EDUCATIONAL D-N-A CARD GAME FOR THE UNDERSTANDING OF DNA AND BIOTECHNOLOGY

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Abstract

In order to promote understanding and sustain a keen interest in DNA and biotechnology among the younger generations in Malaysia, an educational and fun D-N-A card game was developed based on the principles of replication. This paper reports the preparation and also the setting up of the game.

Keywords: teaching tool, DNA replication, game, education

The Introduction

Since the discovery of DNA (Deoxyribonucleic Acid), its structure, and function was probably the most significant biological discovery of the 20th century. It has had a tremendous impact on science and medicine. However, the basic understanding to how this spiral-ladder like molecule stores the genetic information and its vital role in information interpretation through replication, transcription and translation still remain an unknown to the general public and the younger generations. A lot of time, when pieces of scientific information pertaining to DNA or biotechnology, the field that relates closely with DNA, are being conveyed, only a handful of people can appreciate them.

In Malaysia, in order to foster the public education of biotechnology, while at the same time seeding the young minds with the prospects of careers in biotechnology research and industry, a nationwide biotechnology outreach and awareness program for the Malaysian high schools was carried out since 2001 (Mohd. Firdaus-Raih et al., 2005). This was initiated to promote biotechnology as a viable career option among the high schools students and also at the same time to disperse what biotechnology is about among their peers and also family members.

With this in mind, an educational and fun D-N-A card game was designed and developed not only to foster interests of biotechnology among the high school students, but also among the elementary and middle schools' students. It is believed that as the students spend time engaged in educational games, it would promote independent thinking, small group discussions or active learning among the players (Odenweller et al., 1998). Group games also promote children's intellectual development by engaging them in opportunities to exercise reasoning and become more logical in thought (Kamii & DeVries, 1980) and a keen interest in the particular topic (Harms 2002).

It is the hope that this card game would enhance the understanding and interest in the mysteries of DNA replication and biotechnology in general among the young students and at the time stimulates their mind to think and strategize, so as to solve the game.

The Game

D-N-A Card Game

The game consists of 96 cards of various properties. It is based on the basic principles of DNA replication in the biological system. It utilizes cards that represent the four nucleotides (bases) in the DNA molecule: Guanine (G), Cytosine (C), Adenosine (A) and Thymine (T). When the DNA molecule replicates itself in a semi-conservative manner, base A always pairs up with T and G with C. Based on this, this game is played to pair up corresponding bases of the same colour. Specials cards (M+, M-, Skip, Reverse, DP1 and DP3) are also added to reflect the dynamic in the biological system (Fig. 1).

When playing, the students need to understand the basic concept of base pairing and the functions of the special cards, which will be explained clearly in the instruction manual attached. The students need to plan and strategize in order to play all the cards in his/her hand in order to win.

Objectives

The objectives of this game is to foster small group interaction and independent learning through applying the concepts of DNA base pairing in a fun, exciting and interactive setting.

Ultimately the game would be able to trigger the younger generations to marvel at the fascination of DNA replication and at the same time help to promote the understanding and interests of biotechnology in the society.

Deck of Cards

The game consists of 96 cards as follows: 16 blue cards of nucleotides A, T, G and C; 16 red cards of nucleotides A, T, G and C; 16 green cards of nucleotides A, T, G and C; 16 yellow cards of nucleotides A, T, G and C; 6 Mutation/Insertion cards (M+); 6 Mutation/Deletion cards (M-); 6 Reverse cards (R); 6 Skip cards (S); 4 DNA Polymerase I cards (DP1) and 4 DNA Polymerase III cards (DP3).

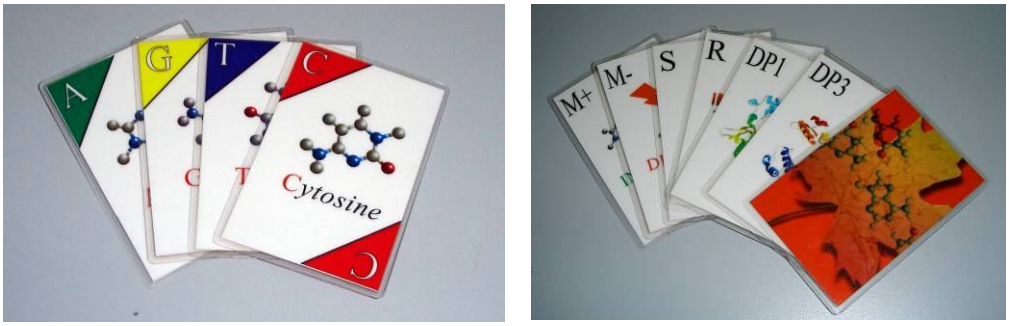

FIGURE 1. The D-N-A Card Game showing the AGTC and also the special cards.

Game Play

1. After dividing the cards for every player, the remaining cards will be placed facedown to form a DRAW pile. The top card of the DRAW pile will be turn over to form a DISCARD pile. If the top card is not either A, T, G or C, return it to the DRAW deck and pick the following card.
2. The initiating player will play first.
3. Play by matching the top card on the DISCARD pile by base pairing only with the same colour or Special Cards.
4. For example, if the top card on the DISCARD deck is Blue A, then one must play a Blue T, after pairing up, one have to take a card (any card) in his/her hand and put it on the DISCARD deck for the next pair-up by the following player.
5. If nothing matches, one must draw a card from the DRAW pile. If you manage to draw a card you can play, then play it immediately, otherwise the turn goes to the next player.
6. If you are playing special cards like DP1 and DP3, whatever cards that you put on the DISCARD deck last will be the pair-up card for the next player.
7. To end the game, you must play ALL your cards at hand. You can use the special cards to end the game as well.
8. Once a player plays his/her last card, the game is over. Points will be totalled up according to the Scoring Table.

If no one is out of cards by the time the DRAW deck is finished, reshuffle the DISCARD deck and continue to play.

If you choose not to deal a playable card in your hand, then you must draw a card from the DRAW deck. If playable, you can play the card immediately, but you cannot play any card from your hand.

If the player has both DP1 and DP3 cards in hand for the final round, he/she can end the game by playing the two cards together.

End Of Game/Scoring Table

If you are the first to finish dealing all your cards in hand, then you will have 0 points for that round of game, other players that did not finish their cards can total up their points according to the Scoring Table that follows:

All the ATGC cards	5 points each
All Mutation cards	10 points each
Reverse (R) cards	10 points each
Skip (S) cards	10 points each
DP1 cards	20 points each
DP3 cards	20 points each

The winner is the player who maintains the lowest points at the end of the games.

The Discussion

This project was aimed at addressing the promotion of science & technology awareness, especially in the field of biotechnology/DNA, to the primary and secondary school students in general in the State of Sabah, Malaysia. Of course, the game was also designed to promote active learning and small group interactions, as this is one of the main concerns of educators today.

To address these concerns, this D-N-A card game has been developed to engage students (especially primary school students) or even family members in active learning through small group activity, strategic thinking and problem solving. This game would enhance the students' ability to learn and have fun at the same time. It is the hope of the authors that the game could help the younger players to better understand the DNA replication process after playing.

Conclusion

The goal of the game is to serve as a supplemental educational tool for the learning of the basic principles of DNA replication and also to trigger the younger generations to develop curiosity and an early anchored interest in the field of biotechnology.

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