Using Cards Games as Learning Objects:

A Case Study

Early Returns and Initial Findings of Work in Progress

Fri. 2-3

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Overview

- Who Am I / What am I Playing Now?
- Benefits of Serious Games
- Designing Games for Learning
- Why This Game?
- About the Game
- Early Results
- Future Directions


Who Am I?
Katrin Becker, PhD
MINKHOLLOW Media

What am I playing now?

Benefits of Serious Games

- Motivation
- Time on Task
- Interactive
- Alternate approach.

Designing Games for Learning

When gamers make games we often get hollow games.

Skinning a game with ‘learnin’

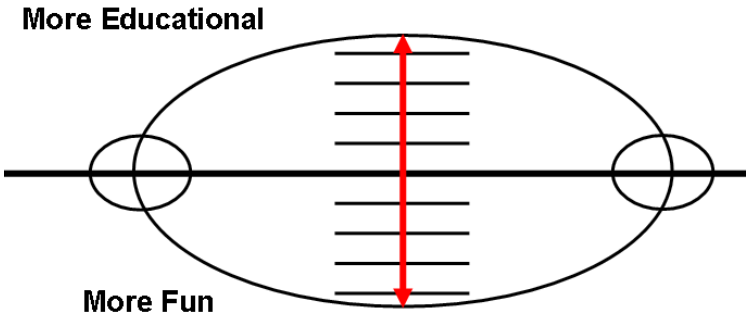
→

“edufication”

Designing Games for Learning

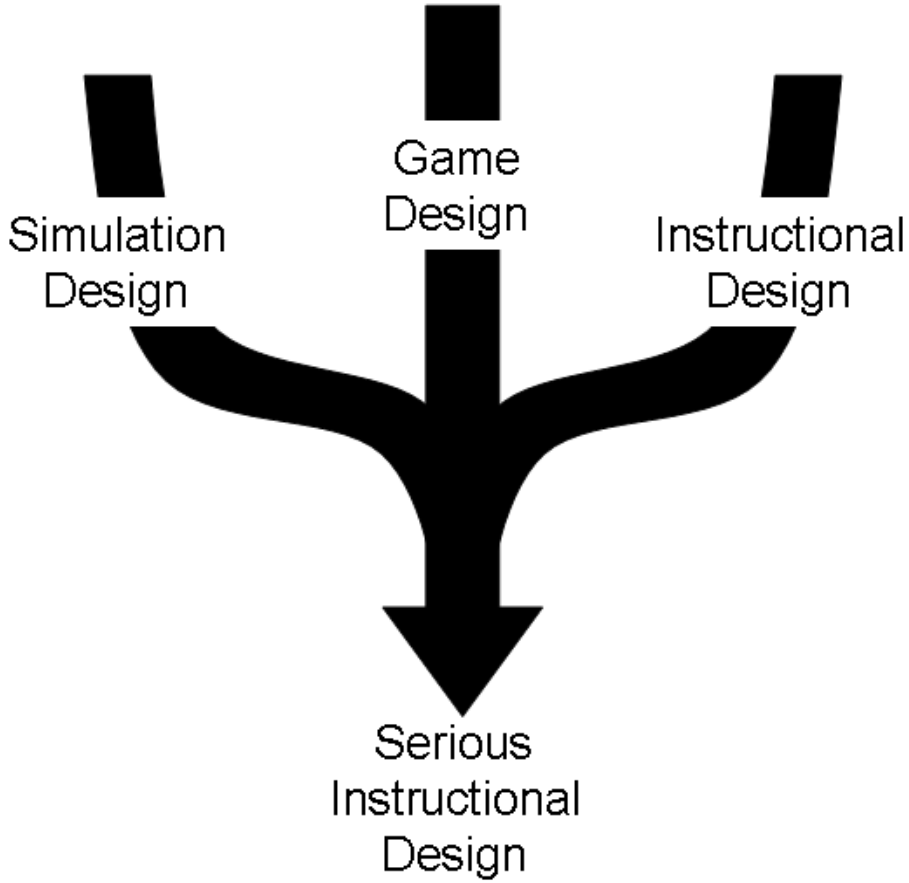
When educators make games we often get "edutainment"

Wrapping a game around instruction:



"education (is) a bitter medicine that needs the sugar-coating of entertainment to become palatable" M.Resnick

Designing Games for Learning



Why *THIS* Game?

