**Lesson 5 – Introduction to Genetics Terminology and Punnett Squares**

**Day 1 Genetics Terms and Line Diagrams**

**Objective:** Students will be able to make effective use of genetics terminology to help solve inheritance problems.

**Assessment:** Use practice 6 to assess student understanding of genetics terms and readiness for using terms in inheritance problems.

**Materials:**

PowerPoint: PRACCIS Genetics Lesson 5 - Day 1 Terms Concept Lesson Class

Word Doc: PRACCIS Genetics Lesson 5 - Day 1 Terms and Line Diagrams Student Packet

Word Doc: PRACCIS Genetics lesson 5 - Terms Diagrams and Punnett Squares Teacher Packet

**Do Now:** Have students complete Practice 1 for their Do Now. This is shown on the first slide of the Genetics Terms Concept Lesson PowerPoint.

**Procedure:** There are detailed instructions below.

**Closure:** Use question 4 (see below for more detail), which is concerned with brainstorming about better methods for solving inheritance problems, as the closure for the first day.

**Homework:** At the teacher’s discretion (please see the important note within the packet). Having student’s finish the line diagram problems would be a good choice for homework.

**Modifications:** Planned by the teacher as it fits the needs of their students.

**Lesson 5 – Introduction to Genetics Terminology and Punnett Squares**

**Unit:** Genetics

**Lesson**: 5

**Main Idea:** Inheritance Patterns, Variation, Genetic Structure and Terminology

**CPI:**

5.1.8.A.3 Use scientific principles and models to frame and synthesize scientific arguments and pose theories. Predictions and explanations are revised based on systematic observations, accurate measurements, and structured data/evidence.

5.1.8.B.3 Use qualitative and quantitative evidence to develop evidence-based arguments. Carefully collected evidence is used to construct and defend arguments.

5.3.8.D.2 Explain the source of variation among siblings.

The unique combination of genetic material from each parent in sexually reproducing organisms results in the potential for variation.

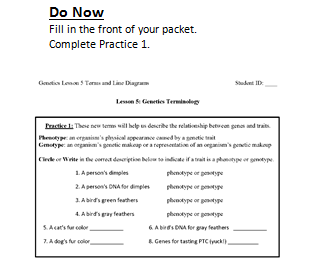
**Lesson Timeline:**

3 Days

Day 1 Genetics Terms and Line Diagrams

Day 2 Punnett Squares

Day 3 Punnett Squares



**Day 1 Genetics Terms and Line Diagrams**

**Important Note for Lesson 5:** Lesson 5 is intended to be somewhat modular and we are very flexible in how teachers use this lesson. We provide a lot of practice problems of different types. We do not expect that you will need students to complete all problems on all worksheets. Please choose an amount of practice that you feel is appropriate for your students. This includes in-class practice as well as homework. We have suggestions for homework but please assign it and review it based on what you think is best for your students. Also, you can choose to have students work on problems individually, in pairs or in groups.

**Do Now**

**Practice 1:**

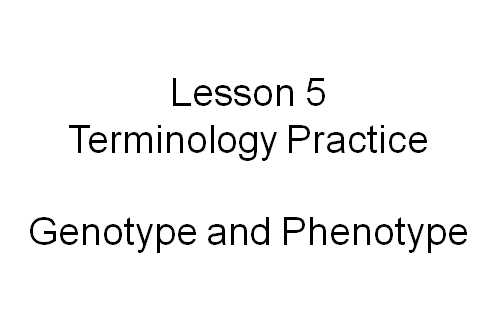
The students are using phenotype and genotype. Remind them that they learned these terms during the last lesson with the wool model. Remind them that the phenotype is what we see and the genotype refers to the genetic material.

Tell the students to circle or write whether each is a genotype or a phenotype.

*Answers: 1) Phenotype 2) Genotype 3) Phenotype 4) Phenotype 5) Phenotype 6) Genotype 7) Phenotype 8) Genotype*

Take just a few minutes to let students finish and go over the answers to the Do Now.

Then move on to the PowerPoint for the concept lesson (next page).



**Day 1 Genetics Terms and Line Diagrams**

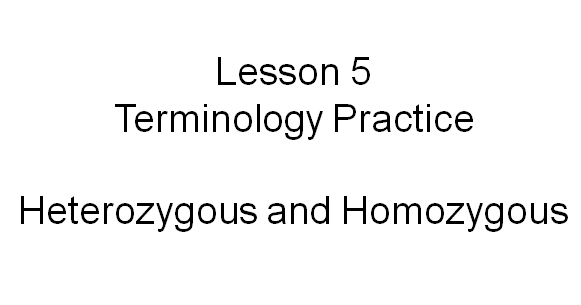
Open the PowerPoint PRACCIS Genetics Lesson 5 - Day 1 Terms Concept Lesson Class

