INSTRUCTIONS

U-kNOw Feynman is an educational tool aimed at secondary school students who are interested in and looking to pursue higher education/careers in Physics. With inspiration taken from the popular game UNO FLIP!™, this game has similar core ideas but has incorporated the world of Particle Physics arising from the Standard Model.

CONTENTS

Each pack is comprised of 132 playing cards, with each containing a Matter card on one side and an Antimatter card on the reverse. The breakdown of each of these categories is summarised below:

Matter Cards: (White background - Blue, Green, Red, Yellow colours):

- 6 Quarks & 6 Leptons (4 x Each Colour)
- 8 Flip cards to Antimatter (2 x Each colour)
- 4 Reverse cards (1 x Each colour)
- 4 Colour change
- 4 Skip cards (1 x Each colour)
- 4 Gluon +4 cards (1 x Each colour)
- 4 Photon +2 cards (1 x Each colour)
- 8 W-Boson +1 cards (2 x Each colour)

Antimatter Cards: (Black background - Purple, Cyan, Pink, Orange colours):

- 6 Anti-Quarks & 6 Anti-Leptons (4 x Each colour)
- 8 Flip cards to Matter (2 x Each colour)
- 4 Reverse cards (1 x Each colour)
- 4 Higgs Boson Mass cards
- 4 Skip cards (1 x Each colour)
- 4 Gluon +4 cards (1 x Each colour)
- 4 Photon +2 cards (1 x Each colour)
- 8 W-Boson +1 cards (2 x Each colour)

U-kNOw Feynman IN A NUTSHELL

U-kNOw Feynman is a shedding type “crazy-eights” style card game played with a double sided deck. It is designed to be educational hence concepts of particle physics interactions form the ruleset yet the game can be played casually.

Initially, the game starts playing with Matter side cards, with players adding particle cards to the discard pile as per the usual rules. A player can choose to play a Wild Card instead with the effects outlined below. Some of these are common rules across similar card games yet the +draw Wild Cards have effects corresponding to the interaction strength of the force card played and may only be nullified by a player if their hand contains particles that can interact through the same force. A player can also choose to play a flip card, triggering the game to switch to the Antimatter side with the draw pile, discard pile and player hands all switching to Antimatter and the game now played according to interactions of Antimatter particles.

When a player plays the penultimate card, they must say “DECAY” otherwise a penalty of drawing two cards to the hand is incurred. The first player that is able to play the final card in their hand without triggering a penalty and thus reach an empty hand is declared the winner.

This product has been inspired from UNO FLIP!™ and is intended to be in line with fair dealing copyright with no infringement on existing intellectual property rights.

SET-UP

1. Since the deck is double sided, make sure all the cards of either side are facing the same way (i.e. all Matter faces on one side, all Antimatter faces on the other side)
2. Choose a player to be the dealer, who shuffles the cards and deals each player 7 cards. Hold the cards with the Matter side facing you and the Antimatter facing your opponents.
3. Place the rest of the deck with the Matter side facing down (Antimatter cards facing up), this is the draw pile.
4. Take the top card from the draw pile and turn it over (playing with the Matter side) to begin the discard pile.

NOTE: If any of the Wild Cards are turned over to start the discard pile, return this card randomly in the middle of the deck and pick another card.

NOTE: The Matter-Antimatter corresponding card colours are: Blue-Purple, Green-Cyan, Red-Pink, Yellow-Orange.

LET’S PLAY

The person to the left of the dealer starts the game.

Whether playing on the Matter or Antimatter side, you must match a card from your hand to the card on top of the discard pile, either by particle (leptons or quarks) or colour. See the Wild Card Functions to see their individual actions.

EXAMPLE: If the card on the discard pile is a red top quark, the player must throw a red card, or any other colour top quark. The player may also place a Wild Card if they have one and wish to do so.

If you don't have a card that matches the one on the discard pile, you need to draw a card from the draw pile. When adding new cards to your hand, make sure the Matter and Antimatter sides stay consistent with your existing cards.

If the card you picked can be played, you are free to put it down as your turn. Otherwise, play moves on to the next person in turn. If you choose not to play a playable card from your hand, you must draw a card from the draw pile and that new card can be played in your turn, however you may not play any other card from your hand after picking.

NOTE: Multiple cards (can be ANY colour) may be played at once, only if the combination is a baryon: proton (uud) or neutron (udd) and their respective antibaryon: antiproton ($\underline{uud}$) and antineutron ($\underline{udd}$).

The Intermediate Particles:

If a player plays an intermediate particle card, the next player has the chance to "neutralise" the effect of the card by completing the interaction, but if they cannot, they must draw the required amount of cards.

The W-boson, photon, and gluon, which are +1, +2, and +4 drawing cards respectively, have the following rules:

- W-bosons can neutralise **any quark flavour change** (2 different quark cards of the same colour), and **any 'charged lepton-neutrino' pair** played within their respective Matter and Antimatter sides.

  EXAMPLE: Player A throws a cyan W-boson card onto a cyan antistrange quark card, player B can avoid the drawing penalty by playing any cyan antiquark to complete the interaction, and player A receives the penalty of drawing 2 cards. If player B does not have a cyan antiquark, they need to draw the +2 card penalty and miss their turn, moving on to the next player C, who can place any cyan card.