Common Misconception:

Genotype ⇔ Phenotype

Relates to challenges in understanding many of the other fundamental concepts (alleles, traits, characteristics, etc.)

Solution…

Concentrate on
the connections and differences
between
Phenotype & genotype.

HOW?

Gene Rummy!

Would you believe me if I told you all these bunnies came from the same mom and dad?

Well, they DID … Almost.
All but one. Can you tell who?
Better yet… Do you know WHY?

Target Audience

Senior High School (Gr. 12)

Freshman College/University

Biology Class

...basically, anyone in need of a fundamental introduction (new or refresher to basic Mendelian genetics and inheritance.

Serious Goal(s)

Through playing the game and matching phenotypes w/ genotypes as well as determining what can be produced given a specific phenotype, players will:

Learn basic principles of genetics:

- Terminology: homozygous, heterozygous, gene, allele, locus,…
- Gene pairs code for specific traits
- There is interaction of separate genes on same locus
- Genes combine to produce more complex effects
- Phenotype vs. genotype
- Homo- vs heterozygous effects

Platform

Specially designed set of playing cards.

P

Black

♂

Castor

Black Agouti

A -	B -	C -	D -
A a^t a	B b	C c^{chd} c^h c	D d

P

Lilac

♀

Lilac Otter

Lilac Tan

a^t -	bb	C -	dd
A a^t a	B b	C c^{chd} c^h c	D d

Background (mine)

I have been:

- Raising rabbits for 20 years
- Studying coat color genetics
- Chronicling rabbit coat colors from birth to adulthood



Why Rabbit Coat Colors?

- Complex enough to be interesting
- Can include or exclude various genes or alleles without loss of realism
- Includes visual effects of
  - Simple dominance
  - Simple recessives
  - Co-dominance
  - Incomplete dominance
- Rabbits are classified by color according to phenotype but bred according to genotype.

Basic Facts (Color Genetics)

- Rabbit Coat Colors determined by 4 basic gene series*:
  - A: "Agouti" pattern (how colour appears on hair) [3 alleles: A, A^{at}, a]
  - B: Black vs Brown [2 alleles: B, b]
  - C: Colour [4 alleles*: C, C^{chd}, C^{ch}, c]
  - D: Dilution [2 alleles: D, d]
- Basic wild color (Agouti) looks like:

A- B- C- D-

*There are in fact a few more (not counting modifiers) but these are the most obvious ones, visually speaking

Reference:

- http://www.minkhollow.ca/MHF/doku.php?id=farm:rabbits:rabbit_colours
- http://www.minkhollow.ca/MHF/doku.php?id=farm:rabbits:rabbit_genetics

Basic Rules of Rummy

1. 2-4 players
2. Fixed # of rounds or target score
3. 1st dealer chosen randomly, then rotate clockwise
4. 2 players: get 8 cards ea.; more players get 7 cards ea.
5. Remainder of deck placed on table (stock); top card placed on discard pile face-up
6. OBJECT: dispose of all your cards (3 ways)
    1. Melding – place a set of cards on the table (variant defines allowable sets)
    2. Laying Off – adding cards to existing meld
    3. Discard – placed on discard pile, face-up

Basic Rummy Rules: http://www.pagat.com/rummy/rummy.html

Gameplay

Each Turn Consists of:

1. **Draw**: take a card from discard or stock
2. **Melding:** place any available melds on table (one per turn)
3. **Discard:** place one card on discard pile

Gene Rummy

- Cards have rabbit's sex, phenotype, known genotype, and a list of possible second alleles (in case where only one of a pair is known)
- A meld consists of 3 cards:
  1. the pick-up (the kit)
     1. from stock (gene pool)
     2. from discard (retirement)
  2. sire – male (buck)
  3. dam – female (doe)