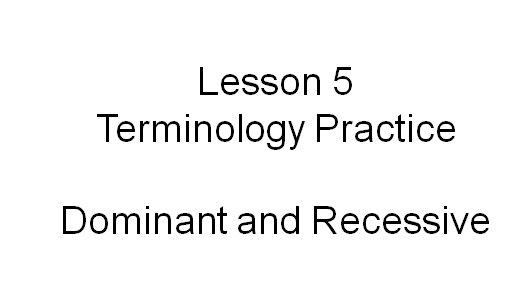
While introducing the concept lesson explain that terminology in science is very important so you are clear when talking to one another. “In this lesson we are going to learn and review some terms so we can be very exact when we are talking about genetics. This way we all understand what we are trying to tell each other. It is very important to learn these new words and the best way to learn them is to use them so we are going to practice using these words. From here on out I expect you to use these terms in your writing and when you are talking!”

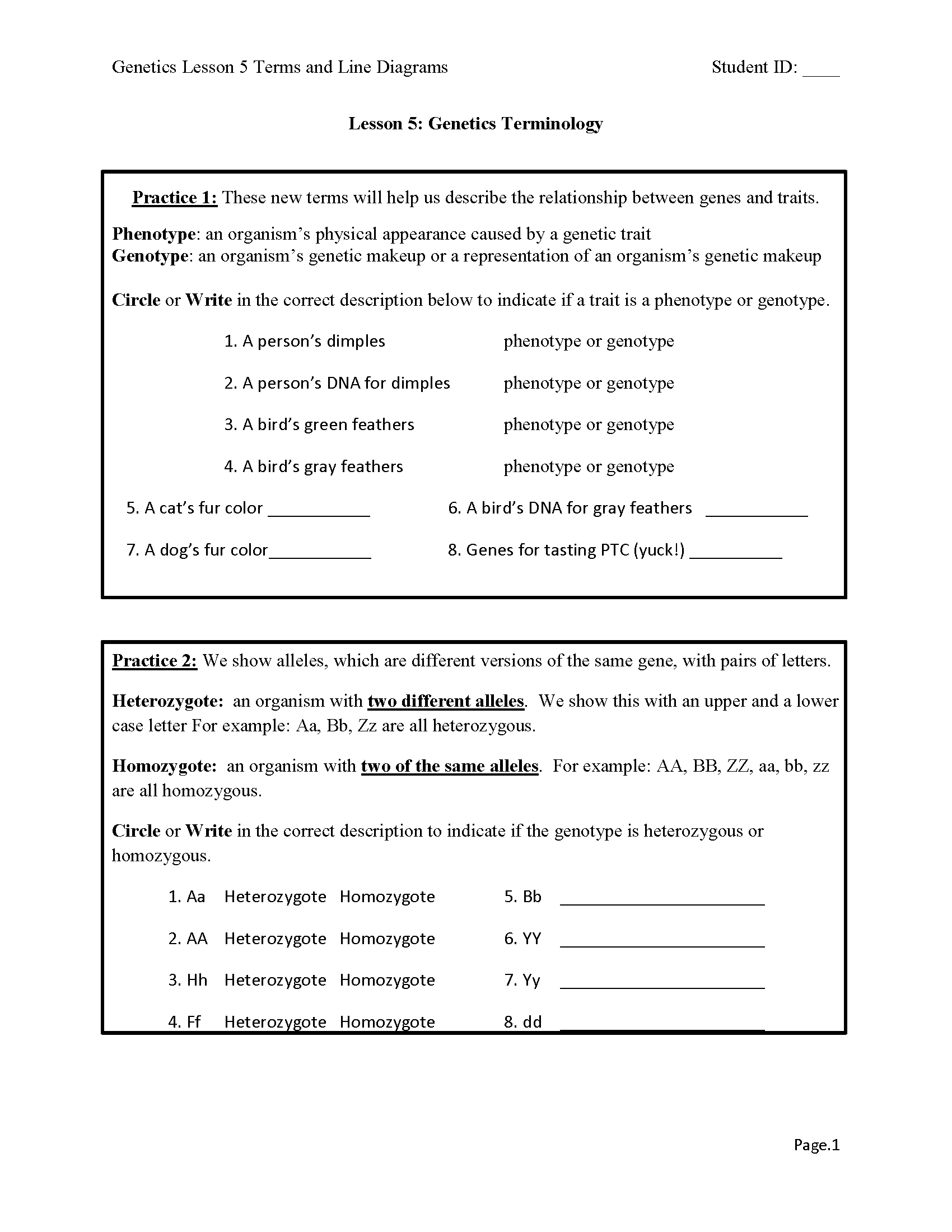
The aim of this PowerPoint is to help students develop facility with using genetics terms. It is a concept lesson so it helps students differentiate between qualitatively distinct ideas. This PowerPoint should not take more than about 10-12 minutes in total because each slide goes very quickly (some requiring no more than 10 seconds, others requiring a little more time).