- Photon interactions are completed by playing any of the **same 'charged lepton-charged lepton', 'quark-quark', 'charged antilepton-charged antilepton', and 'antiquark-antiquark' card pairs**. Except 'neutrino-neutrino' or 'antineutrino-antineutrino' card pairs, which do not interact with photons.

  EXAMPLE: Player A throws a blue photon card onto a blue up quark card, player B can avoid the drawing penalty by playing a blue up quark to complete the interaction, and player A receives the penalty of drawing 2 cards. If player B does not have a blue up quark, they need to draw the +2 card penalty and miss their turn, moving on to the next player C, who can place any blue card, or any up quark card.

- Gluons are the most difficult to neutralise, as the flip card is involved when playing. They can neutralise corresponding **'quark-antiquark' pairs only**.

  EXAMPLE: Player A throws a yellow gluon card on top of a yellow down quark card, Player B needs to have two cards ready: a yellow "flip to Antimatter" card and an orange antidown card. The flip card causes the drawing deck of cards and all the cards in everyone's hands to be flipped to play with the Antimatter side. Player B can only neutralise the +4 penalty by playing the two cards to complete the interaction. If they can't play both

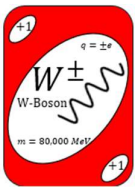
cards, they need to draw 4, and the turn moves on to the next person in the round who can put any yellow card on top of the gluon. If player B has the yellow flip card only, they have the choice to play it to flip the game to Antimatter, however they still take the +4 penalty, and the next person in the round can play any orange Antimatter card. This can be done vice versa, using the "flip to Matter".

GLUON SUMMARY: quark + matter gluon + flip-to-antimatter + antiquark, and playing vice-versa: antiquark + antimatter gluon + flip-to-matter + particle, all keeping to their respective colour changes.

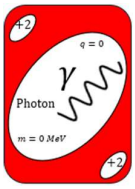
WILD CARD FUNCTIONS

In U-kNOw Feynman, the Wild Cards play a pivotal role in shaping the outcome of the game. The details outlining the result of action and rules associated with each Wild Card is given below:

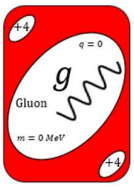
Matter Side (Light Colours)



W-BOSON: When played, the next player must draw 1 card. This can be played after any particle card.



PHOTON: When played, the next player must draw 2 cards. This can be played after any charged particle card (it cannot be played following a neutrino card).

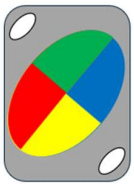


GLUON: When played, the next player must draw 4 cards. This can be played after any quark card (it cannot be played following a lepton card).

REVERSE: When played, the direction of play is reversed (if play is to the right it will change to the left, and vice versa). This can only be played on a matching colour or another reverse card.

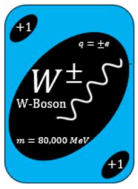
SKIP: When played, the next player loses their turn and the following player will resume the game. This can only be played on a matching colour or another skip card.

FLIP TO ANTIMATTER: When played, everything flips from the Matter side (lighter coloured side) to the Antimatter side (darker coloured side). This includes the discard pile, with the card just played now at the bottom, the draw pile and each player's hands. The game will continue on the Antimatter side until a Flip to Matter Card is played. This can only be played on a matching colour, another flip card, or with the Gluon interaction card.

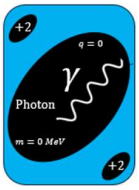


COLOUR CHANGE: When played, you get to choose the colour that play will continue on.

Antimatter Side (Dark Colours):



W-BOSON: When played, the next player must draw 1 card and skip their turn. This can be played after any antiparticle card.



PHOTON: When played, the next player must draw 2 cards and skip their turn. This can be played after any charged antiparticle card (it cannot be played following an antineutrino card).

GLUON: When played, the next player must draw 4 cards and skip their turn. This can be played after any anti-quark card (it cannot be played following an antilepton card).

REVERSE: When played, the direction of play is reversed (if play is to the right it will change to the left and vice versa). This can only be played on a matching colour or another reverse card.

SKIP: When played, the next player loses their turn and the following player will resume the game. This can only be played on a matching colour or another skip card.

FLIP TO MATTER: When played, everything flips from the Antimatter side (darker coloured side) to the Matter side (lighter coloured side). This includes the discard pile, with the card just played now at the bottom, the draw pile and each player's hands. The game will continue on the Matter side until a Flip to Antimatter Card is played. This can only be played on a matching colour, another flip card, or with the Gluon interaction card.

HIGGS BOSON: When played, the following player must draw until they pick up a card of the colour of your choosing. This player will also lose their turn. This card can only be played.

FINISHING THE GAME

- Whether you are playing with the Matter or Antimatter side, when you play your penultimate card, you must yell “DECAY” to indicate that you have one last card left to play. If you don’t yell “DECAY” and another player catches you before the next player throws their card, you must draw two cards as penalty. Once a player has no cards left, the round is over.
- If the last card played in a round is a Photon, or W-Boson, Gluon and the next player can neutralise the action with a flip + particle/antiparticle card, the player who initially threw the card needs to draw the required amount of cards, and the round continues. If the next player can’t neutralise the action, the person who initially threw the card wins, and the round is over.
- If no player is out of cards by the time the draw pile is finished, the discard pile is reshuffled as a new draw pile, and the game continues.