

SHOW ME  
**GENETIC LOCKBOX**

Brought to you by:  
University of Missouri Extension  
University of Missouri Ellis Fischel Cancer Center



University of Missouri

Extension | Ellis Fischel Cancer Center

**Unlock the Secrets of Genes**  
**A Journey of Discovery Awaits!**

# SHOW ME **GENETIC LOCKBOX**

Thanks so much for checking out our Genetic Lockbox! Following your event, please take a moment and let us know how the event went. Your honest feedback is invaluable to us, and we genuinely appreciate the time you take to complete the survey. If you encounter any issues, have questions, or need replacements, please don't hesitate to contact us.



*Heather Conrow*  
Livestock Specialist  
MU Extension  
600 W. Morrison, Suite 17  
Fayette, MO 65248  
O: 660.248.2272  
E: [hconrow@missouri.edu](mailto:hconrow@missouri.edu)  
W: [extension.missouri.edu/howard](http://extension.missouri.edu/howard)

*Robin Dianics, JM, MBA, PMP*  
Associate Director Research Administration  
Ellis Fischel Cancer Center  
University of Missouri & MU Health Care  
O: 573.882.3987  
E: [dianicsr@umsystem.edu](mailto:dianicsr@umsystem.edu)

# SHOW ME GENETIC LOCKBOX

Ge • net • ics (/jə'nediks/) the science of genes and how traits are passed on from one generation to the next

*Crack the codes to open the locks to get the \*prize\* in the box.*

## OBJECTIVES

- Obtain a basic understanding of genetics
- Distinguish genotype and phenotype
- Define dominant and recessive alleles and how they are represented

## WHY A LOCKBOX?

- A great way to introduce a topic or wrap up a unit
- Motivates participants to solve complex puzzles to gain access to a \*prize\* inside
- Provides a fun and interactive way to learn and apply concepts
- Motivates participants to work as a team
- Provides an opportunity to practice communicating clearly with others
- Motivates participants to collaborate with teammates



## HERE YOU WILL FIND...

- General information (p. 1)
- Set-up and provided equipment (p. 3)
- Background information (p. 4)
- Directions for each puzzle (p. 6)
- Additional teacher resources (p. 20)
- Additional student resources (p. 21)
- Glossary (p. 22)
- References (p. 23)
- Fun facts (p. 24)

\*prize not included\*

QUESTIONS? EMAIL [HCONROW@MISSOURI.EDU](mailto:HCONROW@MISSOURI.EDU)

 **Extension**  
University of Missouri

an equal opportunity/ADA institution

# SHOW ME

## GENERAL INFORMATION

Genetic Lockboxes are an innovative and interactive means to educate the public about genetics. Participants exercise communication techniques as they work together to solve the puzzles. The puzzles are designed to make participants think through and apply problem-solving skills to genetic concepts. Participants will struggle, make mistakes, and rely on teammates. Even though it may be difficult, try not to intervene too early in the process.

Genetic Lockbox activities can be modified to meet the needs and capabilities of learners. To simplify the activity, it can be beneficial to complete a puzzle as a group when introducing the topic. This will provide an opportunity to talk about the various styles of locks, how they open, and the problem-solving skills students might need to successfully open the box. Participants must first solve the puzzle to determine (through deductive reasoning) which lock the combination goes to. A cheat sheet (p. 2) can be provided to decrease the level of difficulty. Additionally, it may be helpful to limit the number of locks/puzzles used during the activity.

Team building can add a level of complexity to the Genetic Lockbox. Facilitators can divide the group into teams with each team solving one puzzle. Then, as a group, they will come together to unlock the box. This option encourages individual teams to support each other. The success of the entire group relies on each team; thereby uniting the group.

Time limits can also add a layer of difficulty by creating a sense of urgency motivating students to stay focused and complete the task. However, it is cautioned that this may create undue stress for some participants. Alternatively, facilitators can set optional time limits, such as providing a designated time when participants will receive puzzle clues, to control the time it takes for completion.

# SHOW ME OPTIONAL CHEAT SHEET

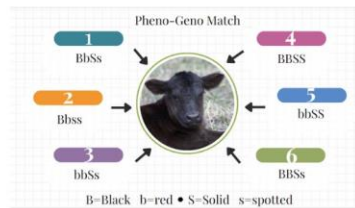
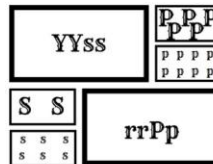
## CHEAT SHEET



DIRECTIONAL WORD SEARCH

1. Genotype  
2. Phenotype  
3. Dominant  
4. Recessive

J	T	E	B	O	V	E	G	Y	P	N
Z	K	P	I	G	O	N	F	O	R	
W	S	Y	A	S	R	G	S	F	F	O
G	F	T	S	R	G	J	D	A	M	H
Y	S	O	G	E	N	O	T	Y	P	E
O	M	N	S	C	V	L	R	G	G	S
G	A	E	M	E	D	E	V	S	S	P
B	R	H	V	S	F	L	Z	D	D	E
H	G	P	N	S	T	P	F	E	E	B
T	N	A	N	I	M	O	D	R	R	L
N	D	A	V	D	O	S	C	C	Q	
G	Y	P	I	E	P	D	B	Y	Z	I



CROSSWORD PUZZLE

DOWN

- The recessive combination of alleles.
- The genotype expression.
- Designating the sex of the sex.
- The gene that controls the trait on the sex chromosome.

ACROSS

- When the two alleles an organism has are the same.
- The gene that is always expressed, always to the dominant and never the recessive.
- When a dominant allele is the only one of the body that will make people who they are.
- When both alleles are dominant and recessive.
- When both alleles are dominant and recessive.
- The gene that controls the trait on the sex chromosome.
- The gene that controls the trait on the sex chromosome.
- The gene that controls the trait on the sex chromosome.

