A Genetics GAME

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This article describes a game that was created to loosely simulate the process of genetic material exchange and to illustrate how two simple sets of genes can lead to a lot of variability. The target audience is high school students, but we have played it with junior high students and also with college students.

Before the game is played, the students must be familiar [at the level of Starr and Taggart (1998) or Russell (2000)] with the concepts of alleles, and the following vocabulary: gene, dominant, recessive, incomplete dominance (which we called "mixing"), homozygous, heterozygous, genotype, phenotype; they should also be familiar with the concept of mutation. Playing this game will give students an opportunity to use the words correctly and to reinforce their understanding of these concepts in an engaging way.

Each student begins with a packet of cards that are the genetic inheritance of their "critter." The cards are color-coded by trait, with two cards for each trait (to simulate the alleles for each gene). We use 5 traits, so each student begins with 10 cards; we give all students the same initial genetic material. Before the game starts, have students draw a picture of their critter based on the traits from their cards (use the template in Figure 1 (see page 506) to insure more consistent pictures. This will be important during later generations for comparisons of critter offspring.) Drawing the critter is a good way to be sure that students understand the expression of dominant vs. recessive, and mixing genes. The picture of the starting critter is given in Figure 2 (see page 507). (The gene cards we use are given on Master Sheets 1-5 (see pages 508-512); others could be used. We reproduced the sheets on lightweight cardstock, using a different color for each trait.)

Students pair up in order to exchange genetic material for their offspring. First they pick a

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card color (gene). Both "parents" lay their cards of that color on the table, face down. Randomly select a card from each partner. (These cards represent the alleles that will be passed on to the offspring.) Before the cards are placed in the Offspring pile, one of the partners rolls a single die. If the roll is not 6, the cards are placed on the Offspring pile and play continues with the next color of cards. If the roll is a 6, then a mutation has occurred and the "parents" must make a selection from the Mutation Cards for that color; this mutation will be passed on as a dominant trait to succeeding generations. (The Mutation Cards we use are included on the Master Sheets. We included both the Startup Cards and the Mutation Cards for a particular gene on one sheet for easy color-coded photocopying.)

There are 4 Mutation Cards for each trait, 3 of which are neutral or bad, and one which is good. (Nature has usually found a pretty good way of doing things, so mutations are generally *not* good.) A bad mutation is recorded in various colors, and a good mutation is recorded in red, so the class can see when mutations occur, and how they affect the critter's fitness. Mention that mutations are often not perceptible (they affect genotype but may not affect phenotype), so we have used a special coloring scheme to make it obvious when a mutation has occurred. In the real world, mutations do not occur with a probability of 1 in 6 chances, but if we used realistic probabilities, we would not see any mutations during the short course of play.

Students should draw their offspring after all the genetic material (cards) has been collected. These new critters can then be paired and the next generation of offspring produced for several generations. The drawing can be posted as a "family tree," which makes it easy to see how traits are passed on.

When the game is over, there are many questions that can be discussed. How is this game like the real world? How is it different? etc. This game is a lot of fun, and can be a hands-on way of learning some of the basic concepts of simple genetic exchange.

References

Russell, P. J. (2000). *Fundamentals of Genetics, 2nd ed.* San Francisco: Addison Wesley Longman Inc.

Starr, C. & Taggart, R. (1998). *Biology: The Unity and Diversity of Life, 8th ed.* Belmont, CA: Wadsworth Publishing Co.

