



# Animal Breeding & Genetics

## Genetics

### Grade Level

9-12

### Lesson Length

3 periods x 55 minutes

### STEM Careers

Beef Reproduction Sales Rep,  
Geneticist

### Nebraska Science Standards

SC12.3.2.d Describe that sexual reproduction results in a largely predictable, variety of possible gene combinations in the offspring of any two parents

### Next Generation Science Standards

HS-LS3-2 Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

### Large Animal Management Standards

AFNR.HS.2.4. Apply principles of animal reproduction to achieve desired outcomes for performance, development and/or economic production.

*These lessons aim to bring the science, skills of inquiry, critical thinking, and problem solving to life through an agricultural context.*



## Learning Objectives

By the end of the unit, students should be able to:

- Determine traits of an offspring based on genetic information from chromosomes.
- Relate the genotype to the phenotype of a trait.
- Determine the mathematical probability of the genotype and the phenotype of offspring.

## Materials List – (per student team)

Amoeba Sisters worksheet  
Large marshmallows  
Mini marshmallows, colored  
Multi colored thumbtacks  
Blue pipe cleaners  
Toothpicks  
Colored toothpicks  
Sire directories

## Preparation

- Print Rebops instructions, Amoeba Sisters video worksheet & lab reports
- Collect, organize, and prepare materials to be used for the Rebops.



## ***Introduction (Interest Approach)***

Anonymously poll the class...

- 1) Can you roll your tongue? Yes or No
- 2) Can your parents roll their tongue? Yes or No
- 3) Do you have hair between the knuckles on your finger? Yes or No
- 4) Do your parents have hair between the knuckles on their fingers? Yes or No

These are just 2 examples of inherited traits in humans. Have them in pairs or groups then jot down all of these possible traits that are inherited in humans.

## ***Essential Questions***

- How are traits passed from parents to offspring?
- How do we use genetics to make improvements in animal performance?

## ***Learning Activity 1: Understanding Basic Genetics***

Encourage students to complete the worksheet while watching the Amoeba Sisters video Monohybrids and the Punnett Square Guinea Pigs.

Worksheet

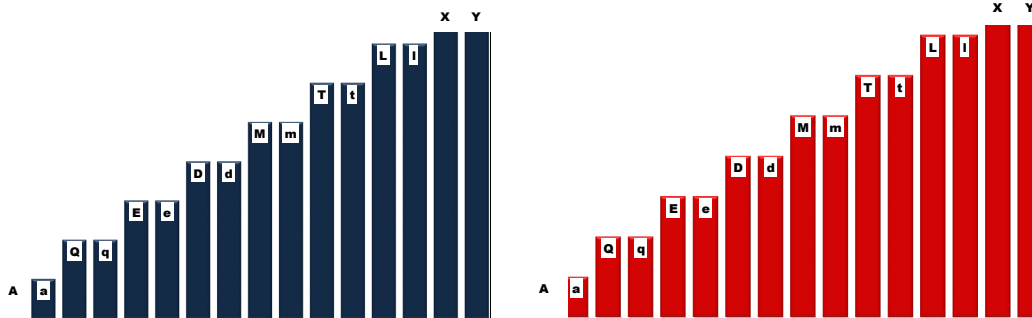
[https://www.amoebasisters.com/uploads/2/1/9/0/21902384/video\\_recap\\_of\\_mendelian\\_monohybrid\\_cross\\_by\\_amoeba\\_sisters.pdf](https://www.amoebasisters.com/uploads/2/1/9/0/21902384/video_recap_of_mendelian_monohybrid_cross_by_amoeba_sisters.pdf)

Video

<https://www.youtube.com/watch?v=i-0rSv6oxSY&list=PLJs6OhQQvXtOHVxnDzPUGew47XFhkiHwR>

## Learning Activity 2: Rebops

1. Create the eight gene pairs listed including the sex chromosomes. All eight gene pairs should be cut at different lengths. Each chromosome should have its partner cut at the same length. Each parent will have a heterozygous pair of genes, the sire's genes are blue, and the dam's genes are red.