Basic Rummy Rules: http://www.pagat.com/rummy/rummy.html



P

Black

♂

Black

Black Self

aa	B -	C -	D -
A a^t a	B b	C c^{chd} c^h c	D d

Genotype:
(Black Self)
aa B- C- D-

P

Lilac

Lynx

♀

Lilac Agouti

A -	bb	C -	dd
A a^t a	B b	C c^{chd} c^h c	D d

Genotype:
(Lilac Agouti)
A- bb C- dd

Genotype:
(Chocolate Agouti)
Aa bb C- Dd

P

Lilac

Lynx

♀

Lilac Agouti

A -	bb	C -	dd
A a^t a	B b	C c^{chd} c^h c	D d

P

Black

♂

Black

Black Self

aa	B -	C -	D -
A a^t a	B b	C c^{chd} c^h c	D d

Genotype:
(Black Self)
aa B- C- D-

P

Chocolate

♂

Chocolate

Chocolate Self

aa	bb	C -	D -
A a^t a	B b	C c^{chd} c^h c	D d

Genotype:
(Chocolate Agouti)
aa bb C- Dd

P

Lilac

♀

Lynx

Lilac Agouti

A -	bb	C -	dd
A a^t a	B b	C c^{chd} c^h c	D d

Genotype:
(Lilac Agouti)
A- bb C- dd

P

Black

♂

Black

Black Self

aa	B -	C -	D -
A a^t a	B b	C c^{chd} c^h c	D d

Genotype:
(Black Self)
aa B- C- D-

P

Lilac

♀

Lynx

Lilac Agouti

A -	bb	C -	dd
A a^t a	B b	C c^{chd} c^h c	D d

Genotype:
(Lilac Agouti)
A- bb C- dd

P

White

♂

Red-Eyed White

Albino

--	--	cc	--
A a^t a	B b	C c^{chd} c^h c	D d

Genotype:
(Chocolate Agouti)
-a b- cc -d

Requirements

- 37 different phenotypes:
  - 4 basic colours:
    - Black: B- D-
    - Chocolate: bb D-
    - Blue: B- dd
    - Lilac: bb dd
  - 3 Agouti types: Agouti [A-]; Tan [a^{at}-]; Self [aa] (x4 = 12)
  - 3 Colour types (+REW): Full [C-], Chinchilla [C^{chd}-], Californian [C^{ch}-] (x 3 = 36)
    - Red-Eyed-White [cc]
      - include 2 of these for a total of 38 cards

Requirements

Counting Score:

- Dominant = 5 points
- Recessive = 10 points
- A homozygous Black: BB DD = 5+5+5+5 = 20
- A Chocolate that is heterozygous on the D-loci: bb Dd = 10+10+5+10 = 35

Requirements

- "Cheat Sheet": genotype sheet
  - This is not a test so providing additional info is fine (they're supposed to be learning, not getting frustrated)
  - Progeny sheets
    - 2D grid showing possible progeny for any 2 given parents

Color	C (full)	c^{chd} (Chinchilla)	c^{h} (Himalayan)	c (Red-Eyed White)
C (full)	CC (Full) 	Phenotypes: 4 alleles, 10 different outcomes		
c^{chd} (Chinchilla)	Cc^{chd} (Full) 	$c^{chd}c^{chd}$ (Chinchilla) 		
c^{h} (Himalayan)	Cc^{h} (Full) 	$c^{chd}c^{h}$ (Chinchilla) 	$c^{h}c^{h}$ (Himalayan) 	
c (Red-Eyed White)	Cc (Full) 	$c^{chd}c$ (Chinchilla) 	$c^{h}c$ (Himalayan) 	cc (Red-Eyed White) 

Early Results

Tested with 3 groups of playtesters:

1. 4th year Game Design class (Cards V3)
2. biology lab instructors (Cards V6)
3. 2nd year genetics class (Cards V9)

Testing Goals

1. Concept Viability
2. Card Design
3. Game Design

1st Round Results

4th year Game Design class (Cards V3)

Comments

- Confusing at first.
- Scoring too complex.
- Too much to learn.
- Too many genes.

Suggestions

- Clearer Instructions.
- Do something w/ list of possible alleles.
- Less info on cards.

