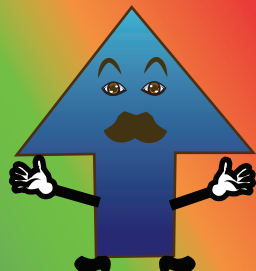


## Up Quark

Electric Charge:  $+2/3$   
Spin:  $1/2$   
Mass: 2.3 MeV  
Half Life: Stable

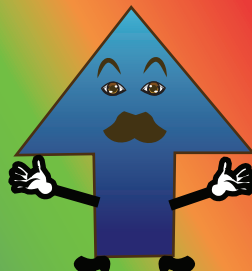
Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Up Quark

Electric Charge:  $+2/3$   
Spin:  $1/2$   
Mass: 2.3 MeV  
Half Life: Stable

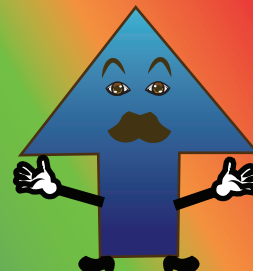
Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Up Quark

Electric Charge:  $+2/3$   
Spin:  $1/2$   
Mass: 2.3 MeV  
Half Life: Stable

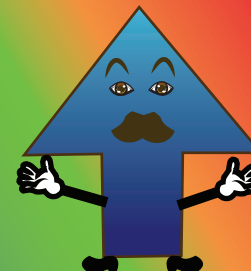
Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Up Quark

Electric Charge:  $+2/3$   
Spin:  $1/2$   
Mass: 2.3 MeV  
Half Life: Stable

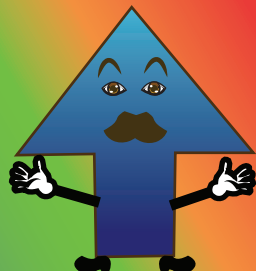
Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Up Quark

Electric Charge:  $+2/3$   
Spin:  $1/2$   
Mass: 2.3 MeV  
Half Life: Stable

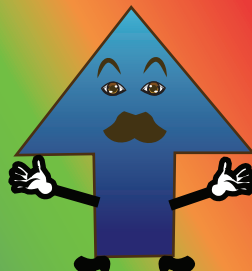
Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Up Quark

Electric Charge:  $+2/3$   
Spin:  $1/2$   
Mass: 2.3 MeV  
Half Life: Stable

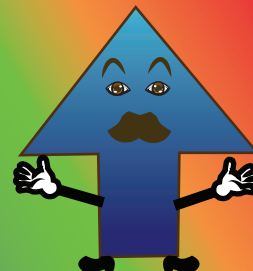
Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Up Quark

Electric Charge:  $+2/3$   
Spin:  $1/2$   
Mass: 2.3 MeV  
Half Life: Stable

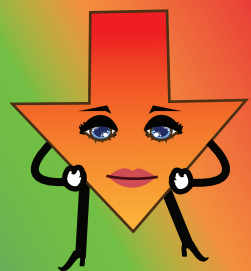
Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Down Quark

Electric Charge:  $-1/3$   
Spin:  $1/2$   
Mass: 4.8 MeV  
Half Life: Stable

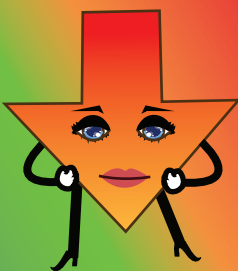
Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Down Quark

Electric Charge:  $-1/3$   
Spin:  $1/2$   
Mass: 4.8 MeV  
Half Life: Stable

Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Down Quark

Electric Charge:  $-1/3$   
Spin:  $1/2$   
Mass: 4.8 MeV  
Half Life: Stable

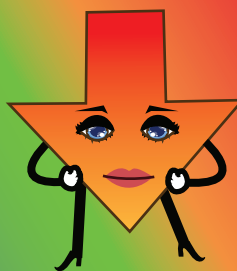
Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Down Quark

Electric Charge:  $-1/3$   
Spin:  $1/2$   
Mass: 4.8 MeV  
Half Life: Stable

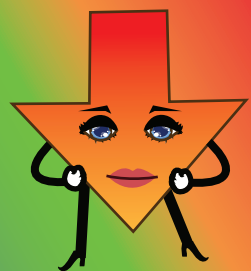
Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Down Quark