# SHOW ME SET UP & PROVIDED EQUIPMENT

Brand, style, and color options are endless. The pictures below depict the provided box. If wanting to set up your own lockbox activity, make sure to purchase locks with adjustable combinations. The best way to set up a new challenge is to purchase a variety of locks and figure out a puzzle to match. Google Docs can be used in the place of the physical locks, but let's face it, playing with locks is much more fun!



## TOOLBOX: ANY TYPE

Make sure the safety hasp fits through the locking hole on the toolbox (highlighted in picture)



## LOCKOUT TAGOUT SAFETY HASP



## COLOR CODED NUMBER LOCK



## THREE-DIGIT LOCK



## FOUR LETTER LOCK



## FOUR-DIGIT LOCK



## FIVE LETTER LOCK

SHOW ME

# BACKGROUND INFORMATION

Genetics - the study of how the dam (mom) and the sire (dad) pass pieces of themselves to their offspring (babies). The baby gets half of it's DNA (alleles) from mom and half from dad.

## GENOTYPE VS. PHENOTYPE

Genes contain the instructions for a trait such as coat color, growth rate, and feed efficiency. A genotype is the inherited combination of alleles in the offspring. It includes the genetic possibilities for how the offspring will display a trait. This leads to the phenotype. The phenotype is the offspring's appearance and/or potential performance. It is how the offspring physically look. A single phenotype can result from more than one genotype.

### GENOTYPE

The inherited combination of alleles

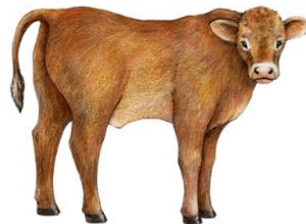
**SS**

**Ss**

**SS**

### PHENOTYPE

The offspring's appearance



**SOLID**



spotted

# SHOW ME

## BACKGROUND INFORMATION

Genetics - the study of how the dam (mom) and the sire (dad) pass pieces of themselves to their offspring (babies). The baby gets half of it's DNA (alleles) from mom and half from dad.

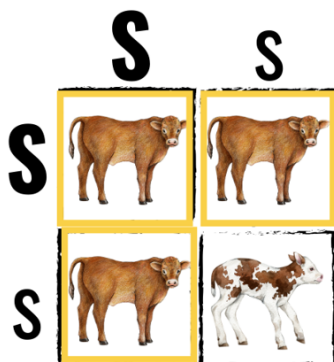
### DOMINANT VS. RECESSIVE

Offspring receive one allele from mom and one allele from dad. In some cases, one version of an allele has a bigger effect than the other.

Dominant alleles “dominate,” or overshadow, the recessive allele. If one of the inherited alleles is dominant, offspring will express the dominant phenotype, regardless of whether a recessive allele is present. The only way recessive alleles are visible, is if both alleles are recessive. Dominant alleles are represented by capital letters (SS). Recessive alleles by lower case letters (ss).

#### DOMINANT

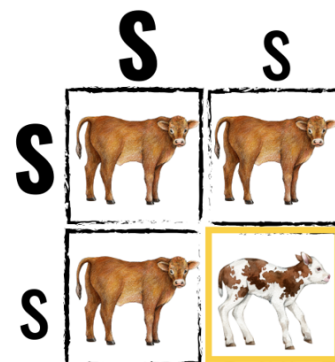
If present, the allele that is always expressed



Represented by a capital letter

#### RECESSIVE

The allele that is NOT always expressed



Represented by a lowercase letter



# SHOW ME COLOR NUMBER MATCH PUZZLE

## Tips, Tricks & Modifications

### DIRECTIONS FOR FACILITATOR

Participants must match the traits expressed by dominant and recessive alleles for pod color (**YELLOW** or green) and number of seeds (**2** or 6) and for petal color (**RED** or blue) and number of petals (**5** or 8).

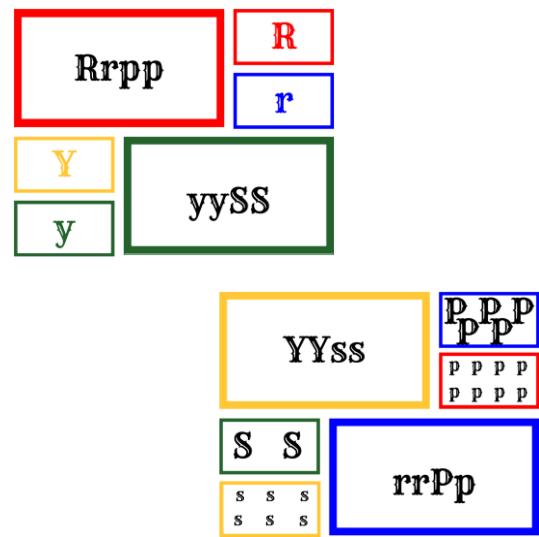
The large cards give the genotypes. Participants must figure out the phenotypes by matching the small cards to the large cards.

For example, the genotype **Yyss** results in the phenotype **YELLOW** pod color with 6 seeds, giving the answer of **YELLOW 6**.

### TIPS & TRICKS

Know your audience to better prepare and provide the most fitting materials (p. 7).

Review terms dominant and recessive and how they are represented prior to the activity.