2nd Round Results

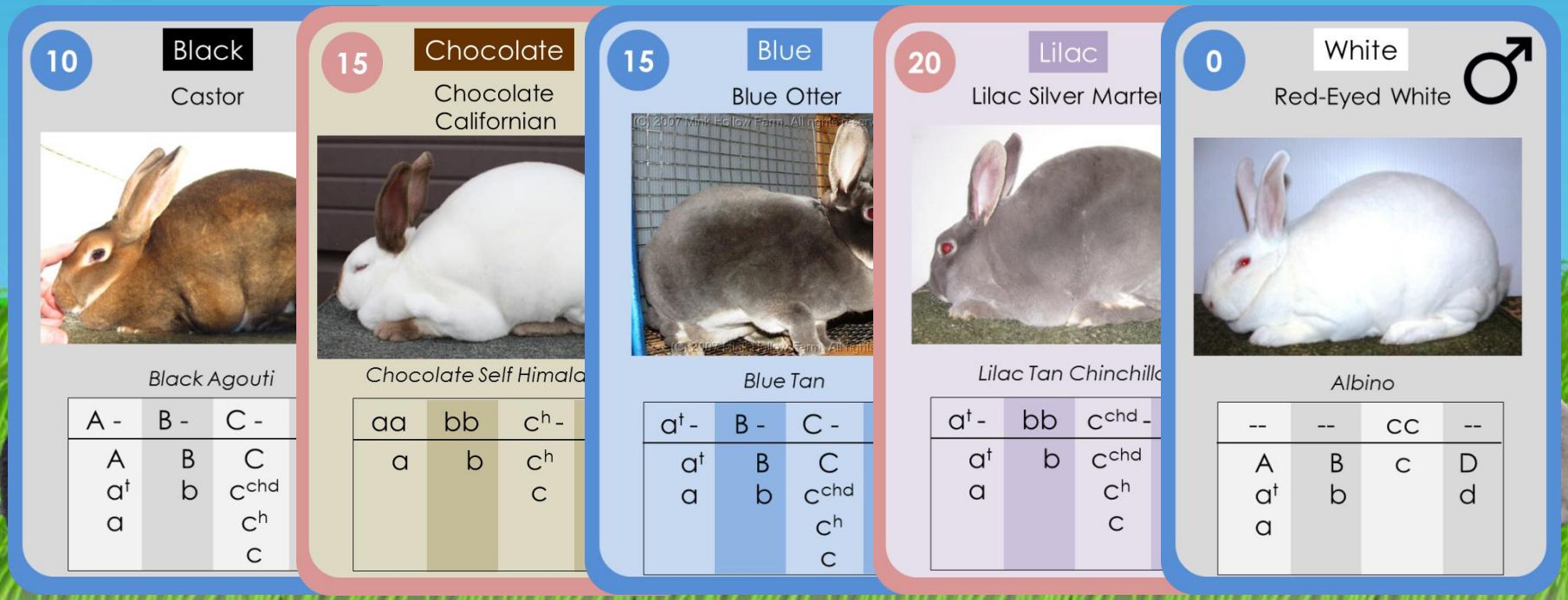
biology lab instructors (Cards V6)

Comments

- Took a while to figure out.
- Scoring too complex.
- Great potential.
- About right # genes.

Suggestions

- More detail in Instructions.
- Sex-linked traits.
- Reminder card.
- Easier scoring.



3rd Round Results

2nd year genetics class (Cards V9)

