Monster Mash-Up of Genetics

Created by Lindsey Evans, Brian Glasby, and Judy McDonald

Focus on Inquiry

The students will collect data about genetics of an individual monster and create a model demonstrating the probability of traits in the offspring.

Lesson Content Overview

Students will participate in determining traits of a monster by throwing a die. Students will develop an understanding of how genetics play a role in determining the phenotype of an individual.

Duration	Setting	Grouping	PTI Inquiry Subskills
45-60 minutes	Classroom	Individual, Pairs	1.1, 3.1, 3.7, 4.2, 4.3, 4.4, 5.2, 5.3, 5.4, 5.6, 5.7, 5.8, 5.9, 7.2, 7.3, 7.4

Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage	5 min	1.1, 5.2	laptop, YouTube	2	Begin by showing video clip, recognizing genetic information is passed from one generation to the next.
Explore	15 min	3.1, 3.7, 4.2, 4.3	countdown timer app	3	Students collect data, creating a monster through various trait stations based on random assignment.
Explain	10 min	5.3, 5.4, 7.2, 7.3, 7.4	none	2	Students answer questions based on their monster offspring.
Expand	10 min	4.4, 5.6, 5.7, 5.8	none	2	Using their data, students will determine the probability of specific traits and predict what their offspring would look like.
Evaluate	5 min	5.6, 5.9	none	1	Students check their understanding as a formative assessment (ticket out the door).

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

Next Generation Science Standards – Inquiry

NGSS Practice 1: Asking questions and defining problems
NGSS Practice 2: Developing and Using Models
NGSS Practice 3: Planning and Carrying Out Investigations
NGSS Practice 4: Analyzing and Interpreting Data
NGSS Practice 5: Using mathematics and computational thinking
NGSS Practice 6: Constructing explanations
NGSS Practice 7: Engaging in arguments from evidence
NGSS Practice 8: Obtaining, Evaluating and Communicating Information

Next Generation Science Standards – Life Science

MS-LS3-2 Variations of inherited traits between parent and offspring arise from genetic differences.

Florida Science Standards – Nature of Science

SC.7.N.3.2: Identify the benefits and limitations of the use of scientific model.

Florida Science Standards – Life Science

SC.7.L.16.2: Determine the probabilities for genotype and phenotype combination using Punnett squares and pedigrees.

Materials and Advance Preparation

Materials List

Class set:

- Minimum of two sets of dice per station
- Container of brown crayons at the fur/spikes station
- Container of red/yellow crayons for eye station
- One set of place markers (**Blackline Masters #1a-f**) for each of the 6 traits stations
- Classroom timer (recommend www.online-stopwatch.com/countdown-timer/)

Student materials:

- Monster Pieces Templates (**Blackline Master #2**, as many as needed for students)
- Lab Sheet (**Blackline Master #3**, 2 pages in length, 1 copy per student)
- Reference Sheet of Each Station (**Blackline Master #4,** 1 copy per student)
- Check For Understanding (**Blackline Master #5**, 1 copy per student)
- Scissors, Glue Stick
- Crayons – red and yellow are needed for eyes; other colors are optional

Blackline Masters

1. **Place markers for each trait (Blackline Masters #1a-f)**
2. **Drawings of the six traits "Monster Pieces Templates" (Blackline Master #2)**
3. **Genetic Mash-Up Lab with Data Table (Blackline Master #3)**
4. **Reference Sheet for Each Station (Blackline Master #4)**
5. **Check for Understanding: Evaluation (Blackline Master #5)**

Advance Preparation

1. Prepare labels to identify each station.
2. Place dice and crayons at appropriate station for fur and eye color.
3. Place glue, scissors and phenotype pieces (in envelopes labeled with type of phenotype) at appropriate stations.
4. Run copies of **Blackline Masters #2, #3, #4, #5** for each student.

Lesson Information

Learning Objectives

1. The students will be able to use the data collected in this lesson to correctly determine the probabilities for genotype and phenotype combinations using Punnett squares.
2. In partners, the students will be able to correctly state, based on their data, what their offspring would look like based on their alleles.

Prior Knowledge Needed by the Students

- General familiarity with probability and Punnett squares. General understanding with content-specific vocabulary; *genotype, phenotype, dominant, recessive, heterozygous, homozygous.*

Background Information

Gregor Mendel, an Austrian monk, is known as the father of genetics. After much success with his now famous pea plant experiment, Mendel found that traits are equally inherited by both parents, with a possibility of certain traits skipping a generation. Traits can be expressed through alleles, various forms of a gene. Dominant alleles are more dominant, taking over the recessive alleles, which are more recessive. Dominant alleles can also mask or hide the recessive alleles in many circumstances, which explains Mendel's conclusion of certain traits skipping a generation. An example of this is when two parents with brown eyes may produce a child with blue eyes. The genotype is the actual alleles of an organism's particular trait (ex. FF), while the phenotype is the observed trait that we see (brown hair).

Background References for Further Reading

O'Neil, D. (1997-2013). Mendel's Genetics. Obtained March 30, 2015, http://anthro.palomar.edu/mendel/mendel_1.htm

Lesson Procedure

Engage

1. To introduce the lesson, watch a short video (pause at 1 min 43 sec) of genetics, introducing Gregor Mendel's famous pea plant experiment and what a Punnett square looks like. (https://m.youtube.com/watch?v=Mehz7tCxjSE) The video should be loaded ahead of time because there may be advertisements. In addition please be on the lookout for "pop up" ads while the video is playing. The entire video clip of how the Punnett square works is 3:06 of how the Punnett square works. However, it will be used as a previewing strategy and will not be shown in its entirety until later in the lesson (Between the Explain and Expand would be a good time).
   Some questions you might ask students include:
   - ***Why do you think in the video we had to go back in time to understand genetics?***
     - *Sample answers: We had to go back in time because: genetics was discovered back then, you get your genes from your grandparents, or various answers using evidence from the video clip.*
   - ***What is another name for "factors"?***
     - *Sample answers: characteristics, genes, traits*
   - ***What is an example from the video of a phenotype?***
     - *Sample answers: yellow, green, round, wrinkled*
   - ***What is an example from the video of a genotype?***
     - *Sample answers: YY, yy, Yy*
   - ***How can you compare and contrast phenotype and genotype?***
     - *Sample answers: phenotype is what is looks like or what you see, physical traits etc…genotype would be the genetics, genes or letters used to represent*

Explore

1. Go over the directions at the top of the lab sheet **(Blackline Master #3)**. Model how to roll the die and how to record the data on the lab sheet. Discuss what to do when rolling a number, matching it to each station guide. Emphasize to students that the die should stay on the top of the desks and off the floor.
2. Assign students to their starting stations. Make sure students push in their chairs and stow their backpacks so that tripping hazards are minimized. Allow data collection to take about 15 minutes (put a countdown timer on the board). Circulate around the room to make sure that students are properly recording their data.

Explain

1. Give the students 5 minutes (reset countdown timer) to answer the questions on their lab sheet. (**Blackline Master #3**)
2. Once the 5 minutes are up, then go over those questions together and answer them aloud as a class.
   - ***Why do you think there are two letters for each trait?***
     - *Sample answers: one from each parent*
   - ***Why are some letters capitalized and some are lower case?***
     - *Sample answers: one is for dominant traits, the other represents recessive*
   - ***What are some similar and different phenotypes between your monster and your lab partner's monster?***
     - *Sample answer: various answers showing similarities/differences such as: same size nose or different eye color*
   - ***Explain why you think that your monster and your lab partner's monster are different?***
     - *Sample answers: they could have different parents, rolled different numbers or different genes*
3. Some questions you might ask students include:
   - *Give a possible reason why some stations had 2 different phenotypes and another had 3 phenotypes. (Teacher can introduce co-dominance for advanced classes)*
   - *Describe the relationship between genotype and phenotype.*
   - *What does rolling the dice simulate?*

- *Give examples of human phenotypes?*
- *If you were to do this same activity again, do you think you would get the same monster?*
- *Can you summarize the monster activity and explain how it relates to Mendel's pea plants?*

Expand

1. Working with another student, use your data to complete six Punnett squares to determine what the probability of the offspring would look like.
    a. After your monster falls in love with your lab partner's monster they have a little monster baby. Complete the following six Punnett Squares to determine what the probability of the offspring would look like.
    b. Students will share their genotypes to complete the Punnett squares, have them use the reference sheet (**Blackline Master #4**) if they need help identifying their genotypes.
2. If time allows you can have the students draw a picture of what their offspring might possibly look like.

Evaluate

FORMAL EVALUTION

1. Have students individually complete: Checking for Understanding Handout (Ticket out the Door: 4 questions) (**Blackline Master #5**)
   Answer Key: 1. 50% 2. D 3. C 4. B
2. Grade lab sheet.

INFORMAL or OPTIONAL EVALUTIONS

1. Students create a picture of their offspring based on Punnett Square data.
2. Check lab sheets during the lab to assess student ability to correctly and accurately collect data.

WRAP UP

1. Bring the lesson to a conclusion by completing the TED movie that we used for engaging students. The video should be loaded ahead of time because there may be advertisements. In addition please be on the lookout for "pop up" ads while the video is playing.
2. Another option would be to have students exchange their Check For Understanding Handout and correct the answers together. If the partner got a question wrong, the other partner would coach of the correct answers.

Supplementary Resources

Teachers

Genetics. Retrieved from www.nclark.net/Genetics
Activities, labs, and links associated with the realm of genetics.