### MODIFICATIONS

#### Easier

- Provide all cards in color
- Provide the hint sheet at the very beginning (p. 9)
- Provide an example prior to activity

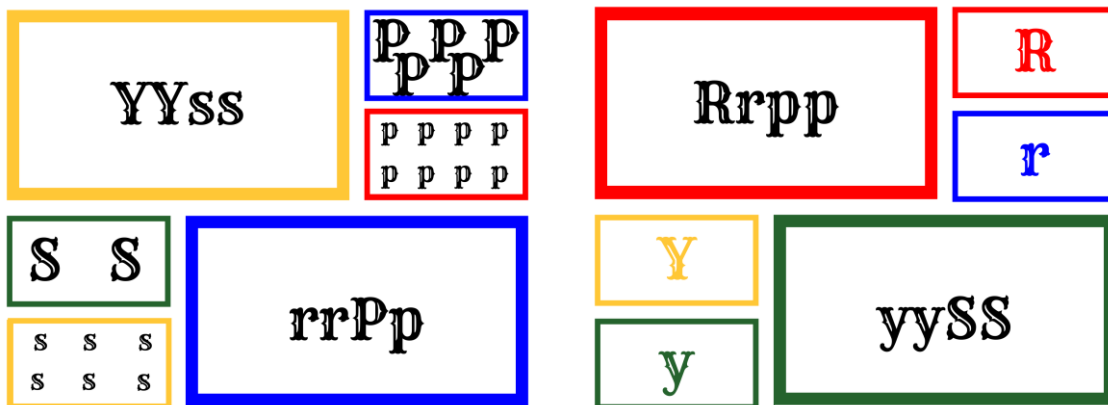
#### More Difficult

- Provide all large cards in black & white and the small cards in color
- Save the hint sheet until needed

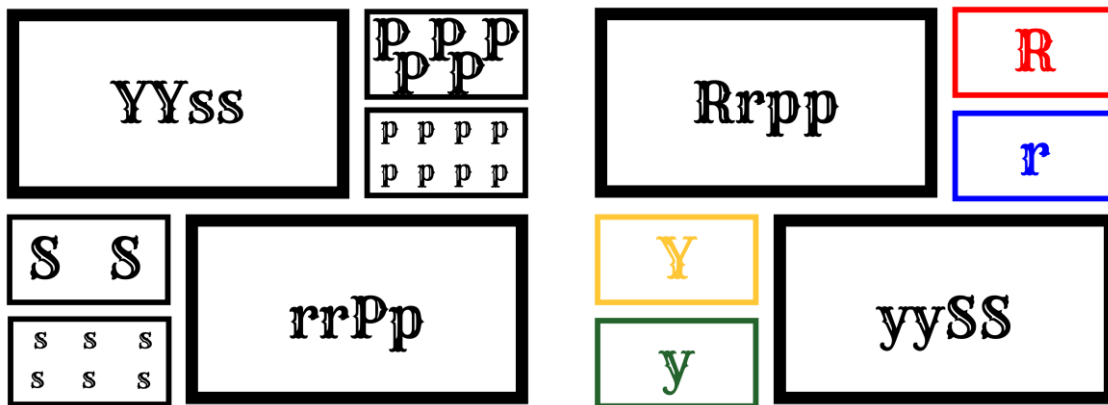
# SHOW ME COLOR NUMBER MATCH PUZZLE

## Modifications

### EASIER VERSION\*



### MORE DIFFICULT VERSION\*



\*Both sets of cards are provided laminated

# SHOW ME COLOR NUMBER MATCH PUZZLE

## Tips

MATCH THE COLORS AND LETTERS  
THEN COUNT THE LETTERS TO FIND THE NUMBER

Rrpp	R	R = Red
	p p p p p p p p	p = 8

yySS	y	y = Green
	S S	S = 2

YYss	Y	Y = Yellow
	s s s s s s	s = 6

rrPp	r	r = Blue
	P P P p p	P = 5



# SHOW ME COLOR NUMBER MATCH PUZZLE

## Hint Card & Answer Key

### HINT CARD

	Dominant	Recessive
Pod Color	Y Yellow	y Green
Number of Seeds	S 2	s 6

	Dominant	Recessive
Petal Color	R RED	r Blue
Number of Petals	P 5	p 8

### ANSWER KEY

$Rrpp$  = \* RED 8

$yySS$  = GREEN 2

$YYss$  = YELLOW 6

$rrPp$  = BLUE 5

\* Order on lock from left to right: RED, GREEN, YELLOW, BLUE

9

# SHOW ME CROSSWORD PUZZLE

## Tips, Tricks, & Modifications

### DIRECTIONS FOR FACILITATOR

Each clue is assigned a number which corresponds to the number for its answer in the grid.

Some boxes will provide a letter for more than one word; so correctly answering one clue will give one or more letters that make up part of a different answer.

The letters to complete the code word at the bottom are highlighted in color within the grid. Match the color of the box to the color of the line in the word.

### TIPS & TRICKS

Explain how crossword puzzles work, if needed.

Explain the letters in the colored boxes in the grid match the colored lines at the bottom.

### CROSSWORD PUZZLE

#### DOWN

2. The inherited combination of alleles.
4. The organism's appearance.
6. Distinguishing characteristics.
8. Each gene has two parts, one from each parent.

#### ACROSS

1. When the two alleles an organism has are the same.
3. The trait that is always expressed, always there-depicted with uppercase letters.
5. The passing of traits from parent to offspring.
7. Genetic information inside the cells of the body that helps make people who they are.
9. The unit with the basic properties of life.
10. A part of the chromosome that contains the instructions for a trait.
11. The trait that is not always expressed, it recedes into the background-depicted with lowercase letters.

B

### MODIFICATIONS

#### Easier

- Provide the *Genetic Terminology* sheet (p. 12) with the answers filled in
- Solve one of the clues as a group
- Require them to only answer clues #3 Across, #11 Across, #4 Down, and #10 Across

#### More Difficult

- Provide the *Genetic Terminology* sheet without the answers or not at all (p. 12)

# SHOW ME CROSSWORD PUZZLE

## Supplemental Material

### DIRECTIONS FOR FACILITATOR

This is NOT a puzzle and does NOT result in a combination for a lock.

Read the definitions listed on the right-hand side and determine which word in the word bank, at the top, best fits that definition.

Each word will be used one time.

### TIPS & TRICKS

This document will help answer the clues in the *Crossword Puzzle*.

*Genetic Terminology* can be used as a review sheet in preparation for the genetic lockbox activity.