Comments

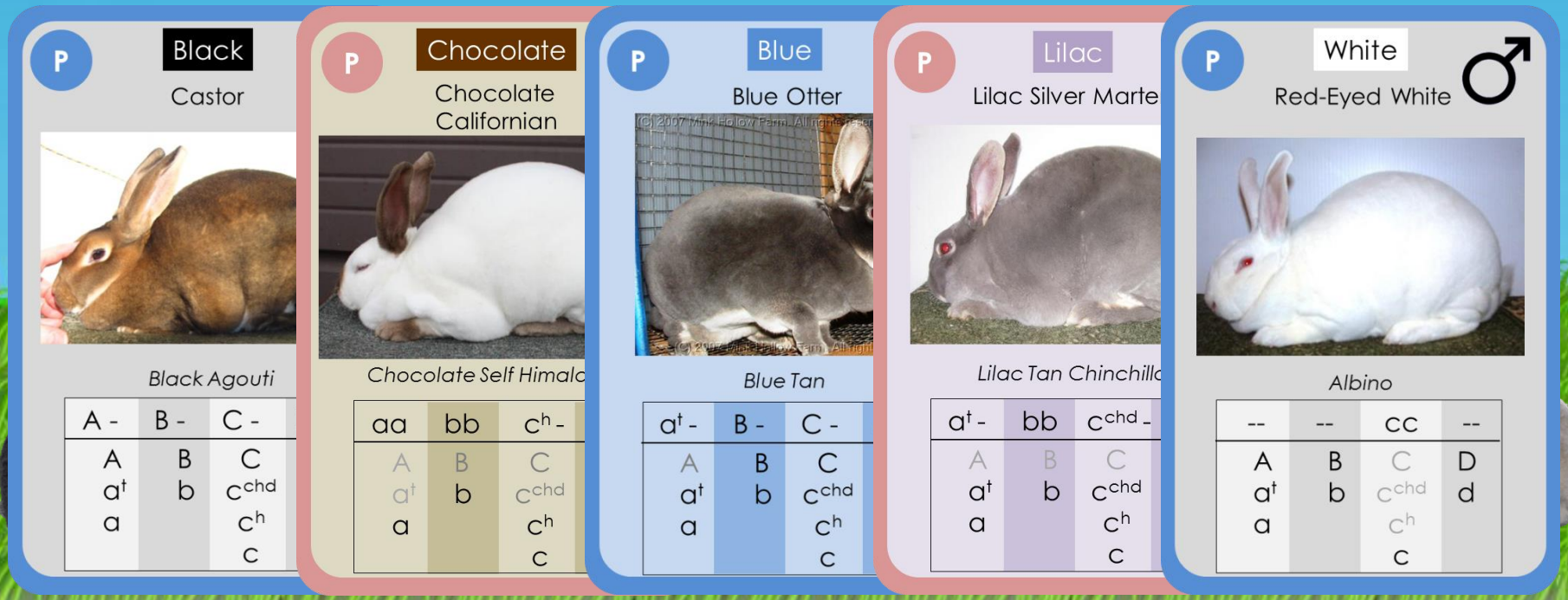
- Confusing at first.
- Scoring too complex at first.
- Too few genes.

Suggestions

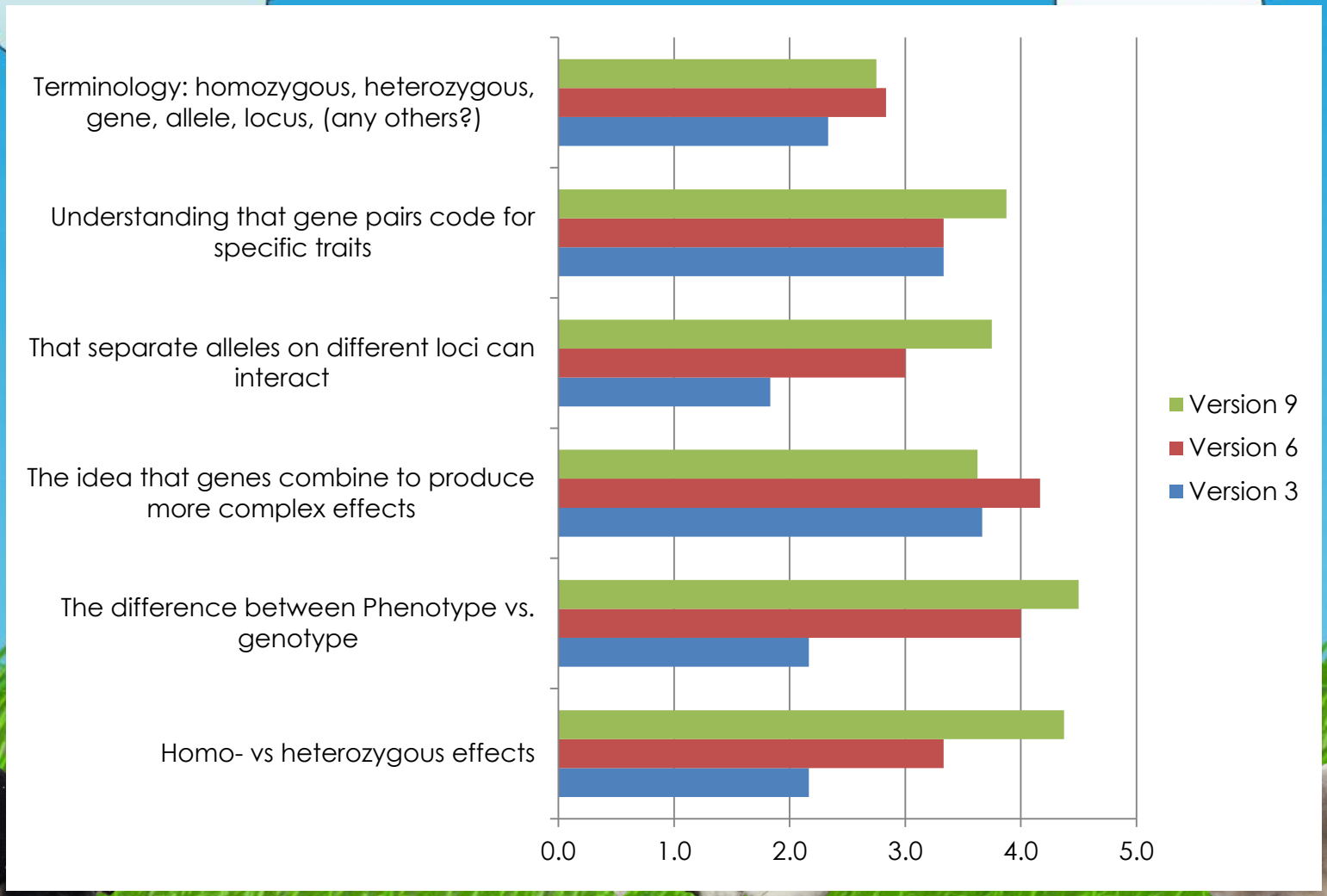
- More detail in Instructions.
- Better demonstration.
- Thicker cards.