Electric Charge:  $-1/3$   
Spin:  $1/2$   
Mass: 4.8 MeV  
Half Life: Stable

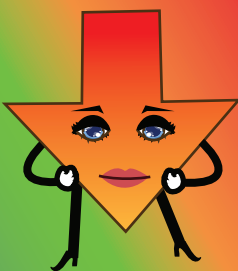
Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Down Quark

Electric Charge:  $-1/3$   
Spin:  $1/2$   
Mass: 4.8 MeV  
Half Life: Stable

Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Down Quark

Electric Charge:  $-1/3$   
Spin:  $1/2$   
Mass: 4.8 MeV  
Half Life: Stable

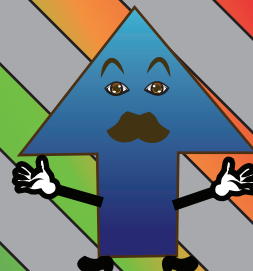
Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Anti-Up Quark

Electric Charge:  $-2/3$   
Spin:  $1/2$   
Mass: 2.3 MeV  
Half Life: Stable

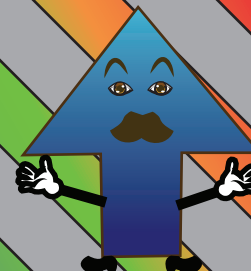
Colour Charge: Yes  
Baryon Number:  $-1/3$   
1st generation (1 point)