**GENETIC TERMINOLOGY**

Heredity	Allele	Phenotype
Genotype	Trait	Cell
DNA	Recessive	Genes
Dominant	Homozygous	

- The organism's appearance
- F** The trait that is always expressed, always three-uppercase letters
- Each gene has two parts, one from each parent
- A part of the chromosome that contains the instructions for a trait
- The passing of traits from parent to offspring
- Distinguishing characteristics
- hh** When the two alleles an organism has are the same
- f** The trait that is not always expressed. It recedes into the background-lowercase letters.
- The unit with the basic properties of life
- The inherited combination of alleles
- Genetic information inside the cells of the body that helps make people who they are

### MODIFICATIONS

#### Easier

- Provide the *Genetic Terminology* sheet with the answers filled in (p. 12)

#### More Difficult

- Require participants to show the completed sheet before all puzzles are distributed









# SHOW ME CROSSWORD PUZZLE

## Modifications

### EASIER

GENETIC TERMINOLOGY









Heredity	Allele	Phenotype
Genotype	Trait	Cell
DNA	Recessive	Genes
Dominant	Homozygous	

Phenotype		The organism's appearance
Dominant	<b>F</b>	The trait that is always expressed, always there-UPPERCASE letters
Allele		Each gene has two parts, one from each parent
Genes		A part of the chromosome that contains the instructions for a trait
Heredity		The passing of traits from parent to offspring
Trait		Distinguishing characteristics
Homozygous	<b>hh</b>	When the two alleles an organism has are the same
Recessive	<b>f</b>	The trait that is not always expressed. It recedes into the background-lowercase letters.
Cell		The unit with the basic properties of life
Genotype		The inherited combination of alleles
DNA		Genetic information inside the cells of the body that helps make people who they are

### MORE DIFFICULT

GENETIC TERMINOLOGY

Heredity	Allele	Phenotype
Genotype	Trait	Cell
DNA	Recessive	Genes
Dominant	Homozygous	

		The organism's appearance
	<b>F</b>	The trait that is always expressed, always there-uppercase letters
		Each gene has two parts, one from each parent
		A part of the chromosome that contains the instructions for a trait
		The passing of traits from parent to offspring
		Distinguishing characteristics
	<b>hh</b>	When the two alleles an organism has are the same
	<b>f</b>	The trait that is not always expressed. It recedes into the background-lowercase letters.
		The unit with the basic properties of life
		The inherited combination of alleles
		Genetic information inside the cells of the body that helps make people who they are

### MOST DIFFICULT

Do not provide either *Genetic Terminology* sheet

# SHOW ME CROSSWORD PUZZLE

## Answer Key

### ANSWER KEY

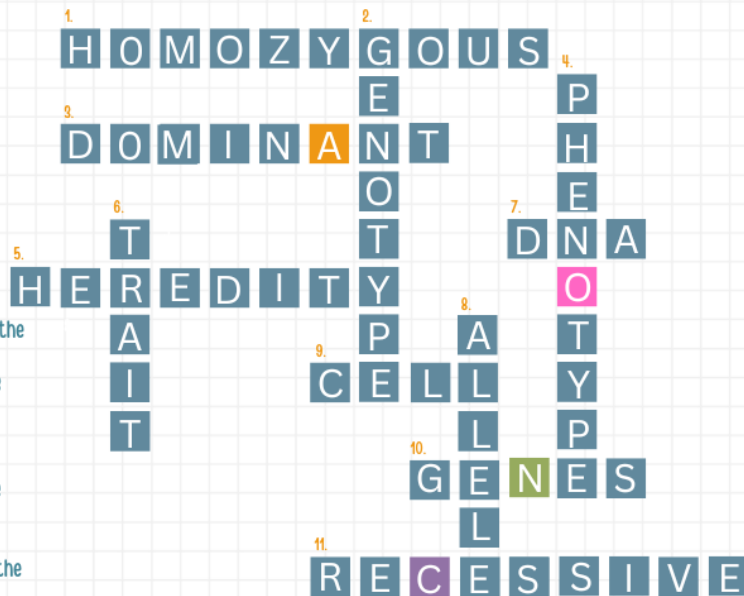
### CROSSWORD PUZZLE

#### DOWN

2. The inherited combination of alleles.
4. The organism's appearance.
6. Distinguishing characteristics.
8. Each gene has two parts, one from each parent.

#### ACROSS

1. When the two alleles an organism has are the same.
3. The trait that is always expressed, always there—depicted with uppercase letters.
5. The passing of traits from parent to offspring.
7. Genetic information inside the cells of the body that helps make people who they are.
9. The unit with the basic properties of life.
10. A part of the chromosome that contains the instructions for a trait.
11. The trait that is not always expressed. It recedes into the background—depicted with lowercase letters.





# SHOW ME

## DIRECTIONAL WORD SEARCH PUZZLE

# Tips, Tricks, & Modifications

### DIRECTIONS FOR FACILITATOR

The words in the puzzle may be hidden traveling to the Left, to the Right, Up or Down.

When the four words are found, determine which direction the words are written – Left, Right, Up, or Down

The first letter of the DIRECTIONAL description is the letter for the code to the lock (L, R, U, D).

For example, if the word is found going from left to right, the letter for the code is R.

### TIPS & TRICKS

Explain the example listed above.

Focus on the list and scan the grid for the first letter of each word.

### DIRECTIONAL WORD SEARCH

1. Genotype
2. Phenotype
3. Dominant
4. Recessive

— — — —  
1 2 3 4

J	T	E	B	O	V	E	C	Y	P	N
Z	K	P	I	G	L	Q	N	F	O	R
W	S	Y	A	S	R	G	S	F	F	O
G	F	T	S	R	G	J	D	A	M	H
Y	S	O	G	E	N	O	T	Y	P	E
O	M	N	S	C	V	L	R	G	G	S
C	A	E	M	E	D	E	V	S	S	P
B	R	H	V	S	F	L	Z	D	D	E
H	G	P	N	S	T	P	P	E	E	B
T	N	A	N	I	M	O	D	R	R	L
N	D	A	A	V	D	O	S	C	C	Q
G	Y	P	I	E	P	D	B	Y	Z	I

### MODIFICATIONS

#### Easier

- Provide the *Directional Word Search* with the directions written under the title (p. 15)