3rd Round Results

2nd year genetics class (Cards V9)



How Well Did the Game Succeed in the Following Areas:



V3, V6, V9, Novice

15

Blue
B- dd

Bb

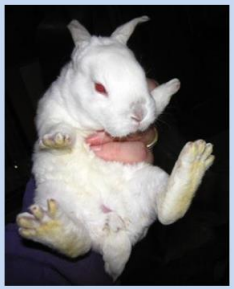
Phenotype:
Blue Californian

Genotype:
(Blue Tan Californian)
A^{at} - B- C^{ch} - dd

Possible second alleles:
A^{at}, a C^{ch}, c

15 Blue

Blue Californian

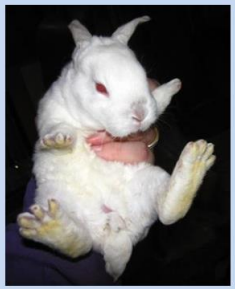


Blue Tan Himalayan

a^t -	B -	c^h -	dd
a^t a	B b	c^h c	d

P Blue

Blue Californian



Blue Tan Himalayan

a^t -	B -	c^h -	dd
A a^t a	B b	C C^{chd} c^h c	D d

N Blue

Opal

Blue Agouti

	B -		dd
	B b		D d

Overall

- Loved the bunnies.
- Liked that they were real.
- Liked fast play / rounds.
- Wanted to play longer.
- Liked the card design.

Future Directions

- Cards are about ready.
- Further testing of instructions.
- Production.
- Efficacy studies.

Thanks!

Abstract of Presentation:

This presentation reports on the early results of a study of a novel card game used to teach concepts of Mendelian genetics and inheritance in a biology class. The card game being tested is currently in the prototype stage, and the current study seeks to determine if the design of the cards, game rules, and support material are appropriate to meet the intended objectives. The game, which uses domestic rabbit coat colours as the theme has both a novice and a standard variant, both of which will be described. Gameplay is patterned after the popular genre of rummy card games where players must match cards in sets according to specified criteria, in this case the genotypes of the rabbits featured on the cards. Through playing the game and matching phenotypes w/ genotypes as well as determining what can be produced given a specific phenotype and underlying genotype, players will learn basic principles of genetics, including familiarity with standard notation, terminology, and concepts such as genotype vs. phenotype. The game has been tested in several other venues and the results of those playtests will be summarized along with the early results from the current study which is the first test of the game in a biology class. Students were invited to play the game, and reflect on their experience through a survey that includes standard playtesting methodologies. Preliminary results will be presented along with a plan for the next steps.

Resources

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