Students

The Tech, Museum of Innovation. Retrieved from http://genetics.thetech.org/online-exhibits
Fun, interactive games for students to practice and deepen knowledge.

CITATION OF SOURCES.

Widow's Peak Picture. Retrieved from http://mdk12.org/assessments/high_school/look_like/2007/biology/guide/g32.html on May 13, 2015.

__✓__ Yes, I cited all materials and resources used in this lesson.

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Judy McDonald
Lesson author signature

Blackline Master #1a

MONSTER EYES

Roll of the Die	Genotype	Phenotype
1 or 2	**EE**	**Red Eyes**
3 or 4	Ee	Red Eyes
5 or 6	**ee**	**Yellow Eyes**

Blackline Master #1b

MONSTER NOSE

Roll of the die	Genotype	Phenotype
1 or 2	**NN**	**Large Nose**
3 or 4	Nn	Large Nose
5 or 6	**nn**	**Small Nose**

Blackline Master #1c

MONSTER CLAWS

Roll of the die	Genotype	Phenotype
1 or 2	**AA**	**Claws**
3 or 4	Aa	Claws
5 or 6	**aa**	**No Claws**

MATH + PARTN

Blackline Master #1d

MONSTER SPIKES OR FUR

Roll of the die	Genotype	Phenotype
1 or 2	**FF**	**Fur**
3 or 4	Ff	Fur
5 or 6	**ff**	**Spikes**

Blackline Master #1e

MONSTER MOUTH

Roll of the die	Genotype	Phenotype
1 or 2	**TT**	**One Mouth**
3 or 4	Tt	One Mouth
5 or 6	**tt**	**Two Mouths**

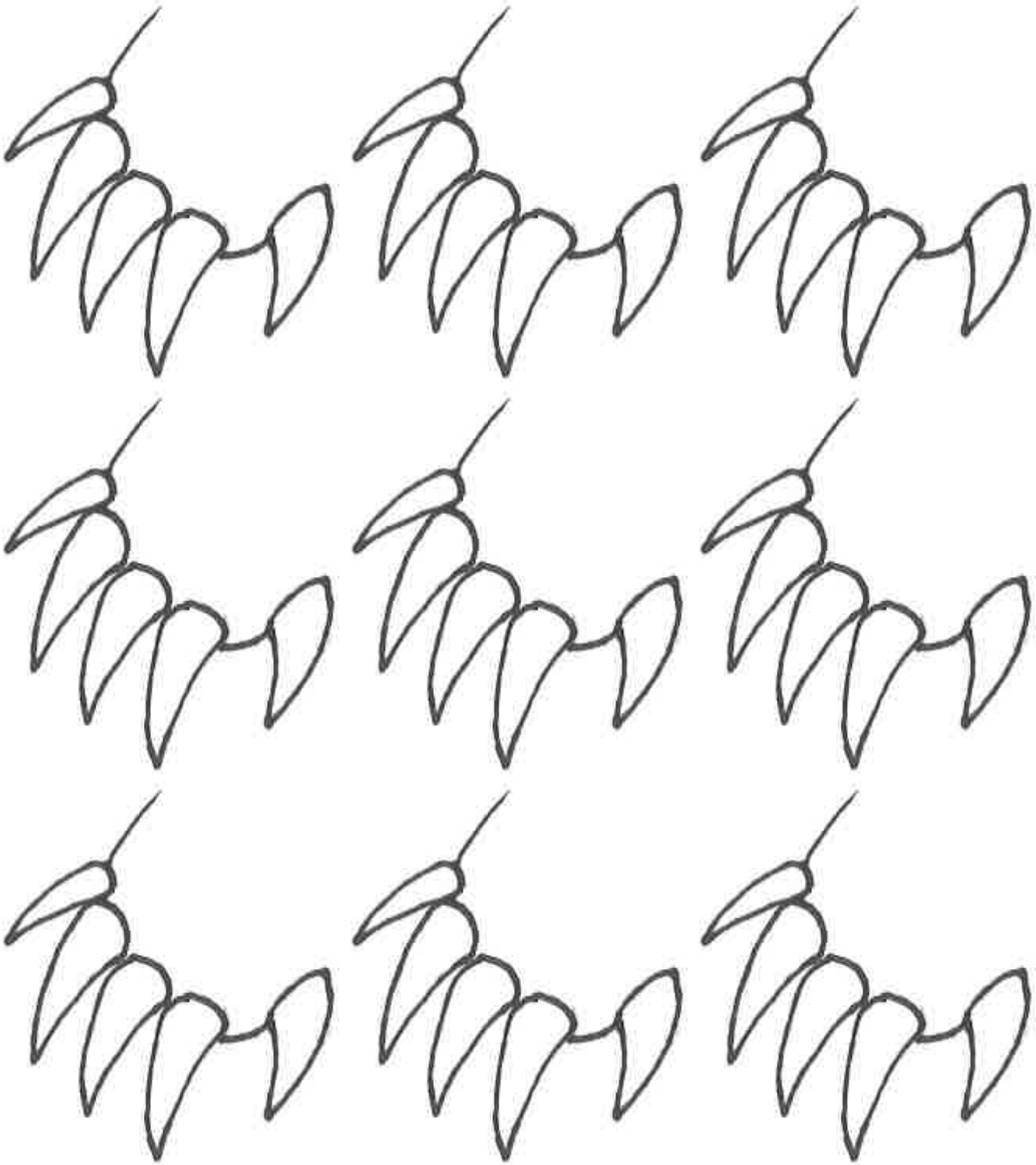
Blackline Master #1f

MONSTER HORNS

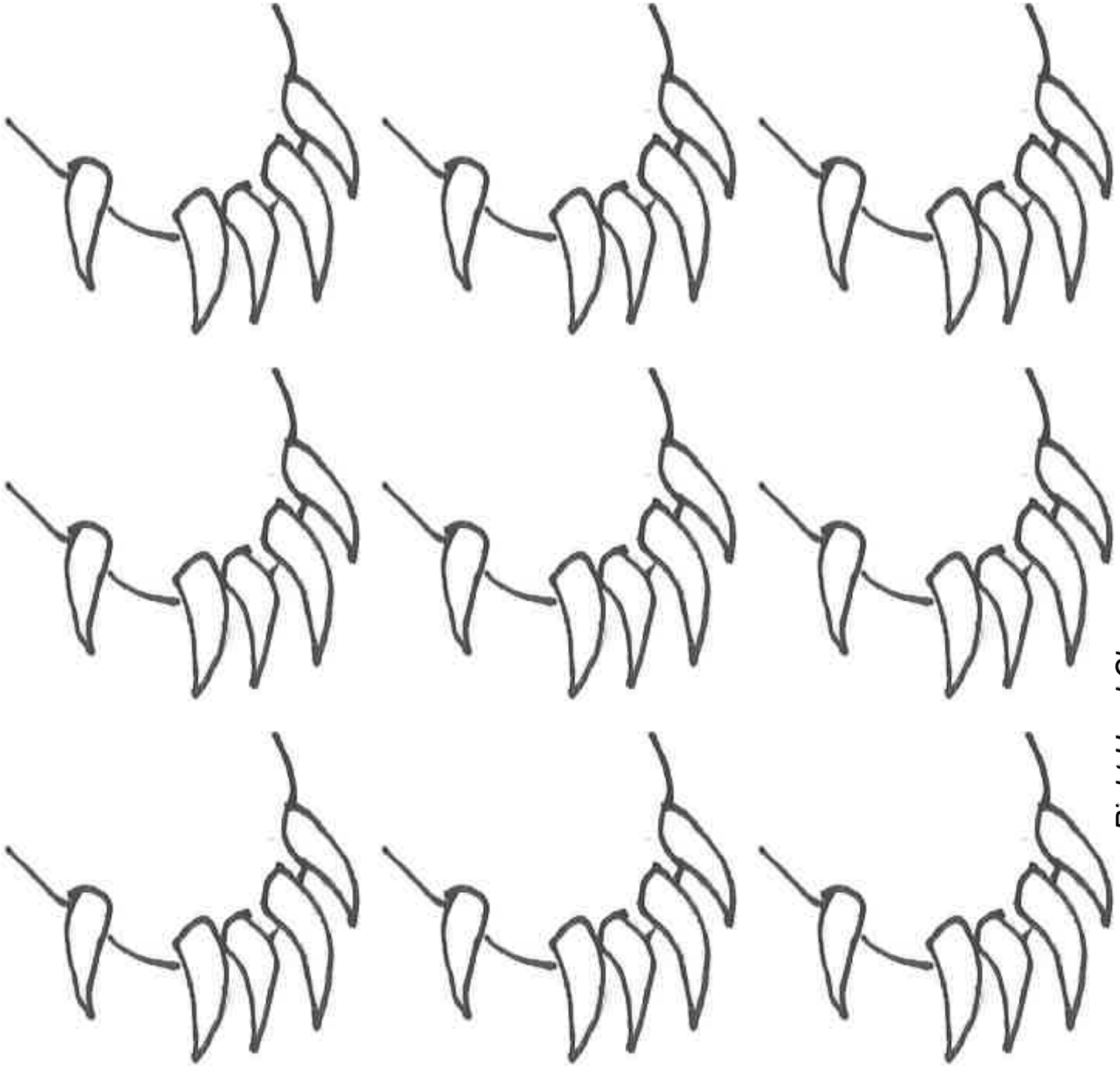
Roll of the die	Genotype	Phenotype
1 or 2	**HH**	**Horns**
3 or 4	Hh	Horns
5 or 6	**hh**	**No Horns**