There are three majors sections in the PowerPoint. They are shown on the left.

Each section has about 8 to 12 slides. The slides usually show a simple image or piece of text (like a genotype combination). Then ask for students to respond. Once they have responded click the left mouse button (or an arrow key) to advance the animation and the answer will be revealed.







**Day 1 Genetics Terms and Line Diagrams**

**Page 1**

**Practice 1:**

Please note that students should have completed this for a Do Now, it is shown here just to be an accurate representation of page 1 of the student packet.

**Practice 2:**

Remind the students of the wool models they made “Remember how there were two different shades of purple, a light purple and a dark purple? There are different versions of a gene for a trait called alleles, an upper case letter is one allele, and a lowercase is another allele. We each have two alleles for each gene. We called this the two gene model, but a better name for it is the two allele model.”

“If two of your alleles are the same they are homozygous, because ‘homo’ means same. If they are different they are heterozygous, because ‘hetero’ means different.”

Tell the students to circle or write whether each pair of alleles are homozygote or heterozygote.

*Answers: 1) Heterozygous 2) Homozygous 3) Heterozygous 4) Heterozygous 5) Heterozygous 6) Homozygous 7) Heterozygous 8) Homozygous*

**Day 1 Genetics Terms and Line Diagrams**

**Page 2**

**Practice 3:**

Tell the students, “Now that you got some practice in one direction, labeling pairs of alleles as homozygote or heterozygote, we need to practice in the other direction.”

Tell the students to circle the correct allele pair for the term.

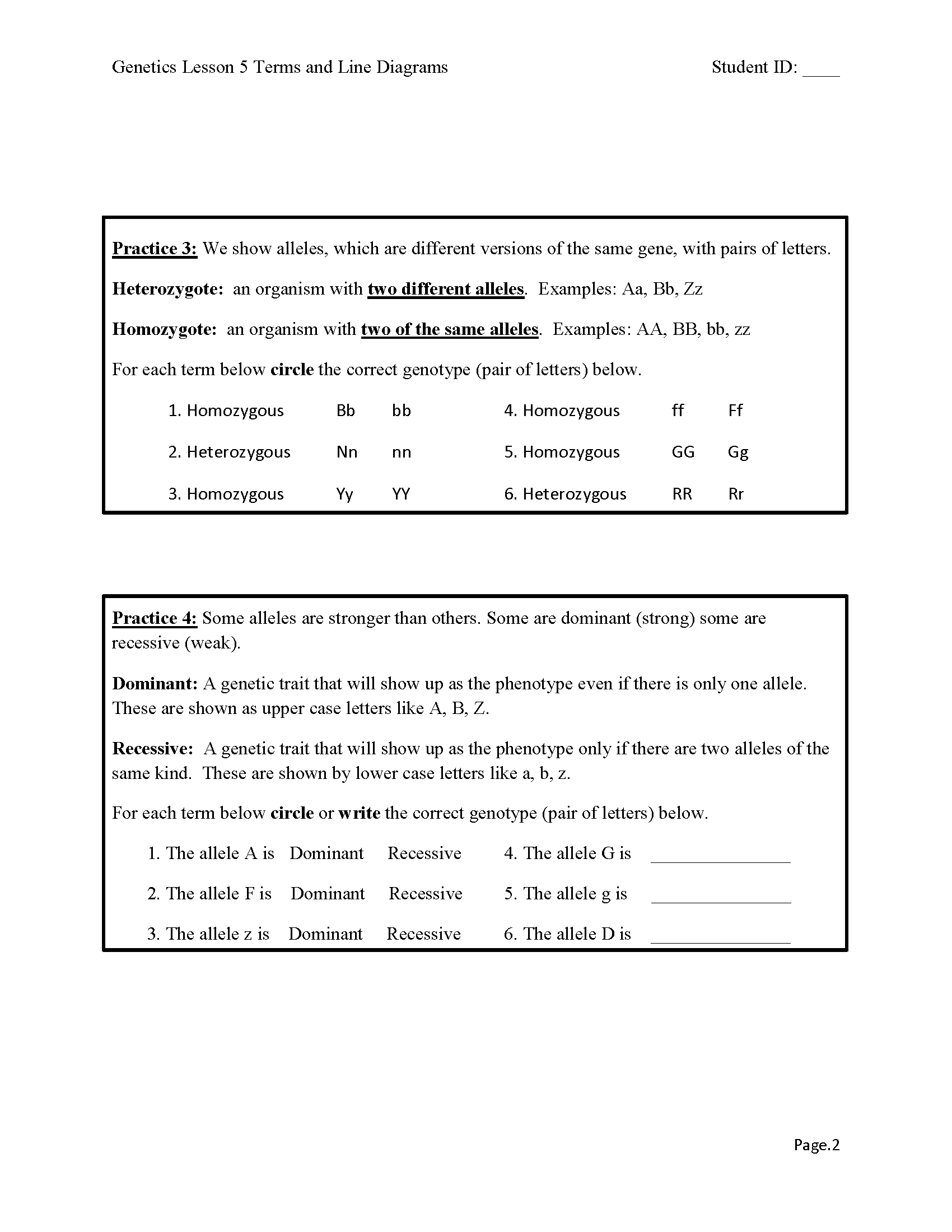
*Answers: 1) bb 2) Nn 3) YY 4) ff 5) GG 6) Rr*