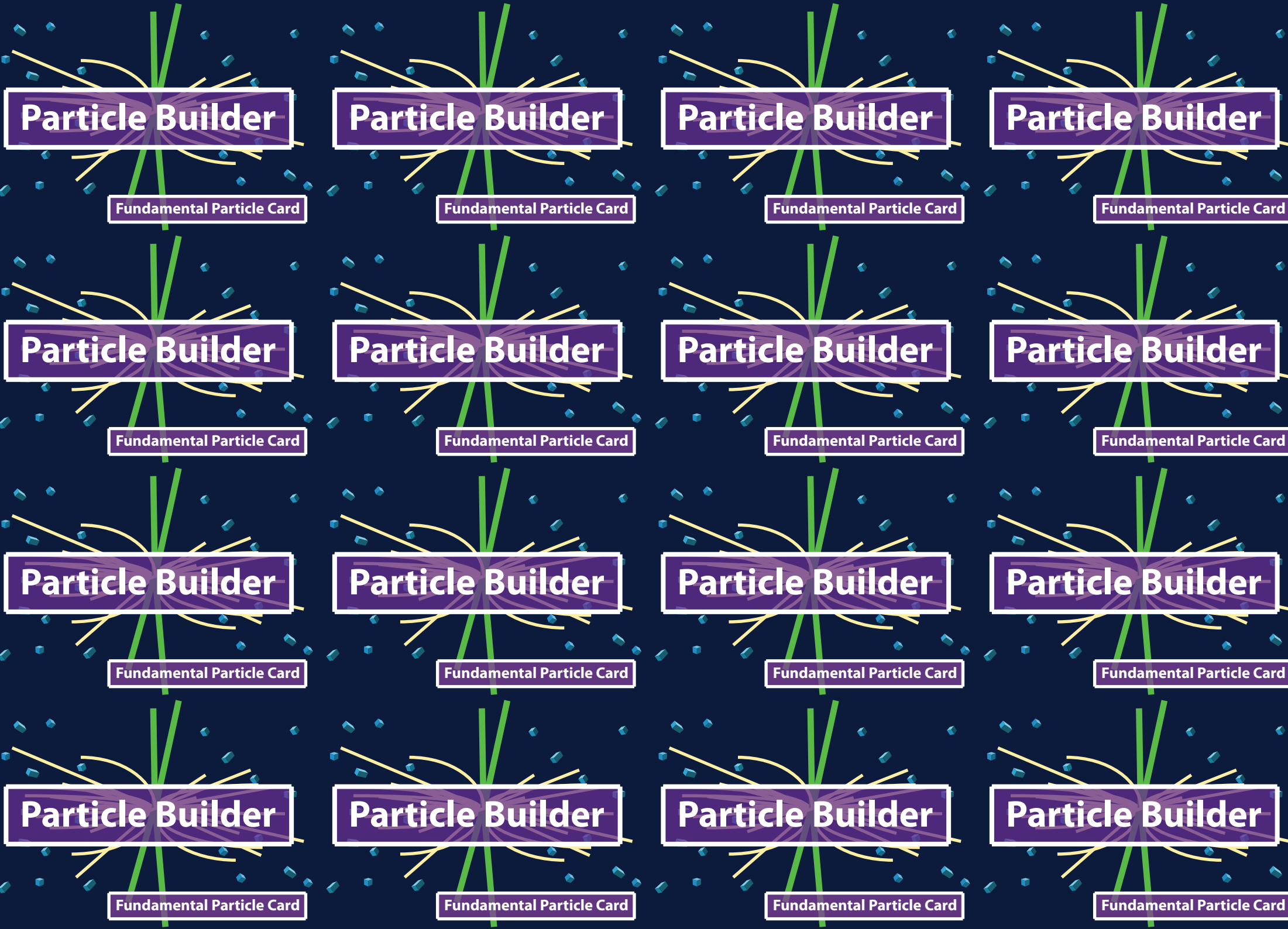


## Anti-Up Quark

Electric Charge:  $-2/3$   
Spin:  $1/2$   
Mass: 2.3 MeV  
Half Life: Stable

Colour Charge: Yes  
Baryon Number:  $-1/3$   
1st generation (1 point)





## Strange Quark

Electric Charge:  $-\frac{1}{3}$   
Spin:  $\frac{1}{2}$   
Mass: 95 MeV  
Half Life: 0.1 nanoseconds

Colour Charge: Yes  
Baryon Number:  $\frac{1}{3}$   
2nd generation (2 points)



## Strange Quark

Electric Charge:  $-\frac{1}{3}$   
Spin:  $\frac{1}{2}$   
Mass: 95 MeV  
Half Life: 0.1 nanoseconds

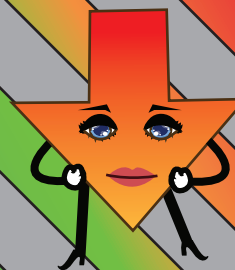
Colour Charge: Yes  
Baryon Number:  $\frac{1}{3}$   
2nd generation (2 points)



## Anti-Down Quark

Electric Charge:  $+\frac{1}{3}$   
Spin:  $\frac{1}{2}$   
Mass: 4.8 MeV  
Half Life: Stable

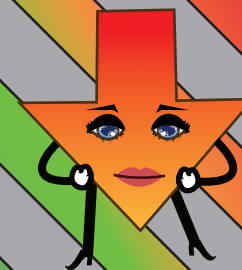
Colour Charge: Yes  
Baryon Number:  $-\frac{1}{3}$   
1st generation (1 point)



## Anti-Down Quark

Electric Charge:  $+\frac{1}{3}$   
Spin:  $\frac{1}{2}$   
Mass: 4.8 MeV  
Half Life: Stable

Colour Charge: Yes  
Baryon Number:  $-\frac{1}{3}$   
1st generation (1 point)



## Anti-Strange Quark

Electric Charge:  $+\frac{1}{3}$   
Spin:  $\frac{1}{2}$   
Mass: 95 MeV  
Half Life: 0.1 nanoseconds

Colour Charge: Yes  
Baryon Number:  $-\frac{1}{3}$   
2nd generation (2 points)



## Anti-Charm Quark

Electric Charge:  $-\frac{2}{3}$   
Spin:  $\frac{1}{2}$   
Mass: 1.29 GeV  
Half Life: 1.1 picoseconds

Colour Charge: Yes  
Baryon Number:  $-\frac{1}{3}$   
2nd generation (2 points)



## Charm Quark

Electric Charge:  $+\frac{2}{3}$   
Spin:  $\frac{1}{2}$   
Mass: 1.29 GeV  
Half Life: 1.1 picoseconds

Colour Charge: Yes  
Baryon Number:  $\frac{1}{3}$   
2nd generation (2 points)