Blackline Master #2

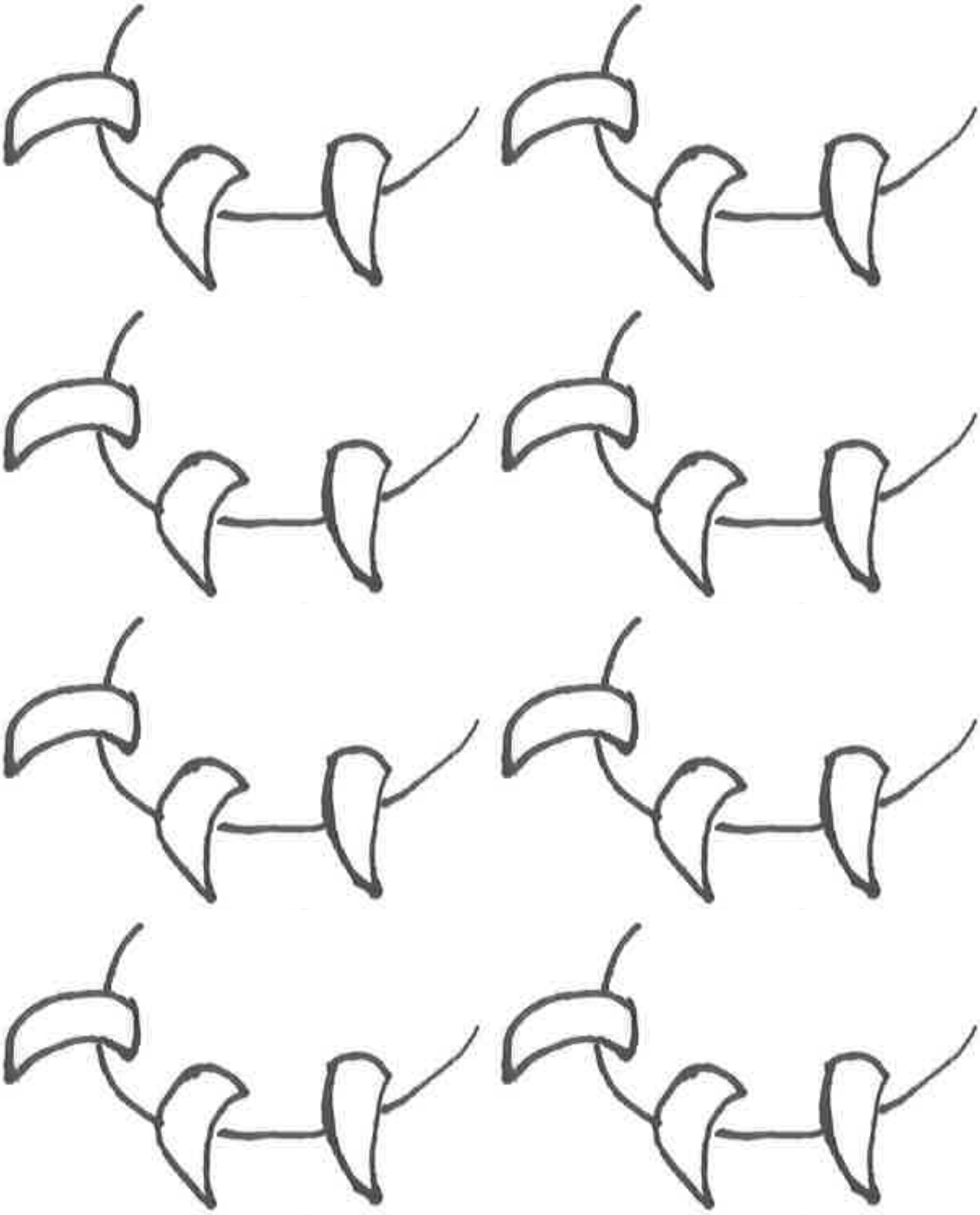
Monster Pieces Templates



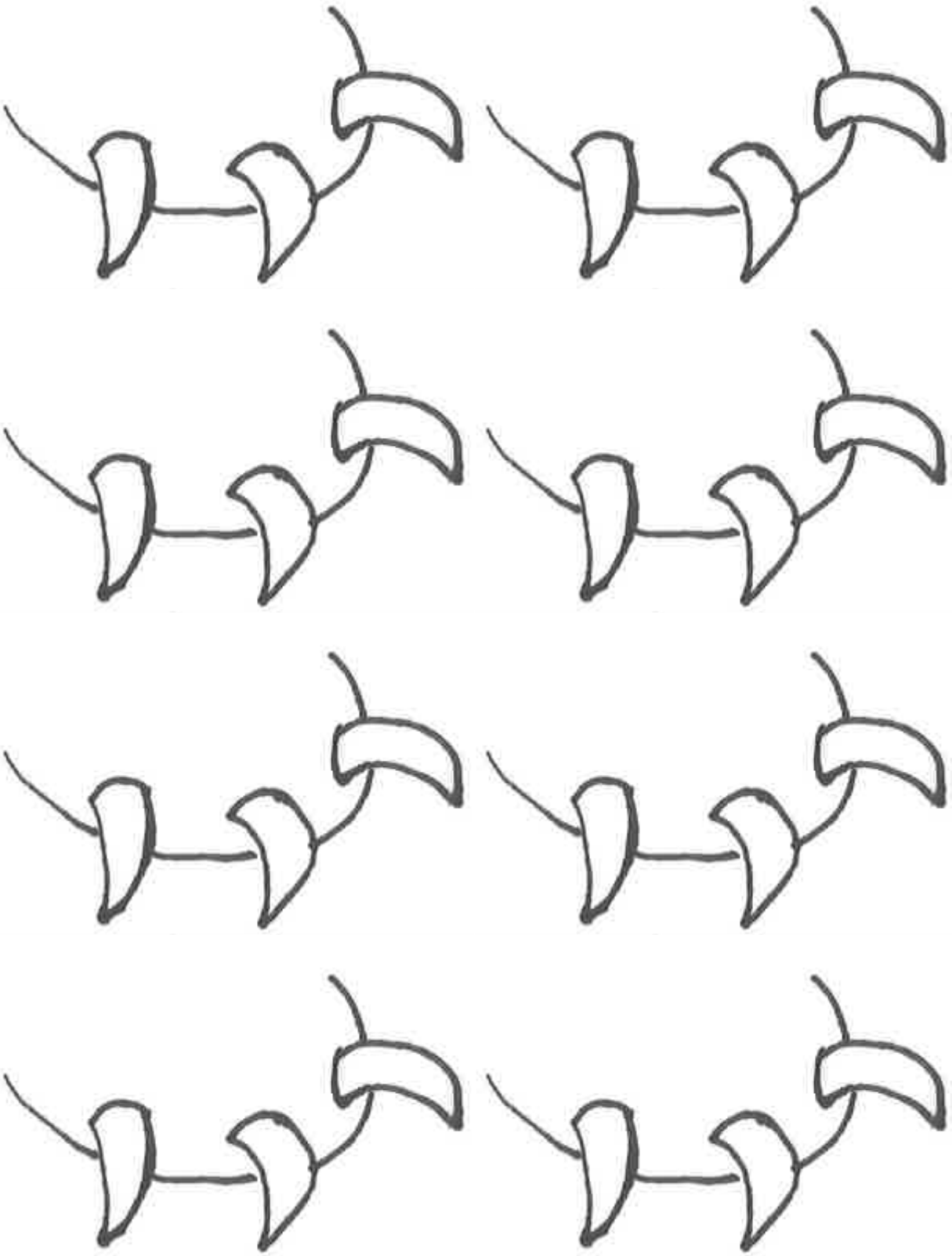
Left Hand Claws



