Leader Guide for Youth Activities

Activity Level: Advanced

Expected Time Needed to Complete This Activity: 2 to 3 hours (may divide into several sessions)

Equipment/Resources:
- Writing utensils
- Copies of activities
- Additional paper
- 3 x 5 blank notecards
- Fine-point markers, colored pencils or pens
- Identical scrapbook paper, spray adhesive and scissors

Horse Skills:
1. Learn about color genetics.
2. Learn to identify and associate genotypes with phenotypes.
3. Learn how to use a Punnett Square to determine phenotypes.

Life Skills:
1. Develop reasoning and problem-solving skills.
2. Develop complex thinking.
3. Work together to accomplish a common goal.

Main Activity - Punnett Practice

Discuss how to complete a Punnett square and assist the youth, as needed, with completion of the additional Punnett squares.

	aE	**Ae**	**aE**	**Ae**
AE	AaEE	AAEe	AaEE	AAEe
AE	AaEE	AAEe	AaEE	AAEe
aE	aaEE	AaEe	aaEE	AaEe
aE	aaEE	AaEe	aaEE	AaEe

12/16: Bay (AaEE, AaEe)
4/16: Black (aaEE)

	AE	**Ae**	**AE**	**Ae**
Ae	AAEe	AAee	AAEe	AAee
Ae	AAEe	AAee	AAEe	AAee
Ae	AAEe	AAee	AAEe	AAee
Ae	AAEe	AAee	AAEe	AAee

8/16: Bay (AAEe)
8/16: Chestnut (AAee)

Advanced Level Activity

© 2016 American Youth Horse Council, Inc.

Riding Further Activity - Who's Your Daddy?

1. Color of mare- Perlino
   Color of foal- Cremello
   Possible stallions- E
2. Color of mare- Cremello
   Color of foal- Palomino
   Possible stallions- A, C
3. Color of mare- Frame overo (chestnut)
   Color of foal- OLWS
   Possible stallions- D
4. Color of mare- Gray
   Color of foal- Blue roan
   Possible stallions- C
5. Color of mare- Bay dun
   Color of foal- Grullo
   Possible stallions-B, D, E

A. Color of stallion - Bay
B. Color of stallion - Chestnut
C. Color of stallion – Red roan
D. Color of stallion – Frame overo (black)
E. Color of stallion - Palomino

Riding Further Activity – Color Coded Challenge

It is recommended that the youth complete the "Coat of Many Colors" chapter prior to this activity. Provide the youth with the supplies needed to create the game cards. You may choose to have the youth create additional genotype/phenotype combinations as an at home assignment. You may also choose to create the game cards at one meeting and then play the game at another meeting. This would give the youth an opportunity to play several games, thereby increasing the potential knowledge gained with this activity.

Decide if the game will be played as competitive or noncompetitive as this will determine the number of cards that will be used. The number of cards used will also determine the difficulty level and you may choose to start out with fewer total cards and then increase the number as the youth learn the basics. Further details regarding creation of the game cards and rules for the game are included in the youth handout.

Advanced Level Activity

Author:
Kathryn T. Graves, PhD
Director /Genetics Testing at Gluck
Gluck Equine Research Center
University of Kentucky

Authors (Youth Activities):
Heather Manring, PhD
Ohio 4-H

© 2016 American Youth Horse Council, Inc.

Susan Baumgartner
American Riding Instructors Association
Certified Instructor

References:

1. Ernest Bailey and Samantha A. Brooks. Horse Genetics. Boston: CABI, 2013. Print.
2. Sponenberg, D. Phillip. Equine Color Genetics, 2nd edition. Ames: Iowa State Press, 2003. Print.