## Charm Quark

Electric Charge:  $+\frac{2}{3}$   
Spin:  $\frac{1}{2}$   
Mass: 1.29 GeV  
Half Life: 1.1 picoseconds

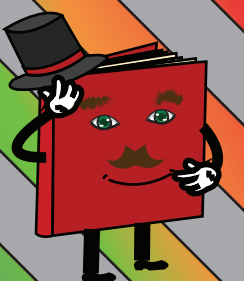
Colour Charge: Yes  
Baryon Number:  $\frac{1}{3}$   
2nd generation (2 points)



## Anti-Top Quark

Electric Charge:  $-\frac{2}{3}$   
Spin:  $\frac{1}{2}$   
Mass: 173.07 GeV  
Half Life:  $4.2 \times 10^{-25}$ s

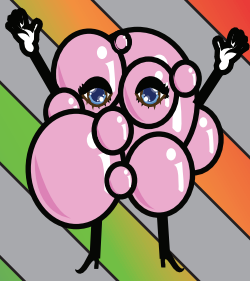
Colour Charge: Yes  
Baryon Number:  $-\frac{1}{3}$   
3rd generation (3 points)



## Anti-Bottom Quark

Electric Charge:  $+\frac{1}{3}$   
Spin:  $\frac{1}{2}$   
Mass: 4.18 GeV  
Half Life: 1.3 picoseconds

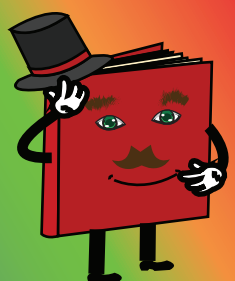
Colour Charge: Yes  
Baryon Number:  $-\frac{1}{3}$   
3rd generation (3 points)



## Top Quark

Electric Charge:  $+\frac{2}{3}$   
Spin:  $\frac{1}{2}$   
Mass: 173.07 GeV  
Half Life:  $4.2 \times 10^{-25}$ s

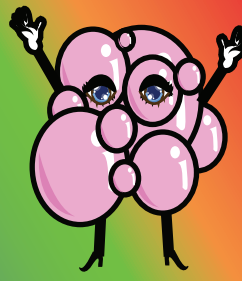
Colour Charge: Yes  
Baryon Number:  $\frac{1}{3}$   
3rd generation (3 points)



## Bottom Quark

Electric Charge:  $-\frac{1}{3}$   
Spin:  $\frac{1}{2}$   
Mass: 4.18 GeV  
Half Life: 1.3 picoseconds

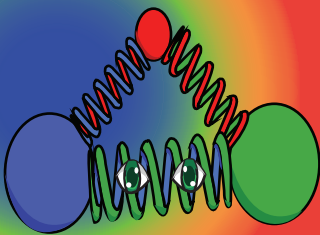
Colour Charge: Yes  
Baryon Number:  $\frac{1}{3}$   
3rd generation (3 points)



## Gluon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

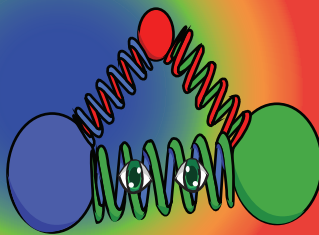
Colour Charge: Yes  
Exchange boson  
(1 point)



## Gluon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

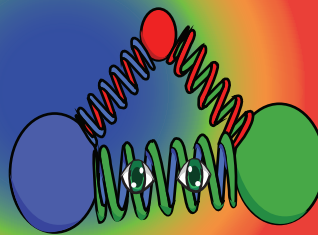
Colour Charge: Yes  
Exchange boson  
(1 point)



## Gluon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

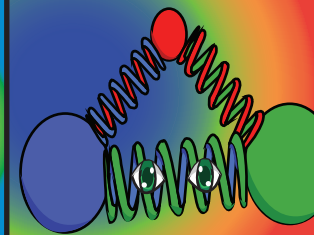
Colour Charge: Yes  
Exchange boson  
(1 point)