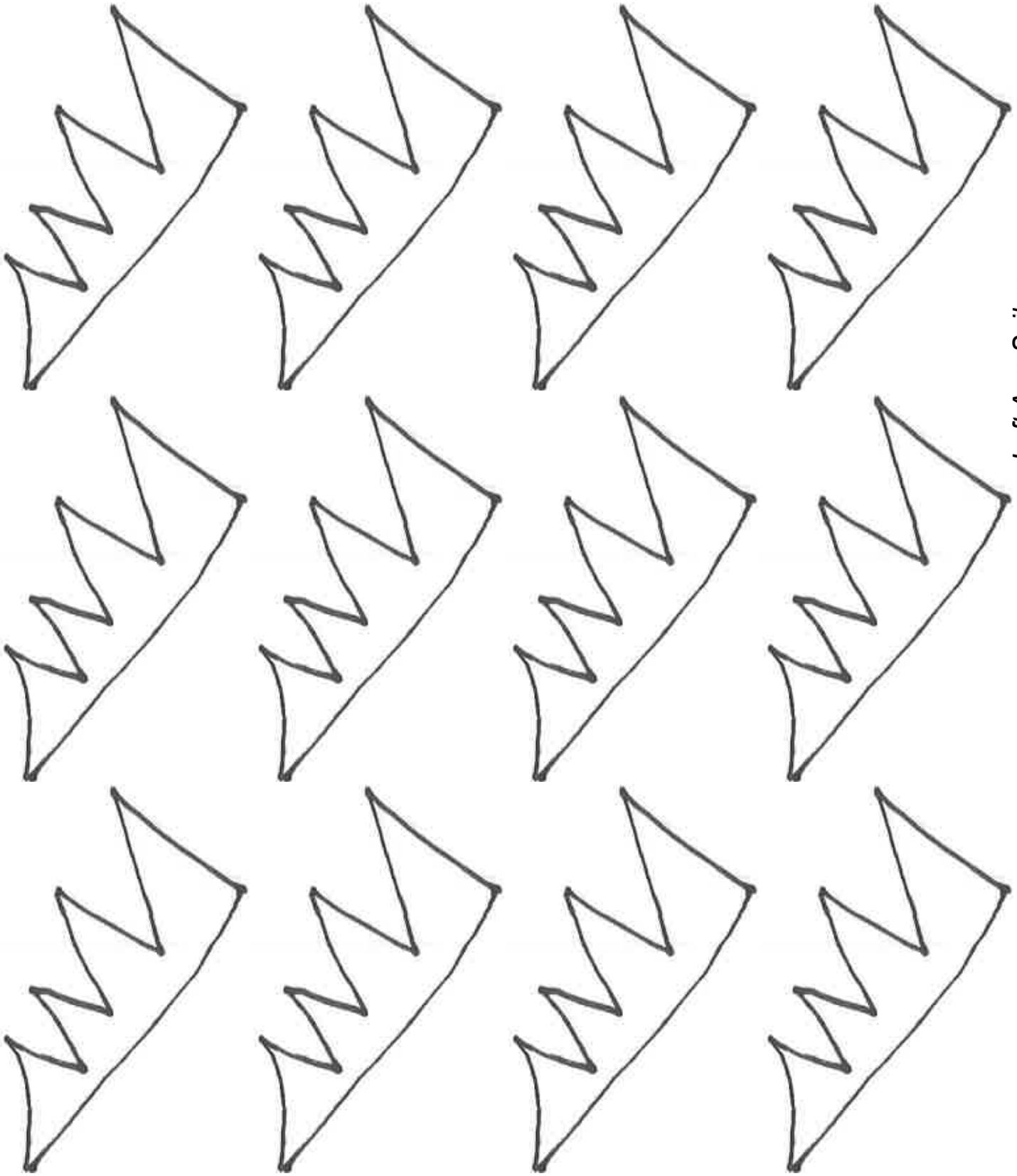
Right Hand Claws



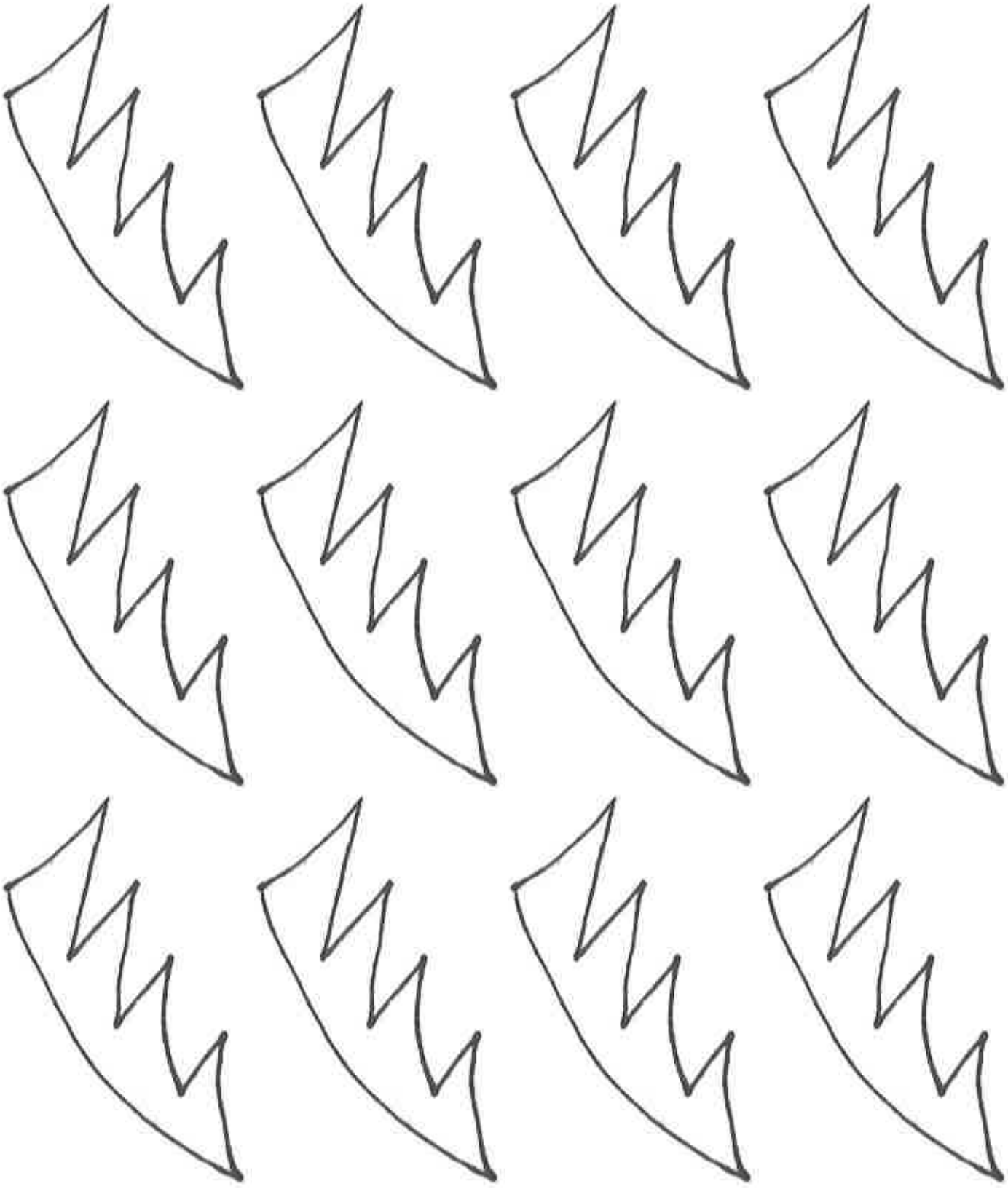
Left Foot Claws



Right Foot Claws

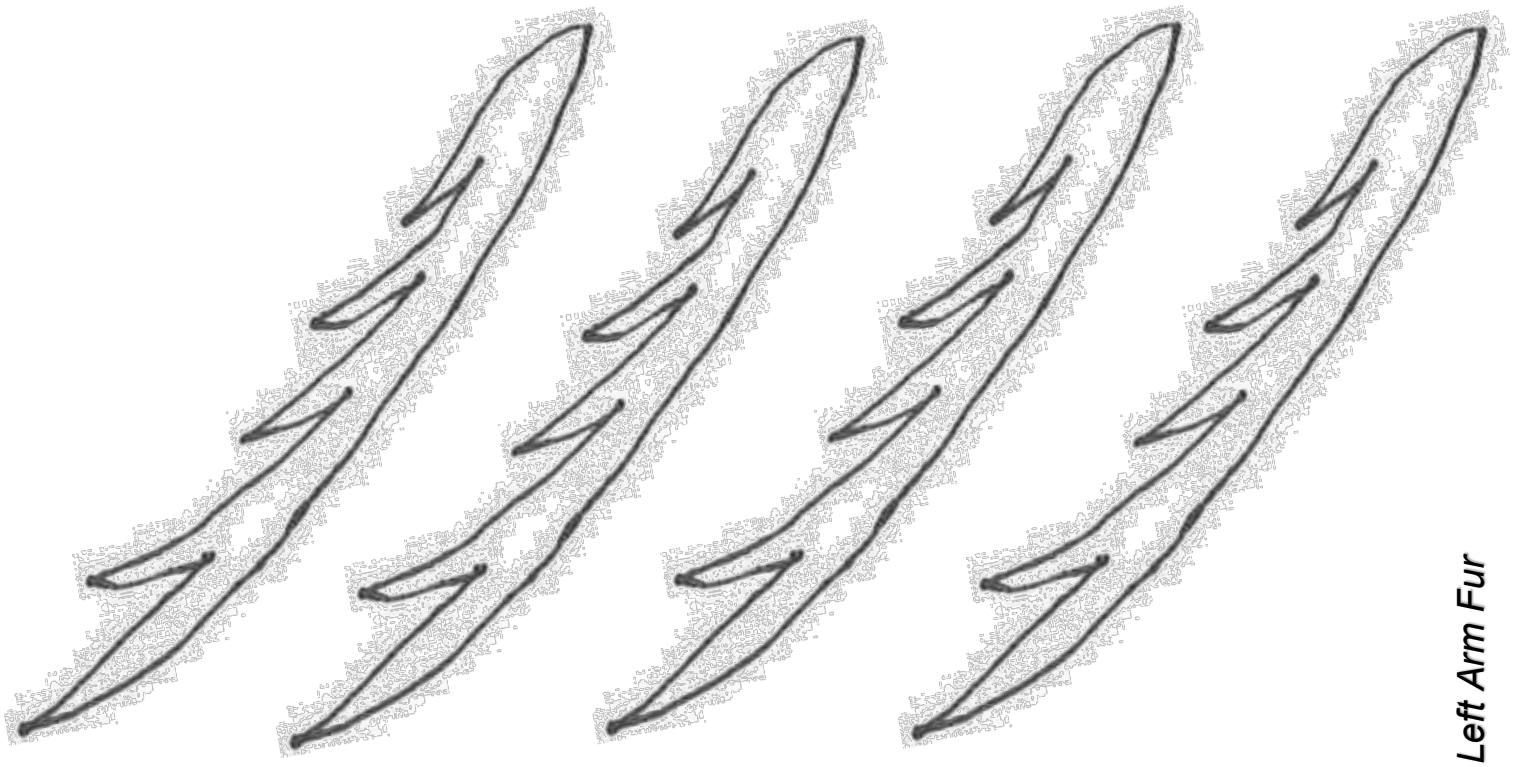