FIGURE 1.
The Critter Template

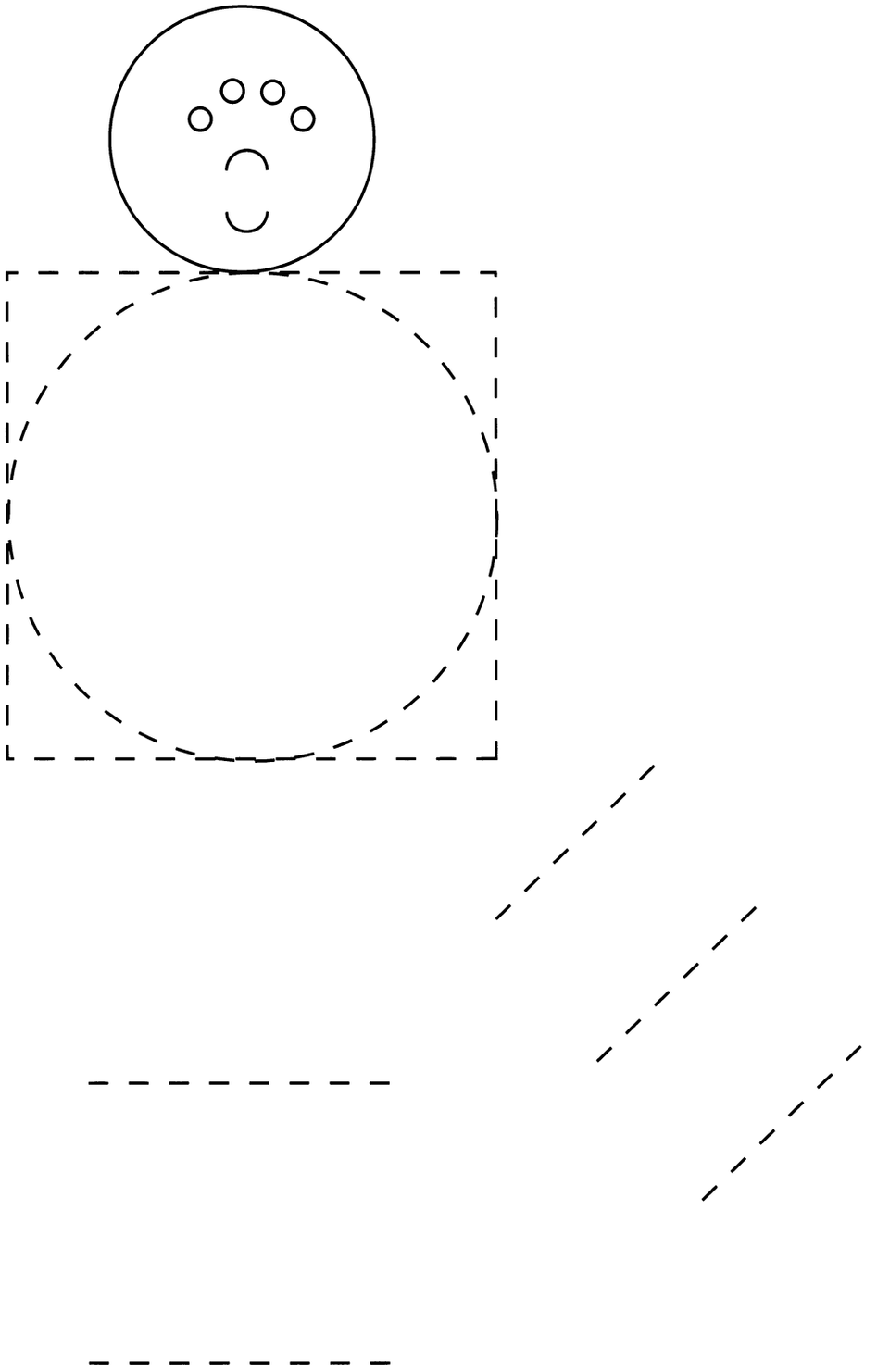
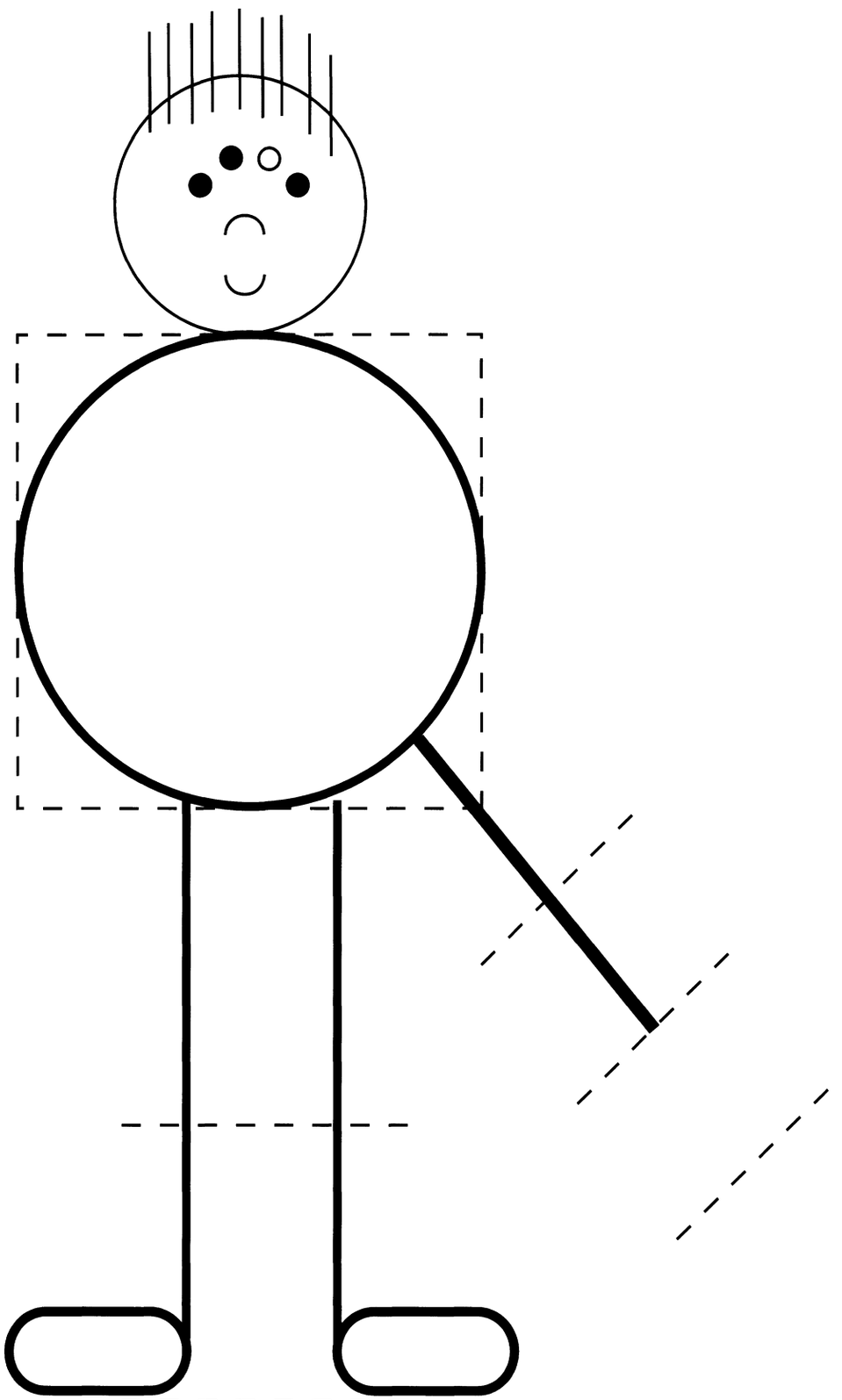