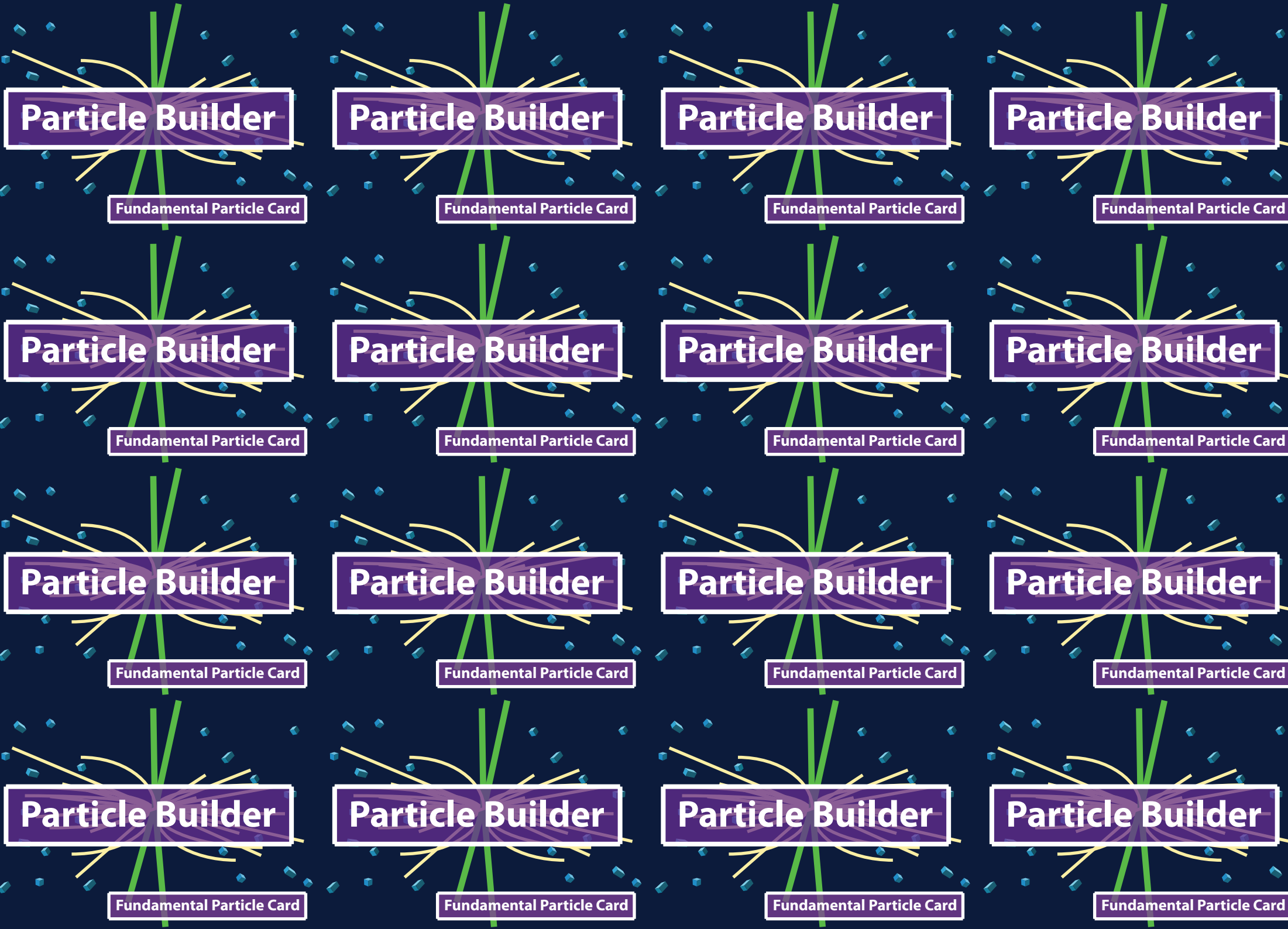


## Gluon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

Colour Charge: Yes  
Exchange boson  
(1 point)



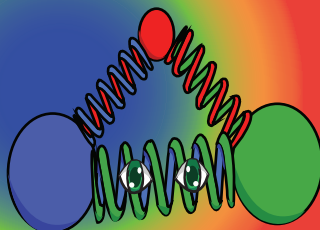




## Gluon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

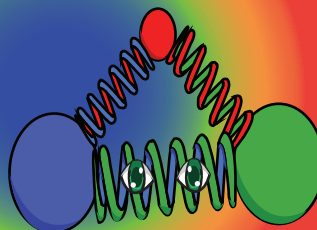
Colour Charge: Yes  
Exchange boson  
(1 point)