**Practice 4:**

For the next set we are going to practice using the terms dominant and recessive. Remind the students that the uppercase letters are dominant and the lower case letters are recessive. That one allele is “stronger” than the other.

Tell the students to circle or write whether each allele is dominant or recessive.

*Answers: 1) Dominant 2) Dominant 3) Recessive 4) Dominant 5) Recessive 6) Dominant*



**Day 1 Genetics Terms and Line Diagrams**

**Page 3**

**Practice 5:**

This is where we are starting to put some of the terms together. Tell the students that “saying someone has the dominate allele is not enough information to get the full picture, you don’t know if they are homozygous or heterozygous. Saying someone is homozygous is also not enough information because they could have the dominant or the recessive allele. So we combine them to be clear. For example, homozygote recessive is enough information to predict what that individual can pass on.”

Tell the students to circle the allele pair that match the terms.

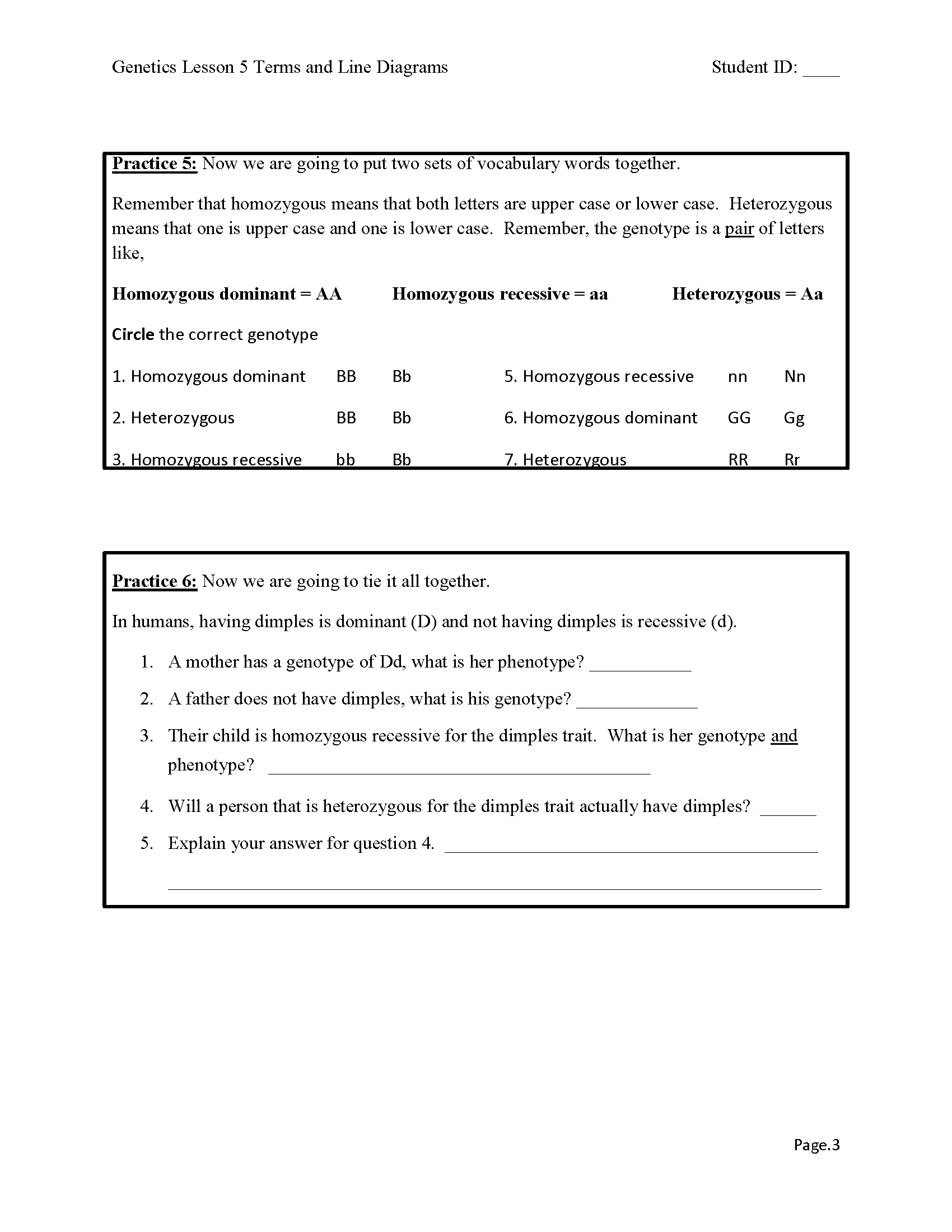
*Answers: 1) BB 2) Bb 3) bb 4) nn 5) GG 6) Rr*