Photo Credits:

1. Bay Roan – Joanne Tobey. Digital Image
2. Chestnut Frame Overo – Kathryn Graves, PhD. Digital Image.
3. Chestnut Tobiano – Kathryn Graves, PhD. Digital Image
4. Gray – Kathryn Graves, PhD. Digital Image
5. Blue Roan – Kathryn Graves, PhD. Digital Image

Reviewers:

Deborah Manring
Ohio 4-H

Dr. Jenifer Nadeau
Associate Professor/Equine Extension Specialist
University of Connecticut

The information and material contained in this manual is accurate to the best of the contributors' knowledge and information. In presenting the suggestions and recommendations in this manual, neither the American Youth Horse Council, Inc., nor the section chief(s), reviewers or contributing authors make any guarantees that they are suitable for all persons, ages, locations, terrain, climates, horses/animals, tack, equipment, physical abilities, mental abilities, and situations. The American Youth Horse Council, Inc., and the section chiefs, reviewers and authors make no promises or guarantees about the accuracy, completeness, or adequacy of the information contained in this manual and disclaim any liability in connection with the use of information contained in this manual. When implementing any of the recommendations and/or hands-on activities in this manual, all users are strongly cautioned to carefully evaluate the knowledge and abilities of each participant or spectator and to make appropriate adjustments in the interests of further promoting safety based on individual circumstances.

In addition, you can find the text of each state's equine activity liability law through the search function on this legal information website: https://www.animallaw.info/ We encourage all readers to review the laws applicable to each state where you live or do business. Please also keep in mind that laws change, and some states have amended their equine activity liability laws.

© 2016 American Youth Horse Council, Inc.

The Code Behind the Color

Youth Activities: Advanced

Main Activity - Punnett Practice

Punnett squares are a method geneticists use to determine possible genotypes and phenotypes from breeding two specific organisms. It is based on the genotypes of each of the parents and their contribution of one allele of each gene to the offspring. The size of the Punnett square will depend on the number of genes. The first step is to determine the number of different allele combinations. For example, if you are looking at two different genes that each have two alleles, there are four different combinations. This will be done for the genotype of the mare and the stallion. In this case, the Punnett square would be a 4 x 4 grid. The allele combinations for the stallion are listed across the top and the allele combinations for the mare are listed down the left side. Then each of the squares are filled in by combining the alleles for the mare and the stallion. From this, you can determine the probability of a certain color resulting from crossing that mare and stallion. An example is provided below.

Stallion Genotype AaEe

Mare Genotype AaEe

	AE	**Ae**	**aE**	**ae**
AE	AAEE	AAEe	AaEE	AaEe
Ae	AAEe	AAee	AaEe	Aaee
aE	AaEE	AaEe	aaEE	aaEe
ae	AaEe	Aaee	aaEe	aaee

4/16: Chestnut (Aaee, AAee, aaee)
9/16: Bay (AAEE, AaEE, AAEe, AaEe)
3/16: Black (aaEE, aaEe)

Using the Punnett square provided, determine the possible genotypes and phenotypes of crossing a bay mare with a black stallion. The bay mare has a genotype of AaEE and the black stallion has a genotype of aaEe.

Advanced Level Handout

© 2016 American Youth Horse Council, Inc.

Using the Punnett square provided, determine the possible genotypes and phenotypes of crossing a chestnut mare and a bay stallion. The genotypes are AAee for the mare and AAEe for the stallion.

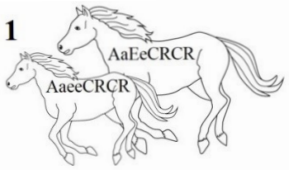
Riding Further Activity - Who's Your Daddy?

Using what you learned in this chapter and a Punnett square, determine which of the stallions could be the sire of the foal. There are five mare-foal combinations (see next page), each of which has a given genotype. The phenotype for each of these horses needs to be determined as well as the phenotype of the five stallions. Identify which stallion could be a possible sire for each of the foals. You may use a stallion more than once and a single mare-foal pair may have more than one possible stallion.

For the genotypes, if a gene is not listed it is considered to be homozygous recessive. For example, the genotype AaEeggcrcr, is considered homozygous recessive for the gray gene and cream gene and would therefore be listed as AaEe.

© 2016 American Youth Horse Council, Inc.