Use the following traits:

Physical trait	Genes	Supply
Antenna	Aa	Thumbtacks
Nose	Qq	Colored Mini Marshmallow: pink, orange or yellow
Eyes	Ee	Thumbtacks or push pins
Body Segments	Bb	Large Marshmallows
Humps	Mm	Green Mini Marshmallows
Tail	Tt	Pipe Cleaner
Legs	Ll	Toothpicks
Sex	XX or XY	

2. Students should work in pairs for this exercise, with each individual building their own Rebop. Each student pair should start with a Sire and Dam Rebop set of chromosomes. Students will select one chromosome from the sire (blue) and one from the dam (red) for each gene pair. This mimics fertilization, where one trait is inherited from each parent, and will result will be a 'genetic code' for their Rebop. (Every student will likely end up with a different genetic code for their Rebop. However, in the event that there two identical Rebop babies...they have twins!)

3. Record the genotype and phenotype of your Rebop.

Genotype	Phenotype

Rebop Decoder Key	
Antenna	AA – one antenna Aa – two antenna aa – zero antenna
Nose	QQ – red nose Qq – orange nose qq – yellow nose
Eyes	EE – 3 eyes Ee – 3 eyes ee – 2 eyes
Humps	MM – 3 green humps Mm – 3 green humps mm – 2 green humps
Tail	TT – curly tail Tt – curly tail tt – straight tail
Legs	LL – blue legs Ll – blue legs

	ll – red legs
Sex	XX – female XY - male

- Each member of the pair now has a Rebop. Hopefully, one is a male and one is female. Using the genotypes of your Rebops, construct Punnett squares to determine the antenna, nose, eyes, body segments, humps, tail, legs, and sex of the possible offspring that may result from this pair.

Extension: Create a dihybrid Punnett square using their own Rebop and someone else's as the mate.

### ***Learning Activity 3: Using a Sire Directory***

- Choose a problematic genetic trait in cattle. (i.e. BRD, TH)
- Work to complete the Lab Report and choose a suitable sire to mate with your cow that has this genetic trait.



## ***Reflection***

Using the prompt below to facilitate reflection, allow each student to respond in writing to the prompts and then facilitate a whole class discussion.

- How does inheritability of traits affect a producer when making choices related to breeding such as bulls to buy, semen to purchase, or heifers to retain?



## ***Apply***

Use the prompt below to facilitate small group and whole class discussion.

- How is the information we studied used every day by companies like ABS, Genex, etc?
- What is the financial impact from using this genetic information in livestock production?
- What moral/ethical issues could arise if humans know the genetic make-up of their baby prior to birth?

## References:

[https://www.amoebasisters.com/uploads/2/1/9/0/21902384/video\\_recap\\_of\\_mendelian\\_monohybrid\\_cross\\_by\\_amoeba\\_sisters.pdf](https://www.amoebasisters.com/uploads/2/1/9/0/21902384/video_recap_of_mendelian_monohybrid_cross_by_amoeba_sisters.pdf)

<https://www.youtube.com/watch?v=i-0rSv6oxSY&list=PLJs6OhQQvXtOHVxnDzPUGew47XFhkiHwR>

<https://communities.naae.org/docs/DOC-1391>

# Rebop Guidelines

## Objectives:

- Determine traits of an offspring based on genetic information from chromosomes.
- Relate the genotype to the phenotype of a trait.
- Determine the mathematical probability of the genotype and the phenotype of offspring.