Left Arm Spikes

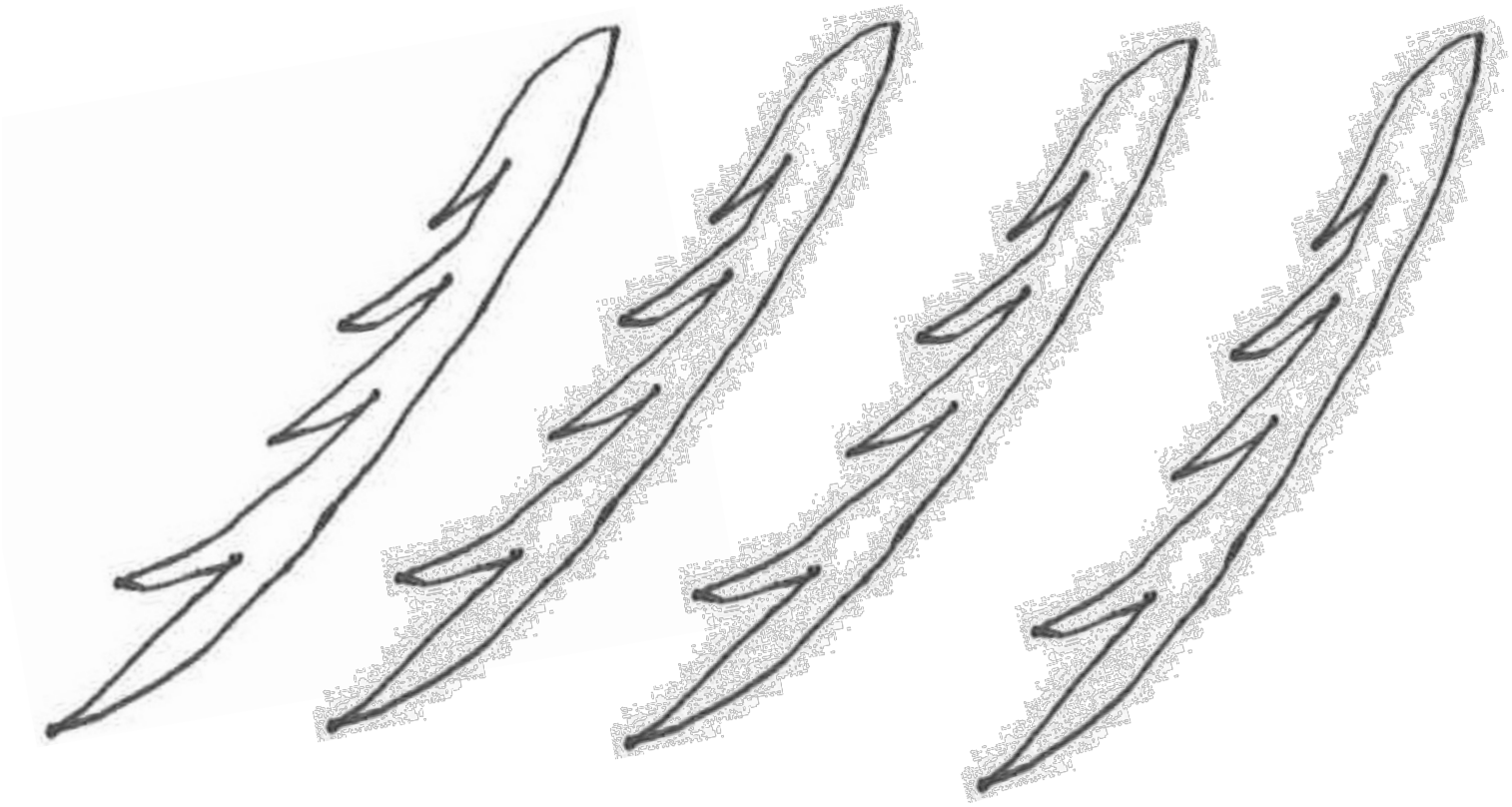


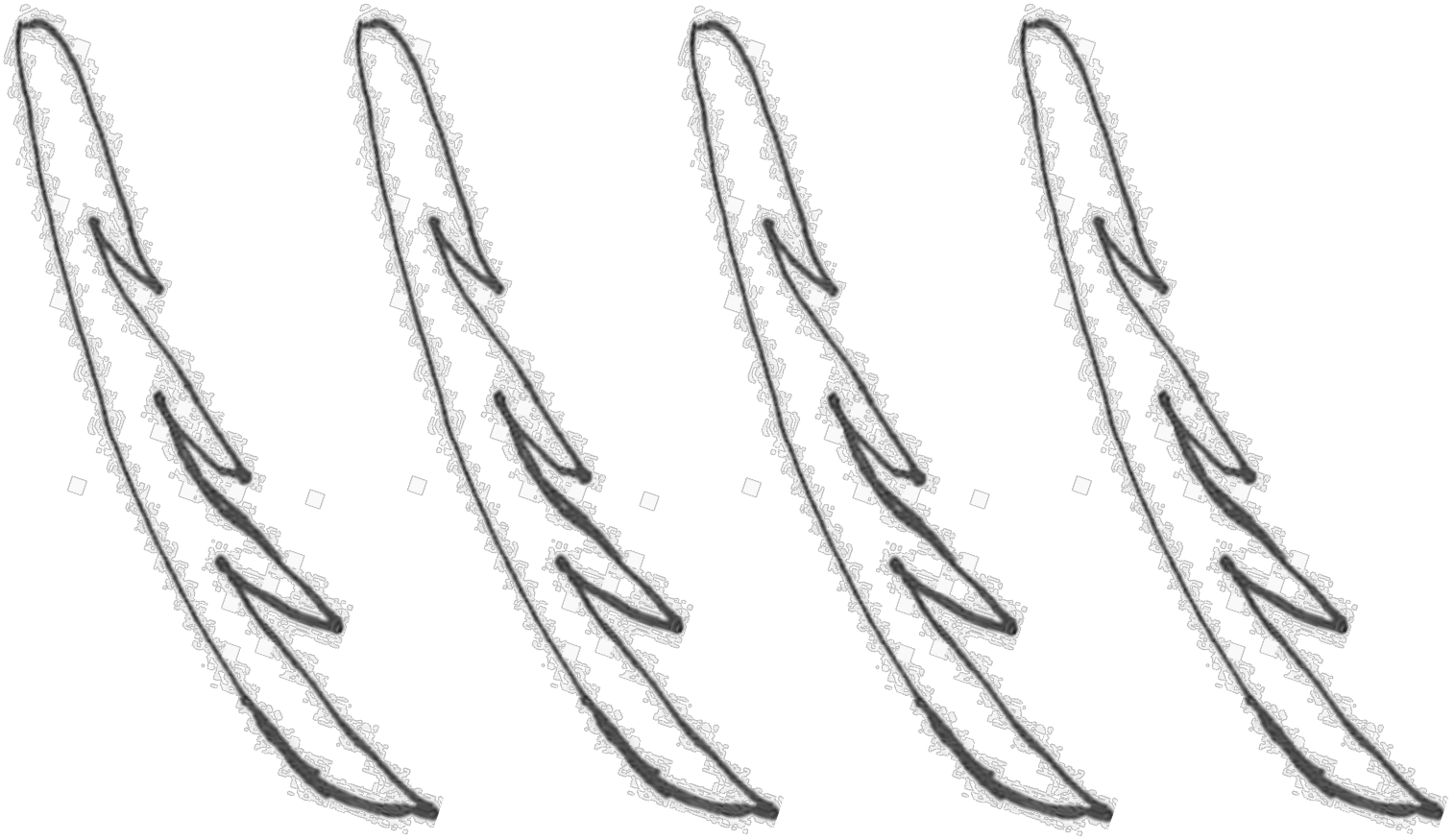
Right Arm Spikes

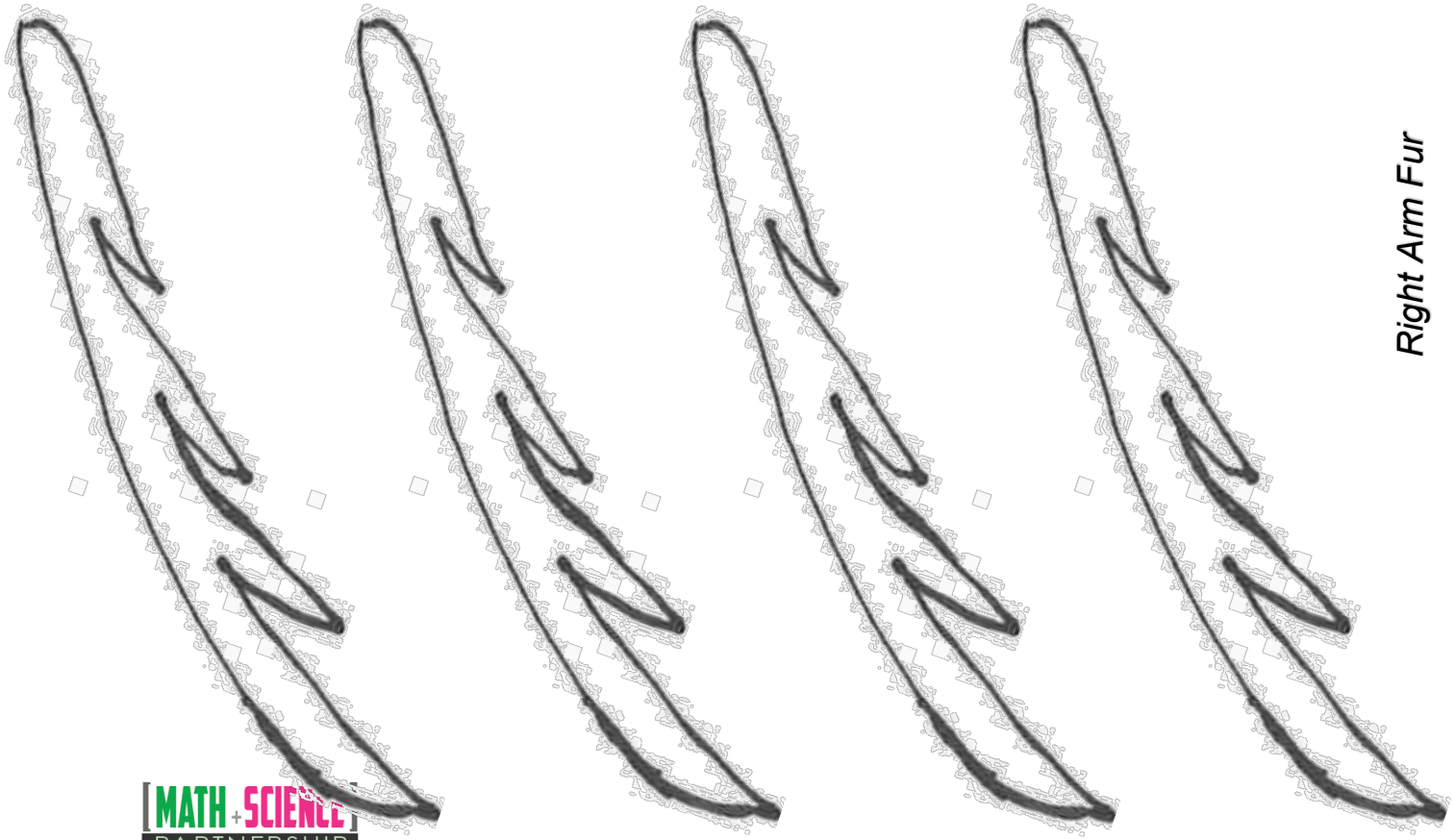
Fur (Head)



