one green!

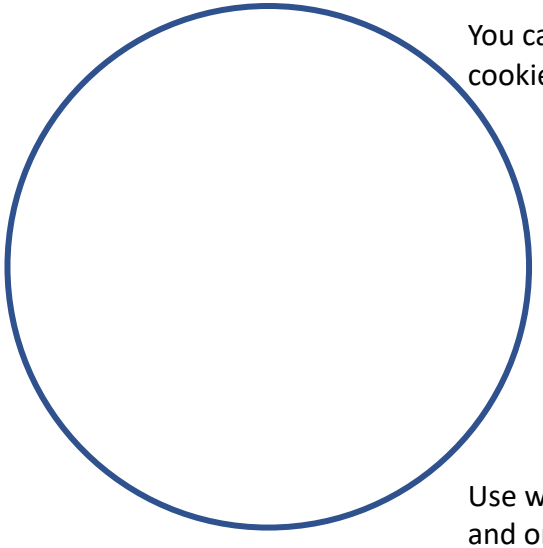
UKRI Science and Technology Facilities Council

# Neutron Cookies



- Neutrons exist inside the nucleus of the atom, along with protons. Electrons whizz around the nucleus.
- Protons and neutrons are made of quarks and gluons. Quarks come in three colours (red, green and blue) and two types (up and down). Gluons bind the quarks together.
- A neutron has two down quarks and one up quark. One of those quarks is red, one is green and one is blue.

Draw your own neutron! Remember to colour in one quark in each colour.



You can make your own neutron cookie at home! You will need:

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- Some chocolate buttons
- Some writing-icing, in red, green and blue

Use water icing for the gluons, and one chocolate button for each quark. Write the type of each quark on each button : one red, one blue and one green!

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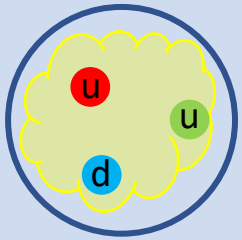
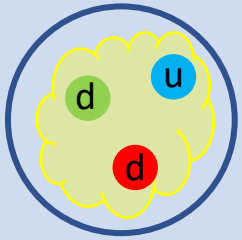
# Particle Cookies

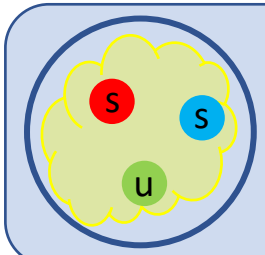
Different particles are made of different quarks: how many can you make?




A proton has two up quarks and one down quark.

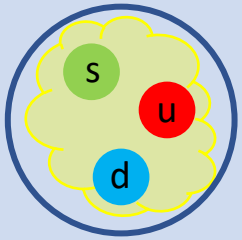
A neutron has two down quarks and one up quark.




A Sigma-0 particle has one up quark, one down quark and one strange quark.

A Xi-0 particle has two strange quarks and one up quark.

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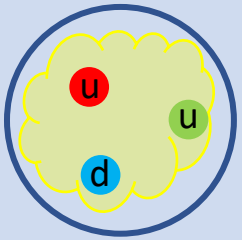
# Particle Cookies

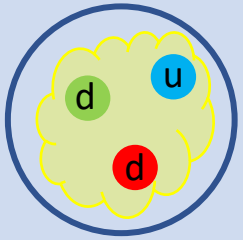
Different particles are made of different quarks: how many can you make?

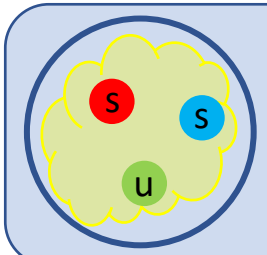





A proton has two up quarks and one down quark.

A neutron has two down quarks and one up quark.

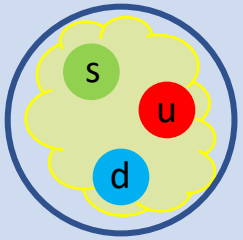





A Sigma-0 particle has one up quark, one down quark and one strange quark.

A Xi-0 particle has two strange quarks and one up quark.



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