#### More Difficult

- Provide the *Directional Word Search* without the directions (p. 15)
- Provide no explanation on how to complete the code

# SHOW ME DIRECTIONAL WORDSEARCH PUZZLE

## Modifications

### EASIER-DIRECTIONS

#### DIRECTIONAL WORD SEARCH

Look for the direction of each word...Right(R), Left(L), Up(U), Down(D)

1. Genotype
2. Phenotype
3. Dominant
4. Recessive

J	T	E	B	O	V	E	C	Y	P	N
Z	K	P	I	G	L	Q	N	F	O	R
W	S	Y	A	S	R	G	S	F	F	O
G	F	T	S	R	G	J	D	A	M	H
Y	S	O	G	E	N	O	T	Y	P	E
O	M	N	S	C	V	L	R	G	G	S
C	A	E	M	E	D	E	V	S	S	P
B	R	H	V	S	F	L	Z	D	D	E
H	G	P	N	S	T	P	P	E	E	B
T	N	A	N	I	M	O	D	R	R	L
N	D	A	A	V	D	O	S	C	C	Q
G	Y	P	I	E	P	D	B	Y	Z	I

1 2 3 4

### HARDER

#### DIRECTIONAL WORD SEARCH

1. Genotype
2. Phenotype
3. Dominant
4. Recessive

J	T	E	B	O	V	E	C	Y	P	N
Z	K	P	I	G	L	Q	N	F	O	R
W	S	Y	A	S	R	G	S	F	F	O
G	F	T	S	R	G	J	D	A	M	H
Y	S	O	G	E	N	O	T	Y	P	E
O	M	N	S	C	V	L	R	G	G	S
C	A	E	M	E	D	E	V	S	S	P
B	R	H	V	S	F	L	Z	D	D	E
H	G	P	N	S	T	P	P	E	E	B
T	N	A	N	I	M	O	D	R	R	L
N	D	A	A	V	D	O	S	C	C	Q
G	Y	P	I	E	P	D	B	Y	Z	I

1 2 3 4

### ANSWER KEY

#### DIRECTIONAL WORD SEARCH

J	T	E	B	O	V	E	C	Y	P	N
Z	K	P	I	G	L	Q	N	F	O	R
W	S	Y	A	S	R	G	S	F	F	O
G	F	T	S	R	G	J	D	A	M	H
Y	S	O	G	E	N	O	T	Y	P	E
O	M	N	S	C	V	L	R	G	G	S
C	A	E	M	E	D	E	V	S	S	P
B	R	H	V	S	F	L	Z	D	D	E
H	G	P	N	S	T	P	P	E	E	B
T	N	A	N	I	M	O	D	R	R	L
N	D	A	A	V	D	O	S	C	C	Q
G	Y	P	I	E	P	D	B	Y	Z	I

1. Right (R)  
2. Up (U)  
3. Left (L)  
4. Down (D)

R U L D  
1 2 3 4

# SHOW ME GENO-PHENO MATCH PUZZLE

## Tips, Tricks, & Modifications

### DIRECTIONS FOR FACILITATOR

The genotype (4 letters) in each of the top four boxes matches a phenotype pictured in the following two lines.

The descriptions of the dominant (**BLACK**, **SOLID**, & **POLLED**) and recessive traits (red, spotted, & horned) are at the end of each line of pictures.

Participants must match the provided genotype to its phenotype. The number written above the correct picture is the number needed for the code.

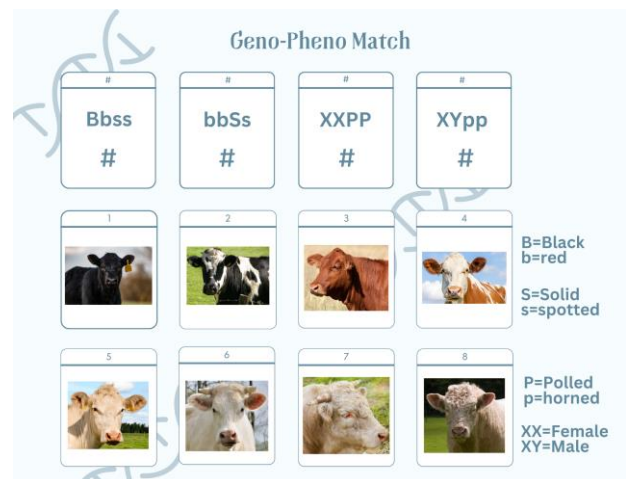
### TIPS & TRICKS

The first two genotype boxes correspond to the first line of the pictures. The last two genotype boxes correspond to the bottom line of pictures.

In the bottom line, the first two pictures are cows (females), and the last two pictures are bulls (males).

The dominant trait of **Polled** (**P**) means the animal does NOT have horns. The recessive trait of horned (**p**) means the animal has horns.

An animal is either female (**XX**) or male (**XY**).



The image shows a 'Geno-Pheno Match' puzzle grid. At the top, four genotype boxes are labeled with numbers 1 through 4: 1. Bbss, 2. bbSs, 3. XXPP, 4. XYpp. Below these are two rows of four cow pictures each, numbered 5 through 8. To the right of the pictures is a legend: B=Black, b=red, S=Solid, s=spotted, P=Polled, p=horned, XX=Female, XY=Male. Hand-drawn blue arrows indicate connections from the genotype boxes to the pictures: from box 1 to picture 1, from box 2 to picture 2, from box 3 to picture 5, and from box 4 to picture 8.