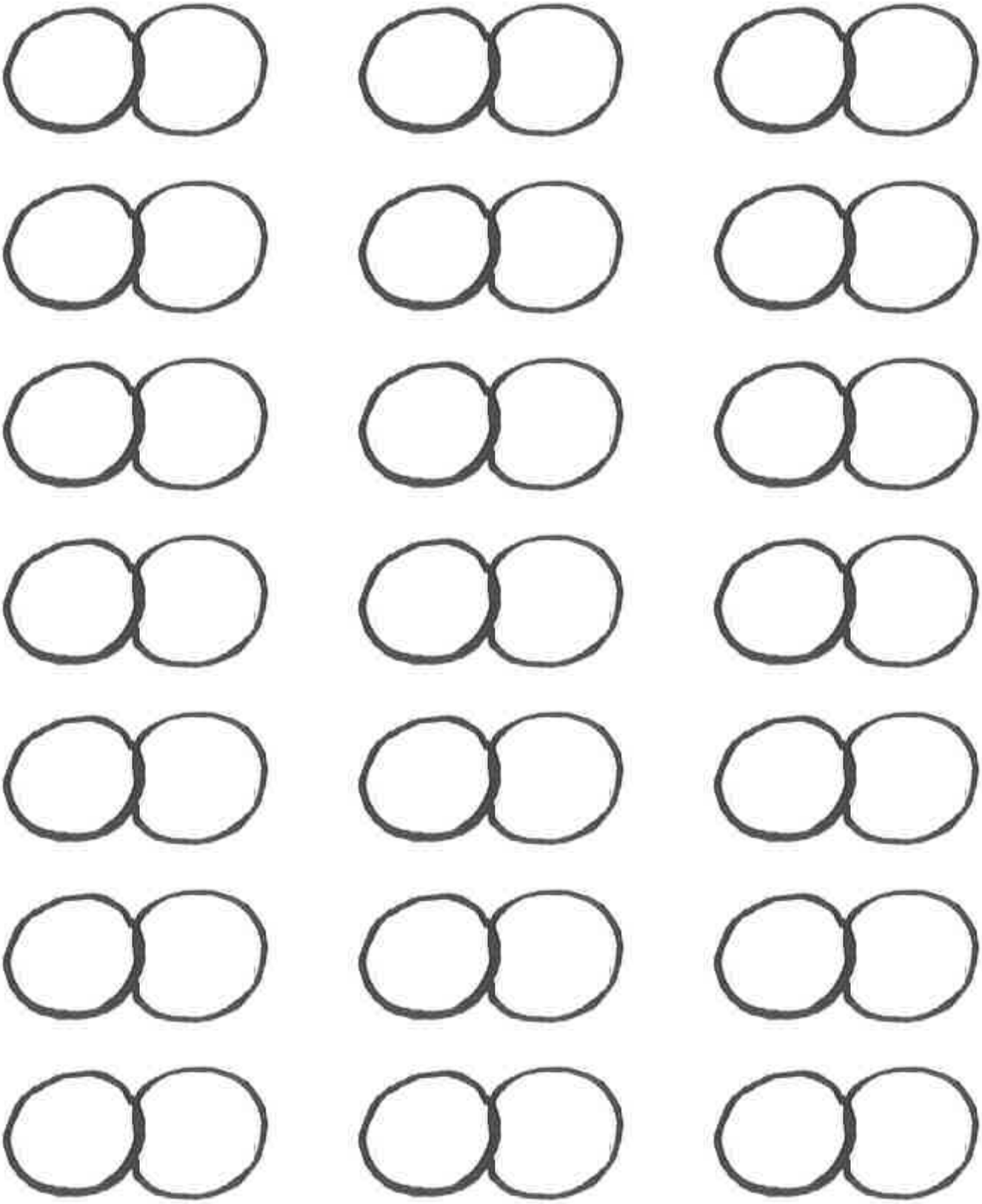
Left Arm Fur



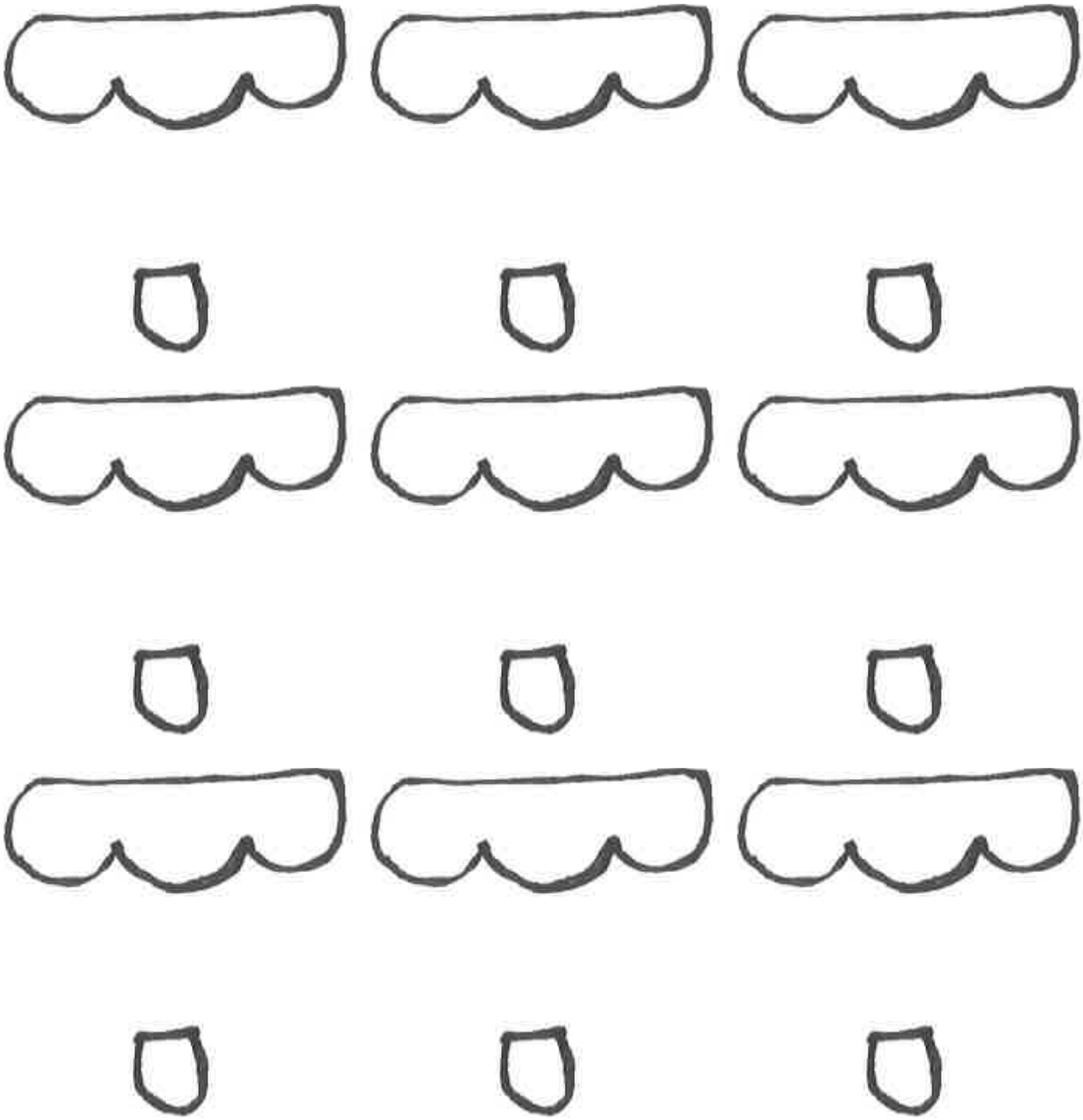




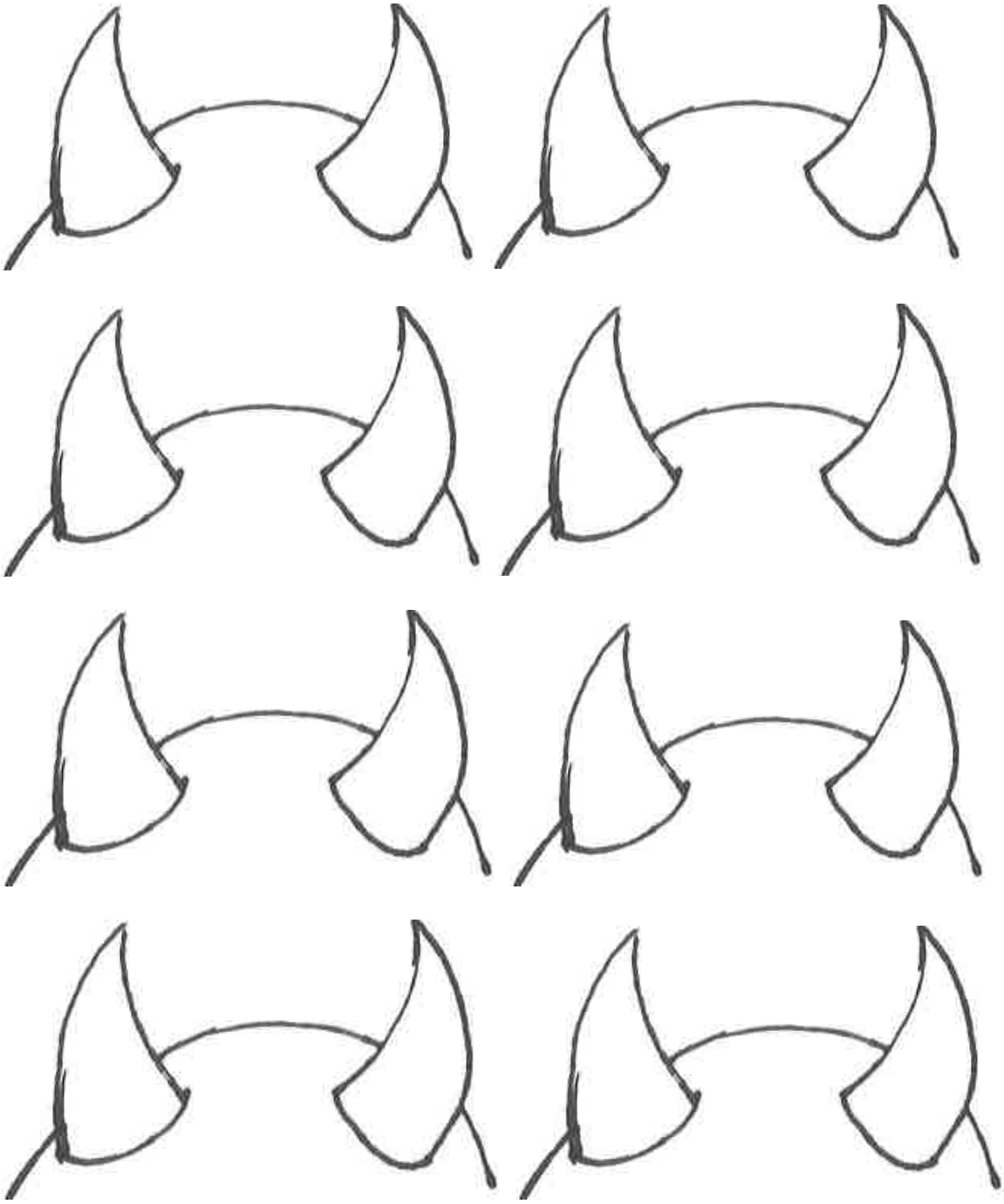
Right Arm Fur



Eyeballs

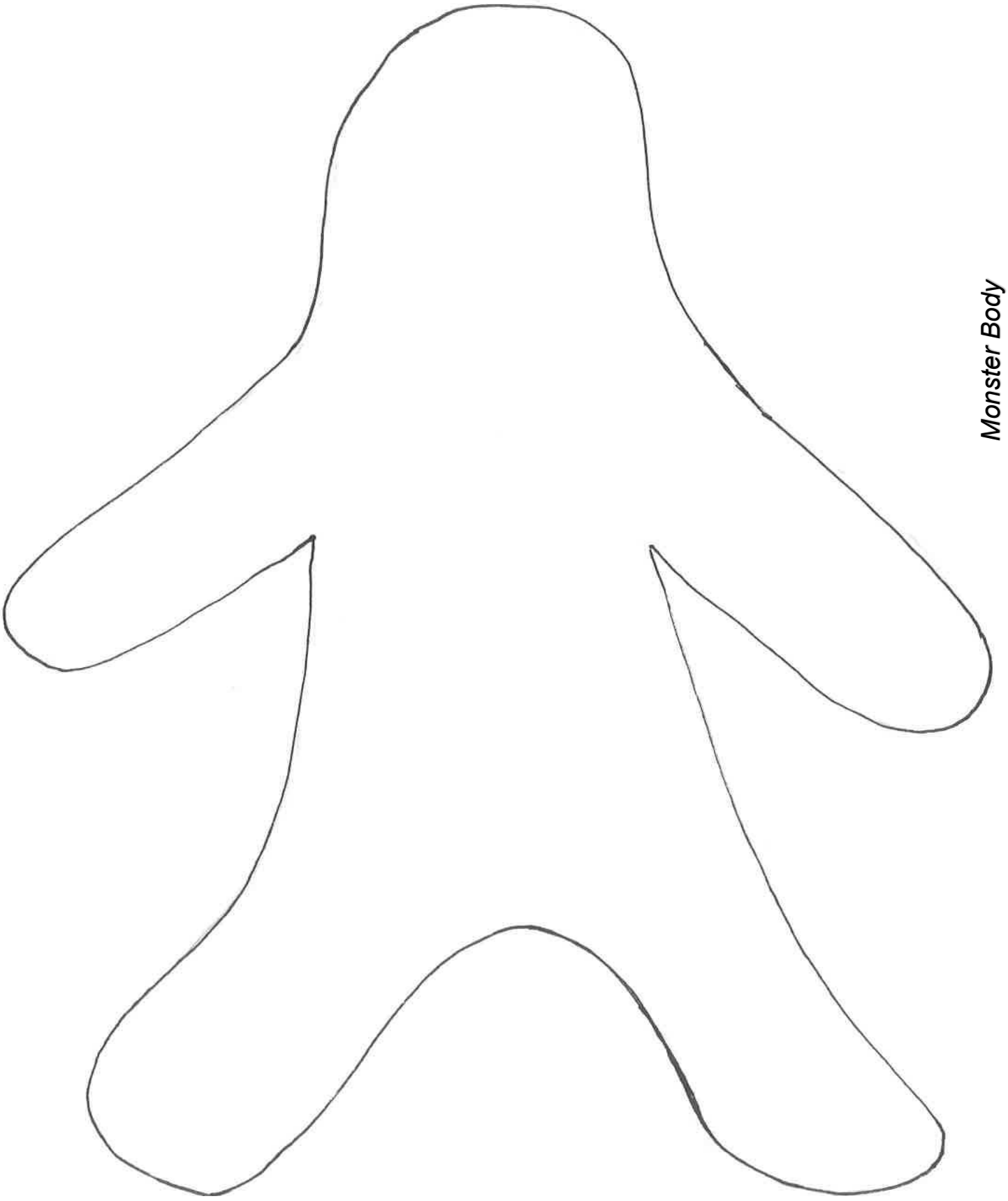


Big and Small Noses



Horns

Mouths



Monster Body

Blackline Master #3

Student Name: _____

Monster Mash Up: Exploring Genetics

Instructions: You are a scientist who is creating a monster—the first of its kind. Each of the 6 stations must be visited in order to have a completed monster.

- **Step 1**: To determine the probability of a monster receiving a specific combination of genotypes or phenotypes, you begin at one station, roll the dice and record the physical trait and the genetic letter code that you rolled.
- **Step 2**: Select the pre-cut phenotype that matches the number you rolled and attach it to your monster. Continue on to the next station, until all 6 stations have been visited and you have the entire data table filled in and your monster has all 6 traits and is complete.

Data Table for Monster Traits	**Genotype:** genetic representation (letters)	**Phenotype:** physical characteristic (appearance)
Eyes: red or yellow		
Nose: large or small		
Mouth: 1 or 2		
Hands: claws or no claws		
Body Type: spikes or fur		
Head: horns or no horns		

Monster Analysis: thinking about your results.