1

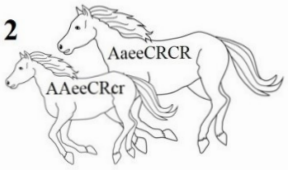


Color of Mare: _____

Color of Foal: _____

Possible stallions: _____

2

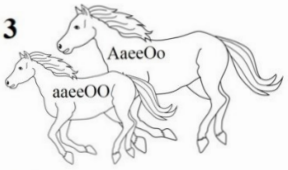


Color of Mare: _____

Color of Foal: _____

Possible stallions: _____

3

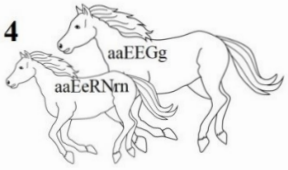


Color of Mare: _____

Color of Foal: _____

Possible stallions: _____

4

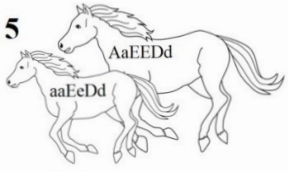


Color of Mare: _____

Color of Foal: _____

Possible stallions: _____

5

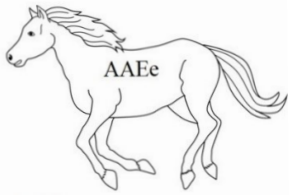


Color of Mare: _____

Color of Foal: _____

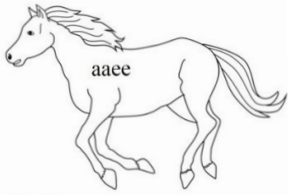
Possible stallions: _____

A



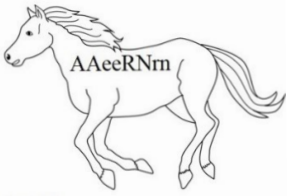
Color of Stallion: _____

B



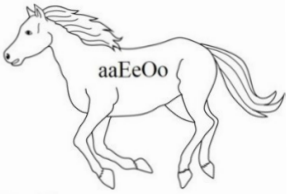
Color of Stallion: _____

C



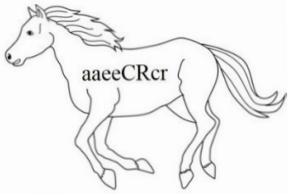
Color of Stallion: _____

D



Color of Stallion: _____

E



Color of Stallion: _____

Advanced Level Handout

© 2016 American Youth Horse Council, Inc.

Riding Further Activity – Color Coded Challenge

The goal of this activity is to match the correct genotype to a phenotype. For this activity, create a set of cards with the coat colors listed below and another set of cards with the corresponding genotypes. You may also choose to include dilution/modifier cards (also listed below). Be sure to make a phenotype card for EACH genotype. Therefore, you will have multiple cards for bay, black and chestnut, as well as other colors depending on which genotypes you include. You are encouraged to write additional genotype/phenotype cards for this game. Include some simple genotypes and some that are more difficult.

Game Cards: Use the 3 x 5 cards provided by your leader and create genotype and phenotype cards. Use the previous guidelines and the following list. Be sure to neatly print each card. Use adhesive spray and identical scrapbook paper to cover the back of the cards. This will lengthen the life span of the cards. Don't forget to include an answer key for all cards.

A - Restricts black to points
a - No change in expression of black
EE - Black
E - Black is expressed
e - Prevents expression of black
G - Gray dilution
CR - Cremello (dilutes red to yellow)
D - Dun dilution with dorsal stripe
RN - Roan dilution
CH - Champagne (dilutes red & black)
Z - Silver (dilutes black)
SW1 - Splashed white
SB1 - Sabino
TO - Tobiano
O - Overo
OO - Lethal (OLWS)
Lp - Appaloosa spotting

EE - Black
aaERNrn - Blue roan
aaEeDd - Grullo
aaEETOto - Black tobiano
EEOo - Black overo
aaEeZz - Black silver
EEaaDd - Grullo
aaECRcr - Smoky black
aaECRCR - Smoky cream

AE - Bay
AERNrn - Bay roan
AEDd - Bay dun
AAEECRcr - Buckskin
EATOto - Bay tobiano
AECRCR - Perlino
AaeECRcr - Buckskin
AEOo - Bay overo
AEOO - Lethal (OLWS)
AEZz - Red silver
EeAaCR - Buckskin
EeCRCRA - Perlino
EeddADd - Bay dun

ee - Chestnut
eeRNrn - Red roan
eeDd - Red dun
eeTOto - Chestnut tobiano
eeCRCR - Cremello
eeZz - Chestnut
eeSB1 - Chestnut sabino
eeOo - Chestnut overo
eeAaCR - Palomino
eeCRCRAA - Cremello
eeDdAa - Red dun
eeRNrnAa - Red roan

© 2016 American Youth Horse Council, Inc.