### MODIFICATIONS

#### Easier

- Work through hair color (**BLACK** or red) for each animal first, then go back and work through the pattern (**SOLID** or spotted). Same goes with Polled (**P**) or horned (**p**) pictures. An animal is either female (**XX**) or male (**XY**)
- Give the information provided in the Tips & Tricks to the left

#### More Difficult









- Do not provide any of the information and only provide them as hints, if needed

# SHOW ME GENO-PHENO MATCH PUZZLE

## Answer Key

### ANSWER KEY

**Geno-Pheno Match**

# <b>Bb</b> → <b>BLACK</b> <b>Bbss</b> <b>2</b> <b>ss</b> → <b>spotted</b>	# <b>bb</b> → <b>red</b> <b>bbSs</b> <b>3</b> <b>Ss</b> → <b>SOLID</b>	# <b>XX</b> → <b>Female</b> <b>XXPP</b> <b>5</b> <b>PP</b> → <b>POLLED</b>	# <b>XY</b> → <b>Male</b> <b>XYpp</b> <b>7</b> <b>pp</b> → <b>horned</b>
1 	2 	3 	4 
5 	6 	7 	8 

**B=Black**  
**b=red**

**S=Solid**  
**s=spotted**

**P=Polled**  
**p=horned**

**XX=Female**  
**XY=Male**

# SHOW ME PHENO-GENO MATCH PUZZLE

## Tips, Tricks, & Modifications

### DIRECTIONS FOR FACILITATOR

The calf in the middle shows the phenotype of the animal. It is **BLACK** (dominant) and **SOLID** (dominant).

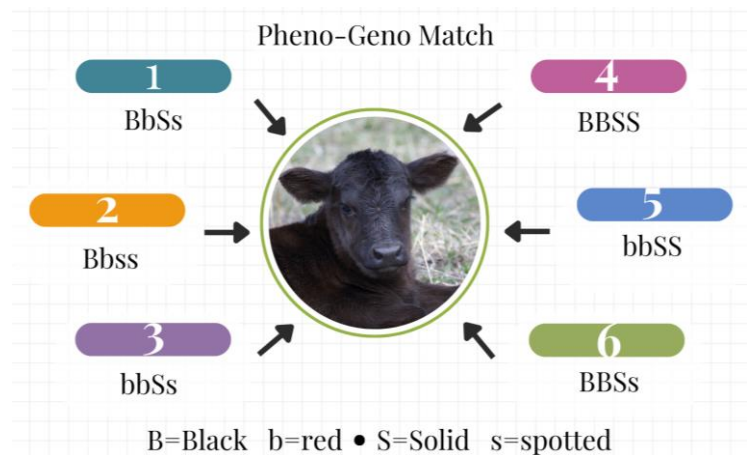
Participants must match the genotypes (4 letters) surrounding the calf that could result in the phenotype of the pictured calf. The number written above the correct genotypes are the numbers needed for the code.

The descriptions of the dominant (**BLACK** and **SOLID**) and recessive (red and spotted) alleles are below the picture of the calf.

### TIPS & TRICKS

Both recessive and dominant genes can be passed down; therefore, a phenotypic black calf could have the genotype BB or Bb.

Participants may benefit from working through one of the genotypes listed to see if it is a possible match.



### MODIFICATIONS

#### Easier

- Work through hair color (**BLACK**) and circle the potential genotypes. Then figure out which of those genotypes would result in the correct pattern (**SOLID**)