1. Why do you think there are 2 letters for each trait?

2. Why are some letters capitalized and some are lower case?

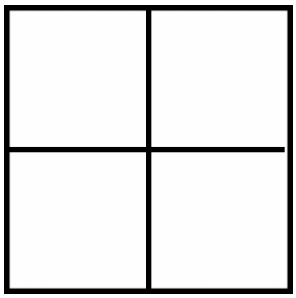
3. What are some similar and different phenotypes between your monster and your lab partner's monster?

4. Explain why you think that your monster and your lab partner's monster are different?

Blackline Master #3

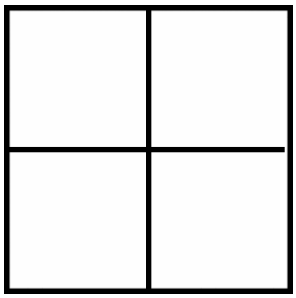
Directions: After your monster falls in love with your lab partner's monster they have a little monster baby. Complete the following six Punnett squares to determine what the probability of the offspring would look like.

Punnett Square 1: EYES (yellow/red)



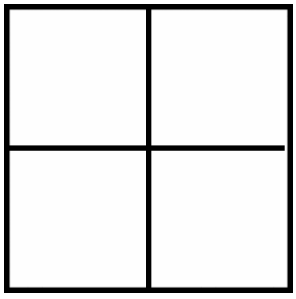
Offspring with red eyes: _____%
Offspring with yellow eyes: _____%

Punnett Square 2: NOSE (large/small)



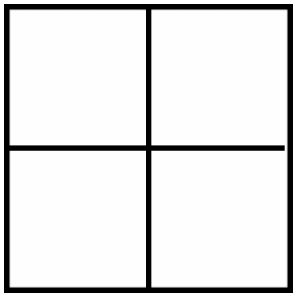
Offspring with a large nose: _____%
Offspring with a small nose: _____%

Punnett Square 3: MOUTH (1 or 2)



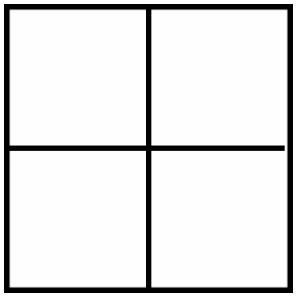
Offspring with one mouth: _____%
Offspring with two mouths: _____%

Punnett Square 4: HANDS (claws or no claws)



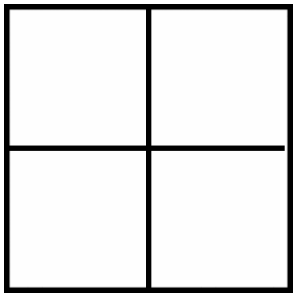
Offspring with claws: _____%
Offspring with no claws: _____%

Punnett Square 5: BODY TYPE (spikes/fur)



Offspring with spikes: _____%
Offspring with fur: _____%

Punnett Square 6: HEAD (horns or no horns)



Offspring with horns: _____%
Offspring with no horns: _____%

SAMPLE ANSWER KEY: (answers will vary)

Monster Mash Up: Exploring Genetics

Instructions: You are a scientist who is creating a monster—the first of its kind. Each of the 6 stations must be visited in order to have a completed monster.

- **Step 1**: To determine the probability of a monster receiving a specific combination of genotypes or phenotypes, you begin at one station, roll the dice and record the physical trait and the genetic letter code that you rolled.
- **Step 2**: Select the pre-cut phenotype that matches the number you rolled and attach it to your monster. Continue on to the next station, until all 6 stations have been visited and you have the entire data table filled in and your monster has all 6 traits and is complete.

Data Table for Monster Traits	**Genotype:** genetic representation (letters)	**Phenotype:** physical characteristic (appearance)
Eyes: red or yellow	*EE*	*Red*
Nose: large or small	*Nn*	*Small*
Mouth: one or two	*TT*	*One*
Hands: claws or no claws	*Aa*	*Claws*
Body Type: spikes or fur	*Ff*	*Fur*
Head: horns or no horns	*Hh*	*Horns*

Monster Analysis: thinking about your results.

5. Why do you think there are 2 letters for each trait?

   Each parent gives one letter to their baby. For example, the eyes had a genotype of EE; the mom gave an E and the dad gave an E. Parents pass traits on, you are a combination of your mom and dad's genes.

6. Why are some letters capitalized and some are lower case?

   Some letters are capitalized because they are dominant and will always be expressed. The lower case letters represent recessive traits which could be expressed if there are 2 of them or could be masked by a dominant trait.

7. What are some similar and different phenotypes between your monster and your lab partner's monster?

   Example answer: My monster had a small nose while my lab partner's monster had a large nose. Also, my monster had fur but my monster had spikes. Our monsters both had the same: eyes, mouth, hands, and no horns.

8. Explain why you think that your monster and your lab partner's monster are different?

   My monster was different from my lab partner's monster because we rolled different dice. If this were real, the monsters maybe had different parents.

SAMPLE ANSWER KEY: (answers will vary)

Directions: After your monster falls in love with your lab partner's monster they have a little monster baby. Complete the following six Punnett squares to determine what the probability of the offspring would look like.

Punnett Square 1: EYES (yellow/red)

EE	EE
EE	EE

Offspring with red eyes: __100__%
Offspring with yellow eyes: ___0___%

Punnett Square 2: NOSE (large/small)

NN	Nn
NN	Nn

Offspring with a large nose: __100__%
Offspring with a small nose: ___0___%

Punnett Square 3: MOUTH (one/two)

TT	TT
TT	TT

Offspring with one mouth: __100___%
Offspring with two mouths: __0____%

Punnett Square 4: HANDS (claws or no claws)

AA	Aa
Aa	aa

Offspring with claws: __75___%
Offspring with no claws: 25___%

Punnett Square 5: BODY TYPE (spikes/fur)

FF	ff
Ff	ff

Offspring with spikes: __50___%
Offspring with fur: ___50___%

Punnett Square 6: HEAD (horns or no horns)

HH	Hh
Hh	hh

Offspring with horns: __75___%
Offspring with no horns: 25___%

Blackline Master #4

Reference Sheet for Each Station

MONSTER EYES

Roll of the Die	Genotype	Phenotype
1 or 2	**EE**	**Red Eyes**
3 or 4	Ee	Red Eyes
5 or 6	**ee**	**Yellow Eyes**

MONSTER NOSE

Roll of the die	Genotype	Phenotype
1 or 2	**NN**	**Large Nose**
3 or 4	Nn	Large Nose
5 or 6	**nn**	**Small Nose**

MONSTER CLAWS

Roll of the die	Genotype	Phenotype
1 or 2	**AA**	**Claws**
3 or 4	Aa	Claws
5 or 6	**aa**	**No Claws**

MONSTER SPIKES OR FUR

Roll of the die	Genotype	Phenotype
1 or 2	**FF**	**Fur**
3 or 4	Ff	Fur
5 or 6	**ff**	**Spikes**

MONSTER MOUTH

Roll of the die	Genotype	Phenotype
1 or 2	**TT**	**One Mouth**
3 or 4	Tt	One Mouth
5 or 6	**tt**	**Two Mouths**

MONSTER HORNS

Roll of the die	Genotype	Phenotype
1 or 2	**HH**	**Horns**
3 or 4	Hh	Horns
5 or 6	**hh**	**No Horns**

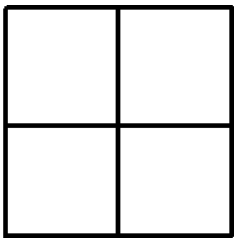
Blackline Master #5

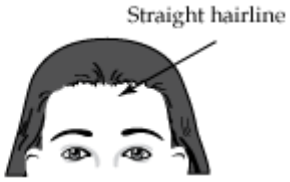
Check For Understanding: Monster Mash-Up of Genetics

Name: _____
Date: _____ PD: _____

1. Brian's mother is heterozygous (Ww) for the widow's peak hairline trait. His father is homozygous recessive (ww) and has a straight hairline? What is the probability that Brian has the widow's peak trait? You may create a Punnett square to help you determine the probability. (SC.7.L.16.2)

_____ %





2. The allele for brown eyes is dominant over the allele for blue eyes. A couple has three brown-eyed children. The parents are heterozygous for brown-eyes (Bb). They believe the fourth child they have will be blue-eyed. Which statement below explains what will happen? (SC.7.L.16.2)
   A) The couple will have a blue-eyed fourth child.
   B) The couple will have a brown-eyed fourth child.
   C) The couple has a 75 percent chance of having a blue-eyed child.
   D) The couple has a 25 percent chance of having a blue-eyed child.

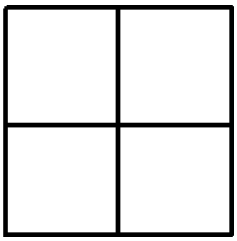
3. A blue-eyed mother (*bb*) and a brown-eyed father (*BB*) have four children. What will the ***phenotype*** of their children be? (SC.7.L.16.2)
   A) *Bb*
   B) *bb*
   C) brown-eyed
   D) blue-eyed

4. A Punnett square is a model of genetic probability. Why is a Punnett square considered a model? (SC.7.N.3.2)
   A) It shows you exactly what your offspring will look like.
   B) It is a representation of what genetically could happen.
   C) It is a perfect example of genetics.
   D) It is a smaller version of genes and genetic crosses.

Check For Understanding: Monster Mash-Up of Genetics
ANSWER KEY

1. Brian's mother is heterozygous (Ww) for the widow's peak hairline trait. His father is homozygous recessive (ww) and has a straight hairline? What is the probability that Brian has the widow's peak trait? You may create a Punnett square to help you determine the probability. (SC.7.L.16.2)

50 _____ %



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