**Practice 6:**

Tell the students that these are the types of questions they are going to be seeing in genetics, all of the terminology is used together to describe a situation.

Tell the students to answer the questions.

*Answer: 1) Dimples 2) dd 3) dd, no dimples 4) Yes 5) Their genotype would be Dd and so the dominant allele would mean the dimples would be in their phenotype.*



**Day 1 Genetics Terms and Line Diagrams**

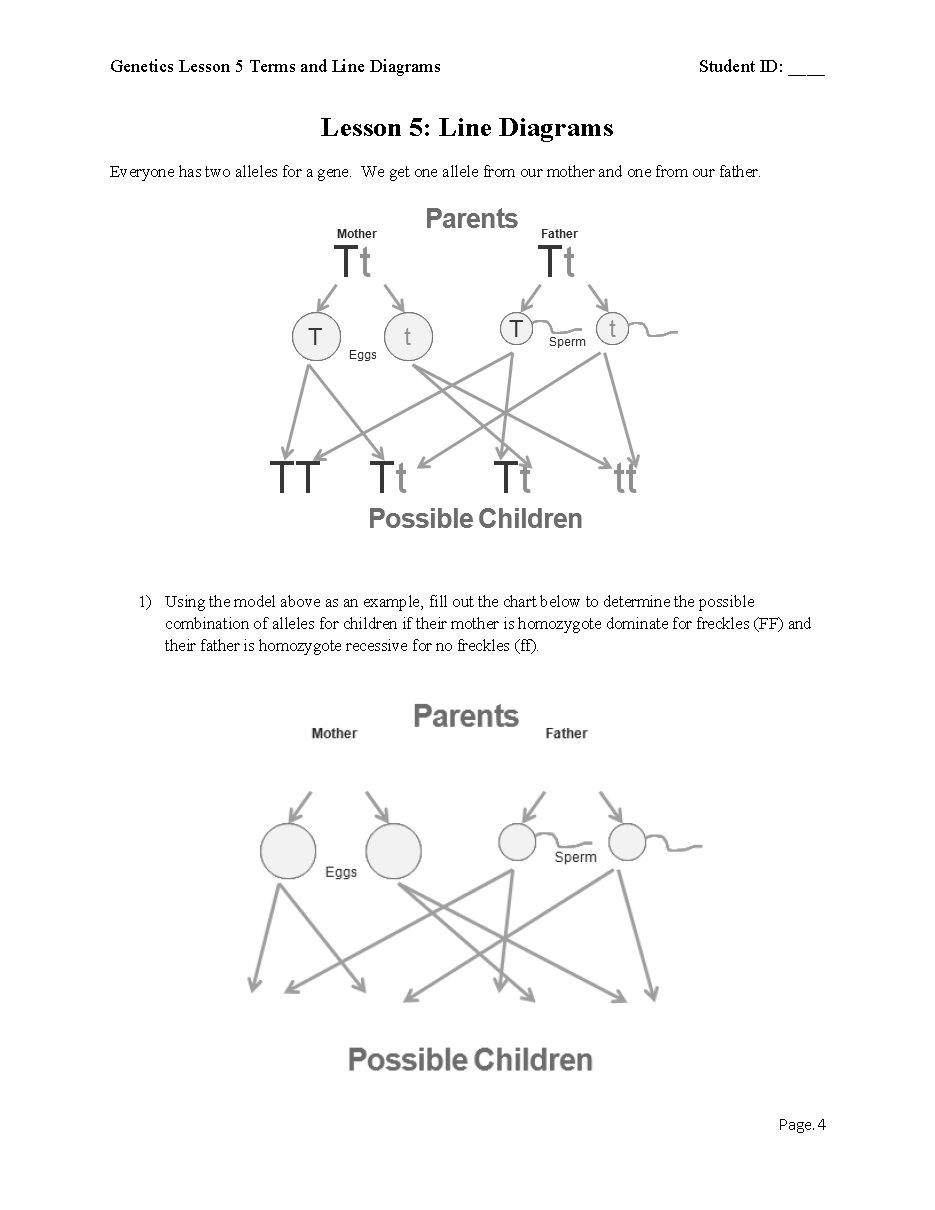
**Pages 4-6** Inheritance Patterns.