## Gluon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

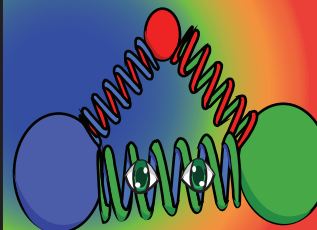
Colour Charge: Yes  
Exchange boson  
(1 point)



## Gluon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

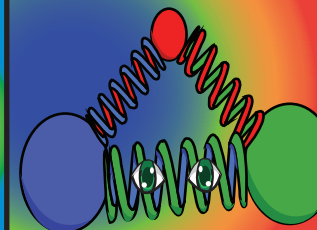
Colour Charge: Yes  
Exchange boson  
(1 point)



## Gluon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

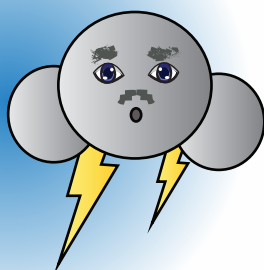
Colour Charge: Yes  
Exchange boson  
(1 point)



## Electron

Electric Charge: -1  
Spin: 1/2  
Mass: 0.511 MeV  
Half Life: Stable

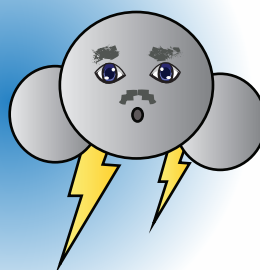
Colour Charge: No  
Lepton Number (e): 1  
1st generation (1 point)



## Electron

Electric Charge: -1  
Spin: 1/2  
Mass: 0.511 MeV  
Half Life: Stable

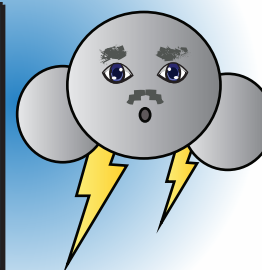
Colour Charge: No  
Lepton Number (e): 1  
1st generation (1 point)



## Electron

Electric Charge: -1  
Spin: 1/2  
Mass: 0.511 MeV  
Half Life: Stable

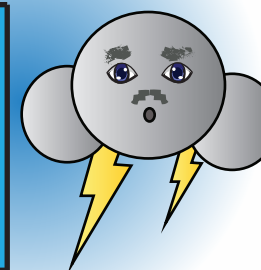
Colour Charge: No  
Lepton Number (e): 1  
1st generation (1 point)



## Electron

Electric Charge: -1  
Spin: 1/2  
Mass: 0.511 MeV  
Half Life: Stable

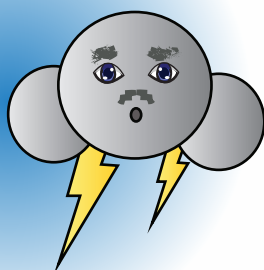
Colour Charge: No  
Lepton Number (e): 1  
1st generation (1 point)



## Electron

Electric Charge: -1  
Spin: 1/2  
Mass: 0.511 MeV  
Half Life: Stable

Colour Charge: No  
Lepton Number (e): 1  
1st generation (1 point)



## Electron Neutrino

Electric Charge: 0  
Spin: 1/2  
Mass: <2.2 eV  
Half Life: Stable

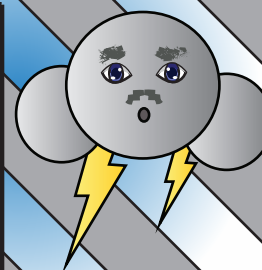
Colour Charge: No  
Lepton Number (e): 1  
1st generation (0 points)