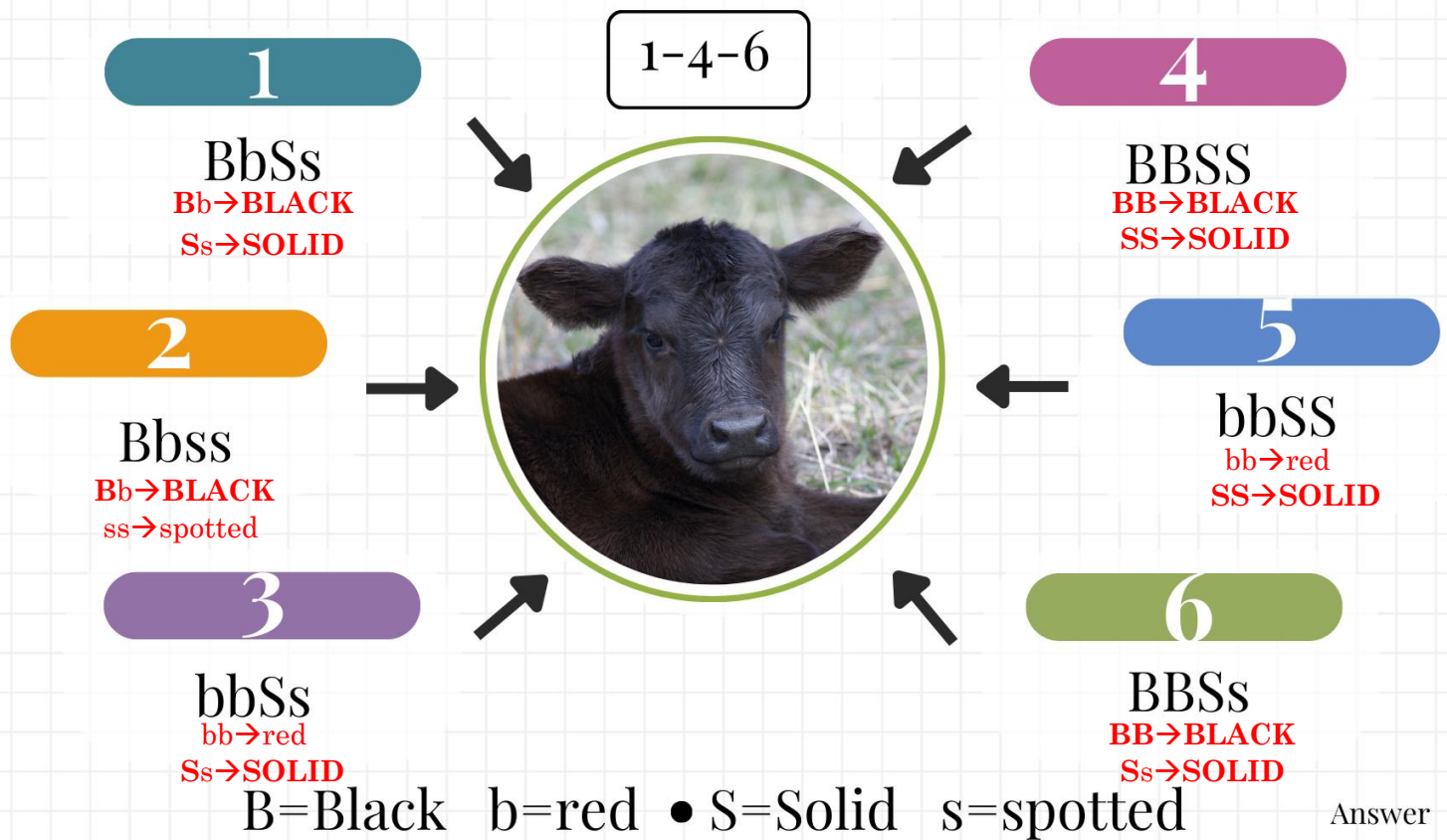
#### More Difficult

- Do not provide any of the information and only provide them as hints, if needed

# SHOW ME PHENO-GENO MATCH PUZZLE

## Answer Key

### ANSWER KEY



# SHOW ME

## ADDITIONAL TEACHER RESOURCES

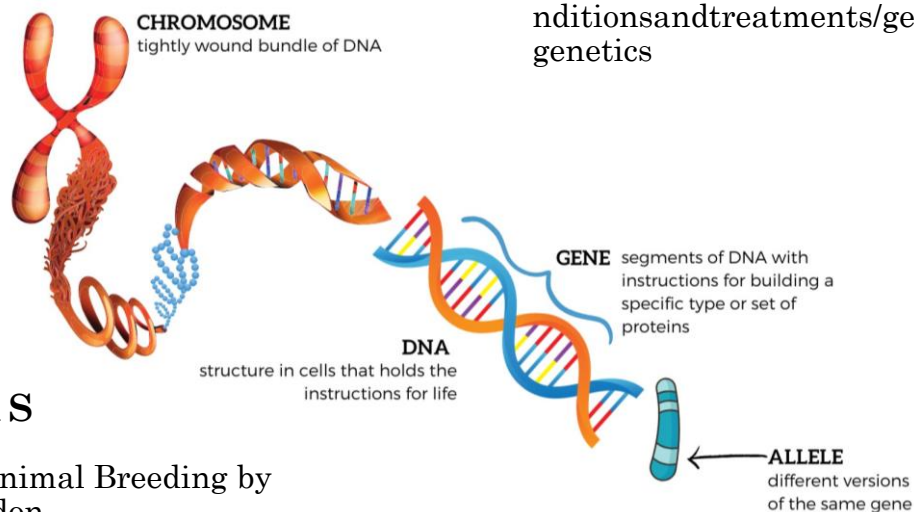
**Genetics - the study of how the dam (mom) and the sire (dad) pass pieces of themselves to their offspring (babies). The baby gets half of it's DNA (alleles) from mom and half from dad.**

### BOOKS

- Endless Forms Most Beautiful: The New Science of Evo Devo and the Making of the Animal Kingdom by Sean B. Carroll
- Who We Are and How We Got Here: Ancient DNA and the New Science of the Human Past by David Reich
- Genome: The Autobiography of a Species in 23 Chapters by Matt Ridley
- The Gene: An Intimate History by Siddhartha Mukherjee

### WEBSITES

- <https://learn.genetics.utah.edu/content/basics/>
- [Biointeractive.org/classroom-resources](https://www.biointeractive.org/classroom-resources)
- <https://www.ck12.org/book/ck-12-life-science-for-middle-school/section/6.2/>
- <https://www.technologynetworks.com/genomics/articles/genotype-vs-phenotype-examples-and-definitions-318446>
- [www.pbs.org/show/gene/](http://www.pbs.org/show/gene/)
- [www.betterhealth.vic.gov.au/health/conditionsandtreatments/genes-and-genetics](http://www.betterhealth.vic.gov.au/health/conditionsandtreatments/genes-and-genetics)



### TEXTBOOKS

- Understanding Animal Breeding by Richard M. Bourdon

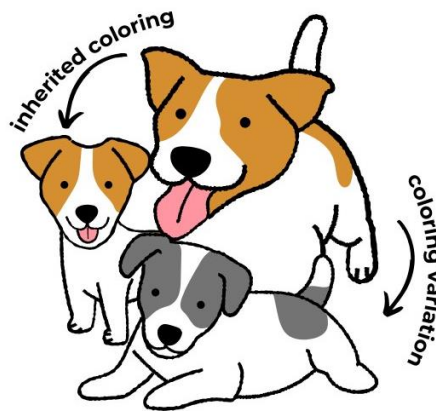
# SHOW ME

## ADDITIONAL STUDENT RESOURCES

**Genetics - the study of how the dam (mom) and the sire (dad) pass pieces of themselves to their offspring (babies). The baby gets half of it's DNA (alleles) from mom and half from dad.**

### BOOKS (AGES)

- You Share Genes With Me by Ariana Killoran (1-5yrs)
- Genetics for Smart Kids by Carlos Pazos (4-8yrs)
- The One & Only Me – A Book About Genes by Ariana Killoran (4-8yrs)
- The Secret Code Inside You by Rajani LaRocca (4-8yrs)
- The DNA Book (The Science Book Series) by Professor Alison Woollard & Dr. Sophie Gilbert (7-9yrs)
- Genetics: Breaking the Code of Your DNA by Carla Mooney (12-15yrs)
- Genome: The Autobiography of a Species in 23 Chapters by Matt Ridley (High School)
- The Gene: An Intimate History by Siddhartha Mukherjee (High School)



*Coloring variation due to inheritance of a different version of the gene or allele*

### WEBSITES

- <https://kids.britannica.com/kids/article/genetics/353170>
- [https://kmos.pbslearningmedia.org/subjects/science/life-science/?rank\\_by=recency](https://kmos.pbslearningmedia.org/subjects/science/life-science/?rank_by=recency)
- <https://humanorigins.si.edu/education>