FIGURE 2.
The Initial Critter



Master Sheet 1

Hair H Dominant Straight	Hair h Recessive Curly	Hair H Dominant Straight	Hair h Recessive Curly
Hair H Dominant Straight	Hair h Recessive Curly	Hair H Dominant Straight	Hair h Recessive Curly
Hair Mutation Critter has immunity to lice. Color hair red.	Hair Mutation Critter's hair grows extra fast. Color hair green.	Hair Mutation Critter's hair is extra fine. Color hair green.	Hair Mutation Critter has no hair at all. Draw critter's head green.

Master Sheet 2

Body Shape B Dominant Circle	Body Shape b Recessive Square	Body Shape B Dominant Circle	Body Shape b Recessive Square
Body Shape B Dominant Circle	Body Shape b Recessive Square	Body Shape B Dominant Circle	Body Shape b Recessive Square
Body Shape Mutation Critter has super immune system. Draw body red.	Body Shape Mutation Critter has weak lungs. Draw body purple.	Body Shape Mutation Critter has many food allergies. Draw body purple.	Body Shape Mutation Critter has defective heart. Critter died.

Master Sheet 3

Eyes e Mixing 4 eyes	Eyes E Mixing 2 eyes	Eyes e Mixing 4 eyes	Eyes E Mixing 2 eyes
Eyes e Mixing 4 eyes	Eyes E Mixing 2 eyes	Eyes e Mixing 4 eyes	Eyes E Mixing 2 eyes
Eyes Mutation Critter can see in the dark. Color eyes red.	Eyes Mutation Critter is blind. Color eyes blue.	Eyes Mutation Critter is colorblind. Color eyes blue.	Eyes Mutation Critter is extremely nearsighted. Color eyes blue.

Master Sheet 4

Legs L Dominant Long	Legs l Recessive Short	Legs L Dominant Long	Legs l Recessive Short
Legs L Dominant Long	Legs l Recessive Short	Legs L Dominant Long	Legs l Recessive Short
Legs Mutation Critter is lame — can't walk. Draw legs orange.	Legs Mutation Critter has weak bones — break easily. Draw legs orange.	Legs Mutation Critter is an exceptionally good jumper. Draw legs red.	Legs Mutation Critter is pigeon-toed. Draw legs orange.

Master Sheet 5

Tail T Mixing Long	Tail t Mixing Short	Tail T Mixing Long	Tail t Mixing Short
Tail T Mixing Long	Tail t Mixing Short	Tail T Mixing Long	Tail t Mixing Short
Tail Mutation Critter has prehensile tail. Draw tail red.	Tail Mutation Critter has 2 tails. Draw tail brown.	Tail Mutation Critter has no tail.	Tail Mutation Critter's tail is hairless. Draw tail brown.