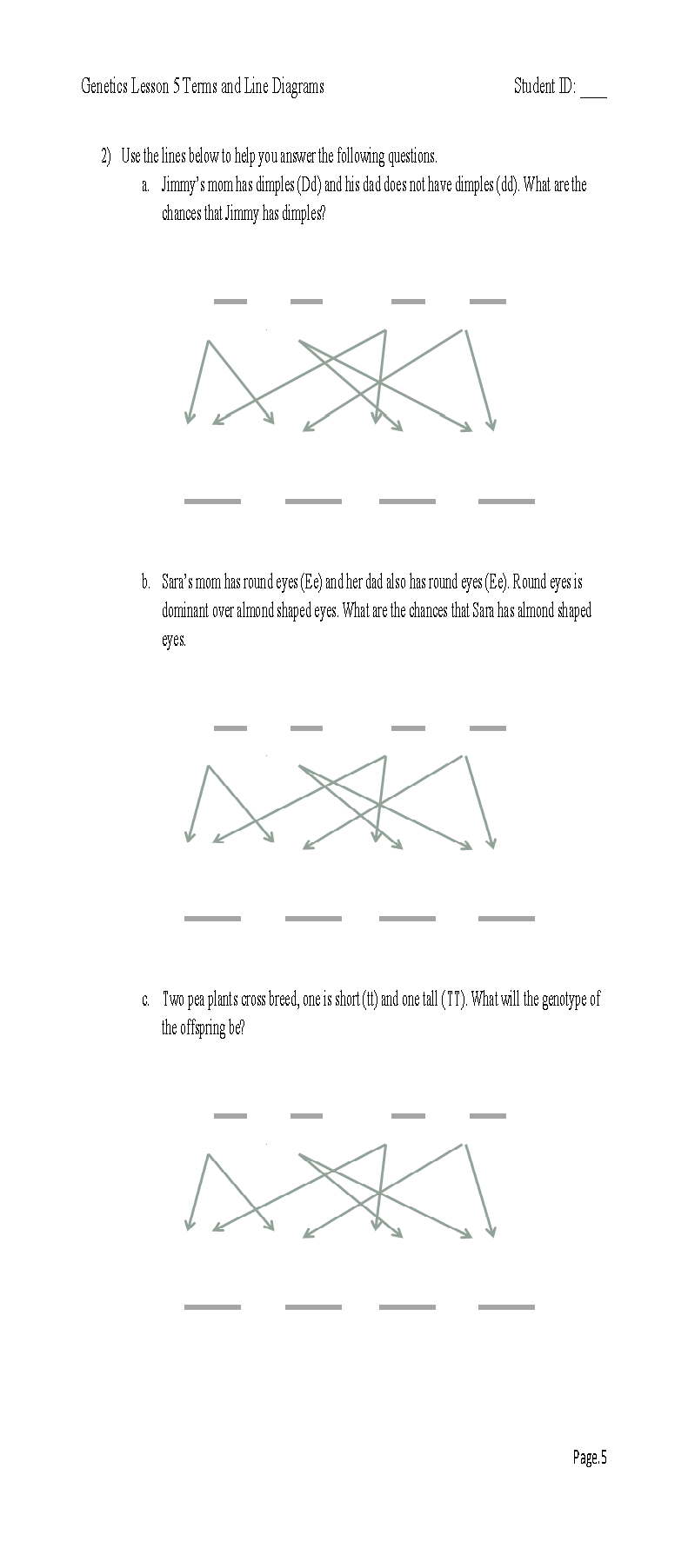
For the next set of questions tell the students they will need to determine the possible combination of alleles from a given parent. Show them that they can find out the combination by drawing lines like it shows in the picture.

**Page 4:**

**Problem 1:**

Draw problem 1 on the board and walk students through the steps of the line diagram. Emphasize that there is a 25% chance of each possible outcome.





**Day 1 Genetics Terms and Line Diagrams**

**Page 5**

Assign students to work in pairs on Question 2a through 2c.