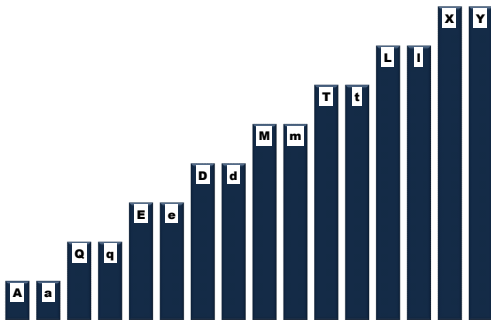
## Instructor Notes & Preparation:

1. Purchase the needed supplies.
2. Make needed copies.

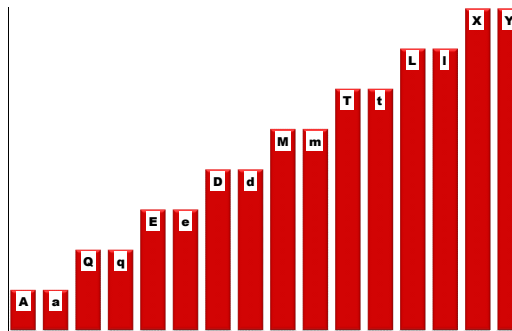
## Procedures:

1. Create the eight gene pairs listed including the sex chromosomes. All eight gene pairs should be cut at different lengths. Each chromosome should have its partner cut at the same length. Each parent will have a heterozygous pair of genes, the sire's genes are blue, and the dam's genes are red.

**REBOP- Sire**



**REBOP - Dam**



Use the following traits:

<u>Physical trait</u>	<u>Genes</u>	<u>Supply</u>
Antenna	Aa	Thumbtacks
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Sex	XX or XY	

- Students should work in pairs for this exercise, with each individual building their own Rebop. Each student pair should start with a Sire and Dam Rebop set of chromosomes. Students will select one chromosome from the sire (blue) and one from the dam (red) for each gene pair. This mimics fertilization, where one trait is inherited from each parent, and will result will be a 'genetic code' for their Rebop. (Every student will likely end up with a different genetic code for their Rebop. However, in the event that there two identical Rebop babies...they have twins!)
- Record the genotype and phenotype of your Rebop.

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Sex	XX – female XY - male

4. Each member of the pair now has a Rebop. Hopefully, one is a male and one is female. Using the genotypes of your Rebops, construct Punnett squares to determine the antenna, nose, eyes, body segments, humps, tail, legs, and sex of the possible offspring that may result from this pair.

# Rebops

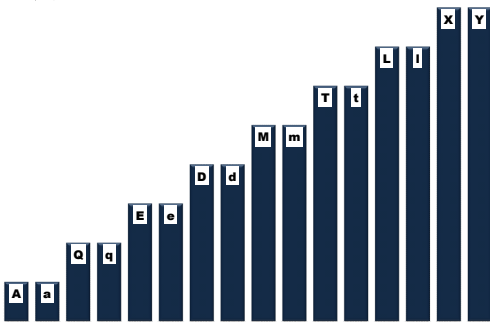
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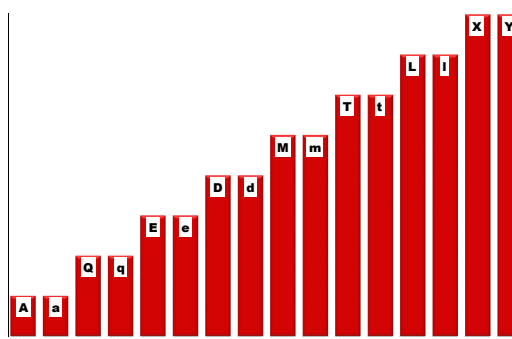
## Your Task:

1. Create the eight gene pairs listed including the sex chromosomes. All eight gene pairs should be cut at different lengths. Each chromosome should have its partner cut at the same length. Each parent will have a heterozygous pair of genes, the sire's genes are blue, and the dam's genes are red.

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Name:

# ***Lab Report***

**Please complete the following report during the design and implementation of your experiment.**

## Research Problem

- Describe what you are investigating and justify why you are investigating the problem.

## Hypothesis

- Formulate one or more hypotheses for your experiment.

## Procedures

- Create the steps you will follow for your experiment.

## Data Collection

- Describe the data that you will collect during your experiment.
- Provide graphs, tables, charts, and raw data as necessary.

## Results

- Explain your results.

## Conclusion

- Based on your data:
  - What can you conclude?
  - Were your hypotheses supported?
  - Were there limitations to your experiment?
  - What are new research questions that derived from this study?