## Positron (Anti-Electron)

Electric Charge: +1  
Spin: 1/2  
Mass: 0.511 MeV  
Half Life: Stable

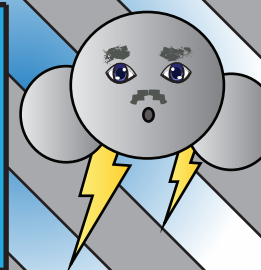
Colour Charge: No  
Lepton Number (e): -1  
1st generation (1 point)



## Positron (Anti-Electron)

Electric Charge: +1  
Spin: 1/2  
Mass: 0.511 MeV  
Half Life: Stable

Colour Charge: No  
Lepton Number (e): -1  
1st generation (1 point)



## Anti-Muon

Electric Charge: +1  
Spin: 1/2  
Mass: 105.7 MeV  
Half Life: 2.2μs

Colour Charge: No  
Lepton Number (μ): -1  
2nd generation (2 points)



## Muon Neutrino

Electric Charge: 0  
Spin: 1/2  
Mass: <0.17 MeV  
Half Life: Stable

Colour Charge: No  
Lepton Number (μ): 1  
2nd generation (0 points)



## Muon

Electric Charge: -1  
Spin: 1/2  
Mass: 105.7 MeV  
Half Life: 2.2μs

Colour Charge: No  
Lepton Number (μ): 1  
2nd generation (2 points)