**Answers:**

a) 50% chance of dimples

b) 25%

c) All offspring will be Tt

**Day 1 Genetics Terms and Line Diagrams**

**Page 6**

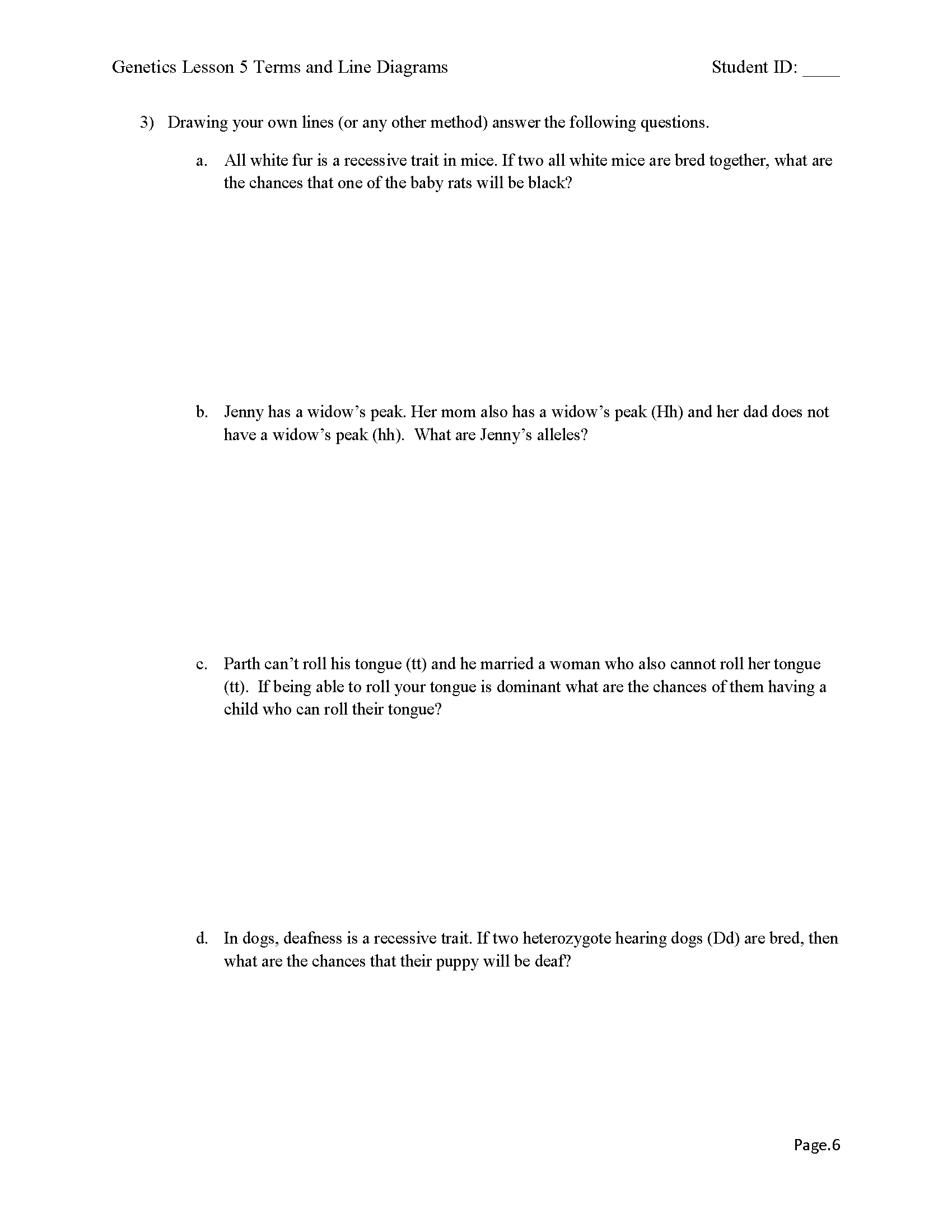
**Question 3 Answers:**

a) 0%

b) Hh

c) 0%

d) 25%



**Day 1 Genetics Terms and Line Diagrams**

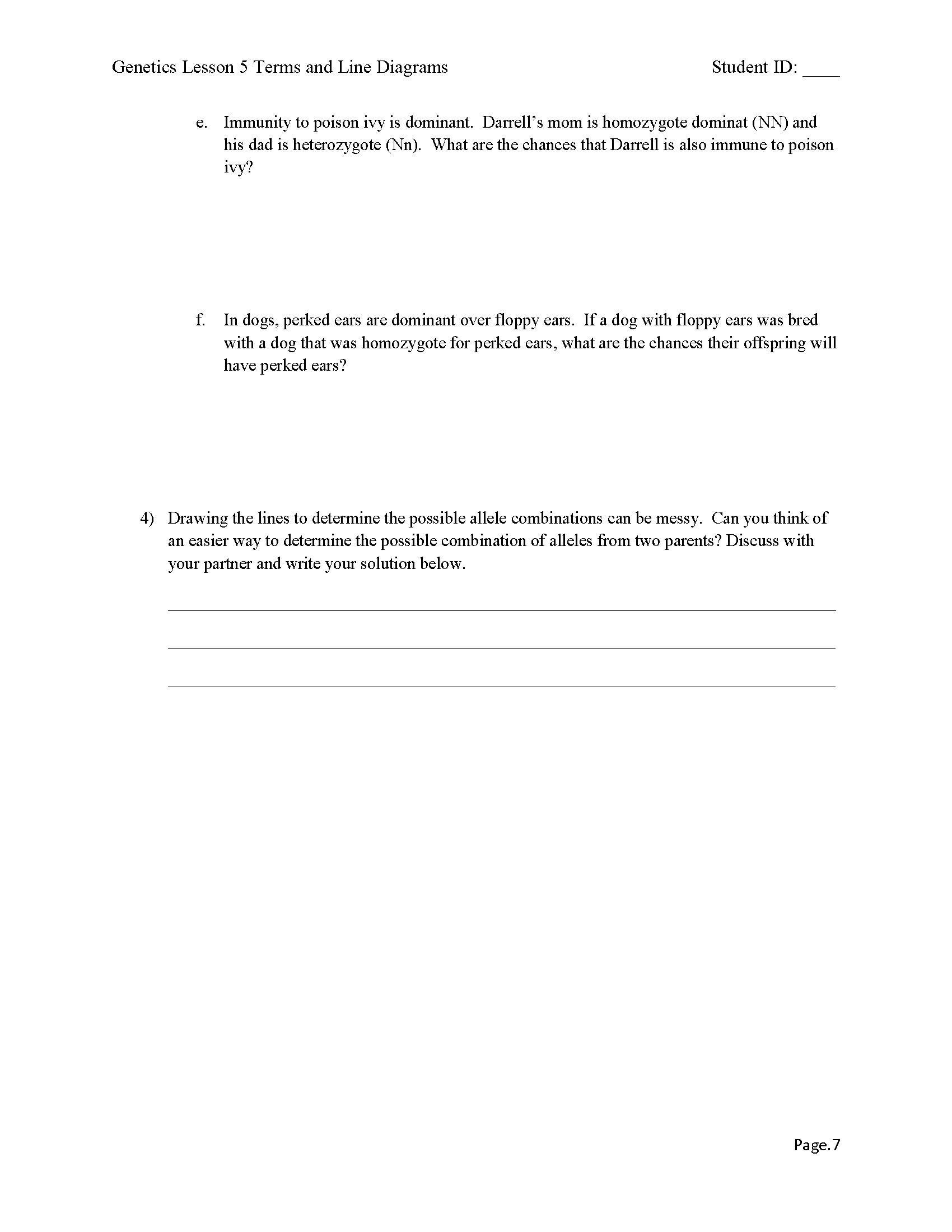
**Page 7**

**Answers (question 3 continued):**

e) 100%

f) 100%

**Closure - Question 4:** Ask them how they feel about drawing the lines and suggest that it can be messy. Ask if they can think of a better way to determine the combinations and have them discuss with their partner. Help students move toward understanding that the Punnett Square is a useful conceptual tool for solving these types of problems.



**Lesson 5 – Introduction to Genetics Terminology and Punnett Squares**

**Day 2 – Punnett Squares**

**Objective:** Students will be able to use Punnet Squares to make predictions about likely genotypes and phenotypes of offspring.

**Assessment:** Question 10 of the in the class practice should be done as an individual measure of student competence with Punnet Squares and the related terminology.

**Materials:**

PowerPoint: PRACCIS Genetics Lesson 5 - Day 2 & 3 Punnett Squares Introduction Class

Word Doc: PRACCIS Genetics Lesson 5 - Day 2 & 3 Punnett Square Class Packet Student Packet

Word Doc: PRACCIS Genetics lesson 5 - Terms Diagrams and Punnett Squares Teacher Packet

