### Noah's Quark The Particle Zoo

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## **Introduction**

The particle zoo was created to classify each new particle that was discovered.

New subatomic particles were being discovered through particle accelerators.

The zoo separates each particle into categories such as *fundamental forces*, *size* & *magnetic/quantum spin.* 

The following will be discussed:

- Quarks
- Leptons
- Hadrons (Mesons & Baryons)





**Definition:** An elementary particle which experiences all four fundamental forces.

Quarks form what is known as a *basic constituent of matter*.

Quarks combine to form other *composite* particles such as protons and neutrons.



Each quark has a fractional charge. In order for particles to be stable they require *net integer charges.* 



### There are 6 quarks and 6 accompanying antiquarks.

u	Up	+2/3	ū	Anti - Up	-2/3
d	Down	-1/3	d	Anti - Down	+1/3
t	Тор	+2/3	ī	Anti - Top	-2/3
b	Bottom	-1/3	b	Anti -Bottom	+1/3
s	Strange	-1/3	s	Anti - Strange	+1/3
С	Charm	+2/3	c	Anti -Charm	-2/3



**Definition:** A subatomic particle, which does not take part in the strong interaction.





There are **3** leptons in 'The Lepton Family' with **3** accompanying neutrino's.



**Note:** All 6 of these particles have corresponding anti-particles.

# Hadrons

**Definition**: a hadron is a subatomic composite particle made of two or more quarks held together by the strong force.

### More About a Hadron

Any particle that contains quarks and experiences the strong nuclear force is a hadron.The hadron experiences all of the 4 fundamental forces of nature.

- Most mass from ordinary matter comes from two hadrons: The neutron and the proton
- Protons and neutrons are both baryons.





# Hadrons cont.

• There are two groups of Hadrons: (1) Baryons and (2) Mesons.

#### **Baryons**

- Hadronic subatomic particles.
- 3 quarks or 3 antiquarks.
- Mass  $\geq$  to that of a proton.
- •Example: Proton

•Structure: uud •Charge: +1



#### <u>Mesons</u>

Also Hadronic subatomic particles.
Were created momentarily in the *Big Bang.*Quarks and an antiquark.
Mass between that of an electron and a proton.

Example: Pion π<sup>\*</sup>
Structure: ud

Charge: +1



Hadron

(contains quarks)

Baryon

3 quarks

Meson

antiquark

1 quark

One thing that mesons and baryons have in common is that, even though their constituent quarks carry colour, they themselves are colour-neutral.



- Today we covered the topics of quarks, leptons and hadrons and the different characteristics that classify them.
- We learned that quarks are the building blocks of all matter. There are 6 quarks and 6 anti quarks.
- A lepton is any particle that is not affected by the strong nuclear force.
- There are 3 leptons in The Lepton Family with 3 accompanying neutrinos. Each of these 6 particles have a corresponding antiparticle.
- A hadron is a particle held together by the strong force.
- There are two types: the baryon which is made of an odd number of quarks and the meson which is made up of an even number of quarks.