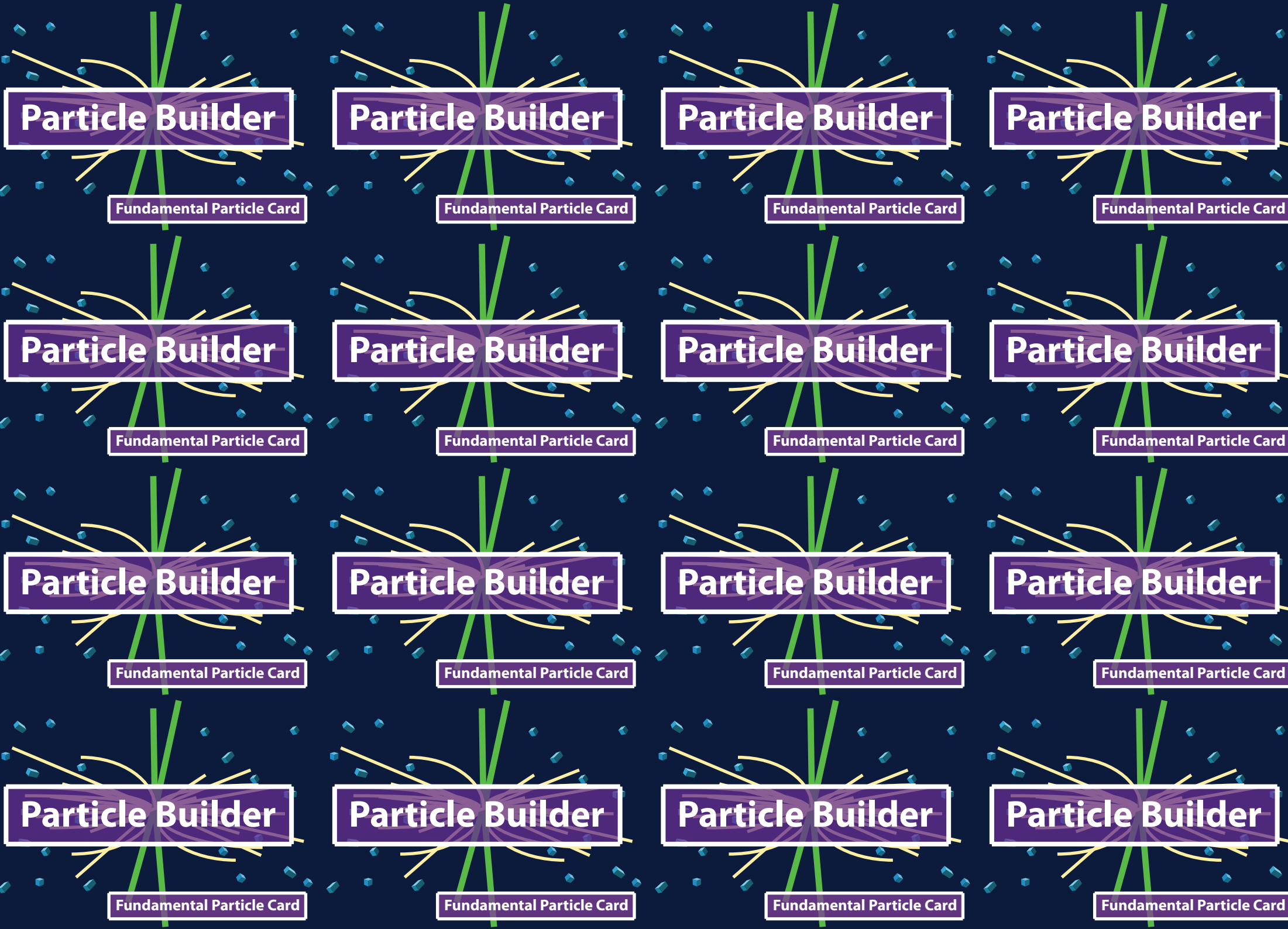


## Anti-Electron Neutrino

Electric Charge: 0  
Spin: 1/2  
Mass: <2.2 eV  
Half Life: Stable

Colour Charge: No  
Lepton Number (e): -1  
1st generation (0 points)





## Tau Neutrino

Electric Charge: 0  
Spin: 1/2  
Mass: <15.5 MeV  
Half Life: Stable

Colour Charge: No  
Lepton Number ( $\tau$ ): 1  
3rd generation (0 points)



## Anti-Tau Neutrino

Electric Charge: 0  
Spin: 1/2  
Mass: <15.5 MeV  
Half Life: Stable

Colour Charge: No  
Lepton Number ( $\tau$ ): -1  
3rd generation (0 points)



## Tau

Electric Charge: -1  
Spin: 1/2  
Mass: 1.777 GeV  
Half Life: 0.3 picoseconds

Colour Charge: No  
Lepton Number ( $\tau$ ): 1  
3rd generation (3 points)



## Anti-Tau

Electric Charge: +1  
Spin: 1/2  
Mass: 1.777 GeV  
Half Life: 0.3 picoseconds

Colour Charge: No  
Lepton Number ( $\tau$ ): -1  
3rd generation (3 points)



## Anti-Muon Neutrino

Electric Charge: 0  
Spin: 1/2  
Mass: <0.17 MeV  
Half Life: Stable

Colour Charge: No  
Lepton Number ( $\mu$ ): -1  
2nd generation (0 points)



## Photon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

Colour Charge: No  
Exchange boson (1 point)  
Note: the photon is its own antiparticle.



## Photon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

Colour Charge: No  
Exchange boson (1 point)  
Note: the photon is its own antiparticle.



## Photon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

Colour Charge: No  
Exchange boson (1 point)  
Note: the photon is its own antiparticle.



## Photon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

Colour Charge: No  
Exchange boson (1 point)  
Note: the photon is its own antiparticle.



## Photon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

Colour Charge: No  
Exchange boson (1 point)  
Note: the photon is its own antiparticle.



## Photon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

Colour Charge: No  
Exchange boson (1 point)  
Note: the photon is its own antiparticle.



## Photon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

Colour Charge: No  
Exchange boson (1 point)  
Note: the photon is its own antiparticle.



## Higgs Boson

Electric Charge: 0  
Spin: 0  
Mass: 126 GeV  
Half Life:  $\sim 10^{-22}$ s

Colour Charge: No  
(5 points)  
The Higgs Boson is an excitation of the Higgs field which gives particles their mass.



## W<sup>+</sup> Boson

Electric Charge: +1  
Spin: 1  
Mass: 80.4 GeV  
Half Life:  $3 \times 10^{-25}$ s

Colour Charge: No  
Exchange boson (1 point)



## W<sup>-</sup> Boson

Electric Charge: -1  
Spin: 1  
Mass: 80.4 GeV  
Half Life:  $3 \times 10^{-25}$ s

Colour Charge: No  
Exchange boson (1 point)



## Z Boson

Electric Charge: 0  
Spin: 1  
Mass: 91.2 GeV  
Half Life:  $3 \times 10^{-25}$ s

Colour Charge: No  
Exchange boson (1 point)  
Note: the Z boson is its own antiparticle.