# SHOW ME GLOSSARY

**Genetics - the study of how the dam (mom) and the sire (dad) pass pieces of themselves to their offspring (babies). The baby gets half of it's DNA (alleles) from mom and half from dad.**

**Allele:** each gene has two parts, one from each parent; a particular version of a gene

**Cell:** the unit with the basic properties of life

**Chromosome:** threadlike structure in a cell's nucleus that contains DNA. Bacterial chromosomes are loops of DNA and are not in a nucleus

**DNA (deoxyribonucleic acid):** genetic information inside the cells of the body that helps make living things who they are

**Double Helix:** shape of the DNA molecule, like a ladder twisted to the right

**Dominant:** the allele that is always expressed, always there, represented by UPPERCASE letters

**Genes:** a part of the chromosome that contains the instructions for a trait

**Genome:** complete set of the DNA in a living thing

**Genotype:** the inherited combination of alleles

**Heredity:** the passing of traits from parent to offspring

**Heterozygous:** when the two alleles an organism has at a given locus are not the same

**Homozygous:** when the two alleles an organism has at a given locus are the same

**Inheritance:** characteristics received from parents through the passing on of their genes. The process of inheritance is called heredity

**Locus:** the specific physical location of a gene or other DNA sequence on a chromosome

**Phenotype:** the organism's appearance

**Recessive:** the allele that is not always expressed, it recedes into the background, represented by lowercase letters

**Trait:** distinguishing characteristics

# SHOW ME REFERENCES

**Genetics - the study of how the dam (mom) and the sire (dad) pass pieces of themselves to their offspring (babies). The baby gets half of it's DNA (alleles) from mom and half from dad.**

## WEBSITES

- <https://learn.genetics.utah.edu/content/basics/>
- [biointeractive.org/classroom-resources](http://biointeractive.org/classroom-resources)
- <https://www.ck12.org/book/ck-12-life-science-for-middle-school/section/6.2/>
- <https://www.technologynetworks.com/genomics/articles/genotype-vs-phenotype-examples-and-definitions-318446>
- [www.pbs.org/show/gene/](http://www.pbs.org/show/gene/)
- [www.betterhealth.vic.gov.au/health/conditionsandtreatments/genes-and-genetics](http://www.betterhealth.vic.gov.au/health/conditionsandtreatments/genes-and-genetics)
- <https://kids.britannica.com/kids/article/genetics/353170>
- [https://kmos.pbslearningmedia.org/subjects/science/life-science/?rank\\_by=recency](https://kmos.pbslearningmedia.org/subjects/science/life-science/?rank_by=recency)
- <https://www.nationalgeographic.com/magazines/pdf/SingleIssue/YourGenes.pdf>

## BOOKS

- Genetics for Smart Kids by Carlos Pazos
- The One & Only Me – A Book About Genes by Ariana Killoran
- The DNA Book (The Science Book Series) by Professor Alison Woollard & Dr. Sophie Gilbert
- Understanding Animal Breeding by Richard M. Bourdon

# SHOW ME FUN FACTS

**Genetics - the study of how the dam (mom) and the sire (dad) pass pieces of themselves to their offspring (babies). The baby gets half of it's DNA (alleles) from mom and half from dad.**

## Number of Chromosomes

People: 46  
Cattle: 60  
Pigs: 38  
Sheep: 54  
Goats: 60  
Chickens: 78  
Dogs: 78  
Cats: 38

## Genetic similarity to humans

Each other: 99.9%  
Chimps: 98.8% (our closest living relative)  
Dogs: 94%  
Cats: 90%  
Cows: 80%  
Fruit flies: 60%  
Bananas: 60%

It's important to note that genes make up just 2% of DNA; therefore, something that is 50% genetically similar to humans may only share a fraction of their DNA

## Dominant Alleles vs. Recessive Alleles (in humans)

Brown eyes over blue  
Brown hair over blond  
Right-handedness over left-handedness  
Unattached earlobes over attached  
Color vision over color blindness  
Double-jointedness over normal  
Able to curl tongue over not

- If one human strand of DNA was unraveled, it would be about 6 feet long
- If all DNA strands in all the cells of one person were stretched out, it would reach to the sun and back more than 600 times
- All humans receive 3 feet of DNA from Dad and 3 feet from Mom
- The number of proteins an allele produces determines whether it is dominant or recessive
- Bone marrow transplant patients end up with 2 different DNA profiles
- Heart, eye, and brain cells never replicate; therefore, they can never be replaced if damaged
- DNA replication begins at multiple locations along the chromosome to speed up the copying process
- Less than 2% of our DNA codes for proteins - the rest is called "junk DNA," but is still useful
- Scientists can never clone a dinosaur because DNA has a half-life of 521 years
- A mouse uses more DNA from its father than its mother
- Almost all tortoiseshell cats are female, only one in 3,000 calico cats is male

# SHOW ME **GENETIC LOCKBOX**

Thanks so much for checking out our Genetic Lockbox! Following your event, please take a moment and let us know how the event went. Your honest feedback is invaluable to us, and we genuinely appreciate the time you take to complete the survey. If you encounter any issues, have questions, or need replacements, please don't hesitate to contact us.



*Heather Conrow*  
Livestock Specialist  
MU Extension  
600 W. Morrison, Suite 17  
Fayette, MO 65248  
O: 660.248.2272  
E: [hconrow@missouri.edu](mailto:hconrow@missouri.edu)  
W: [extension.missouri.edu/howard](http://extension.missouri.edu/howard)

*Robin Dianics, JM, MBA, PMP*  
Associate Director Research Administration  
Ellis Fischel Cancer Center  
University of Missouri & MU Health Care  
O: 573.882.3987  
E: [dianicsr@umsystem.edu](mailto:dianicsr@umsystem.edu)

SHOW ME  
**GENETIC LOCKBOX**

**THANK YOU!**

Funding provided by  
University of Missouri Ellis Fischel Cancer Center