**Do Now:** Have students complete the do now which is in their packet as well as the first slide of the PowerPoint PRACCIS Genetics Lesson 5 - Day 2 & 3 Punnet Squares Introduction Class.

**Procedure:** There are more detailed instructions below.

**Closure**: Use question 11 as a closure and formative assessment of student competence with Punnet Squares and terminology up to this point.

**Homework:** At the teacher’s discretion. If homework will be assigned then it is recommended that one of the practice sets in Punnett Square Practice 2 should be assigned to students.

**Modifications:** Planned by the teacher as it fits the needs of their students.

**Lesson 5 – Introduction to Genetics Terminology and Punnett Squares**

**Unit:** Genetics

**Lesson**: 5

**Main Idea:** Inheritance Patterns, Variation, Genetic Structure and Terminology

**CPI:**

5.1.8.A.3 Use scientific principles and models to frame and synthesize scientific arguments and pose theories. Predictions and explanations are revised based on systematic observations, accurate measurements, and structured data/evidence.

5.1.8.B.3 Use qualitative and quantitative evidence to develop evidence-based arguments. Carefully collected evidence is used to construct and defend arguments.

5.3.8.D.2 Explain the source of variation among siblings.

The unique combination of genetic material from each parent in sexually reproducing organisms results in the potential for variation.

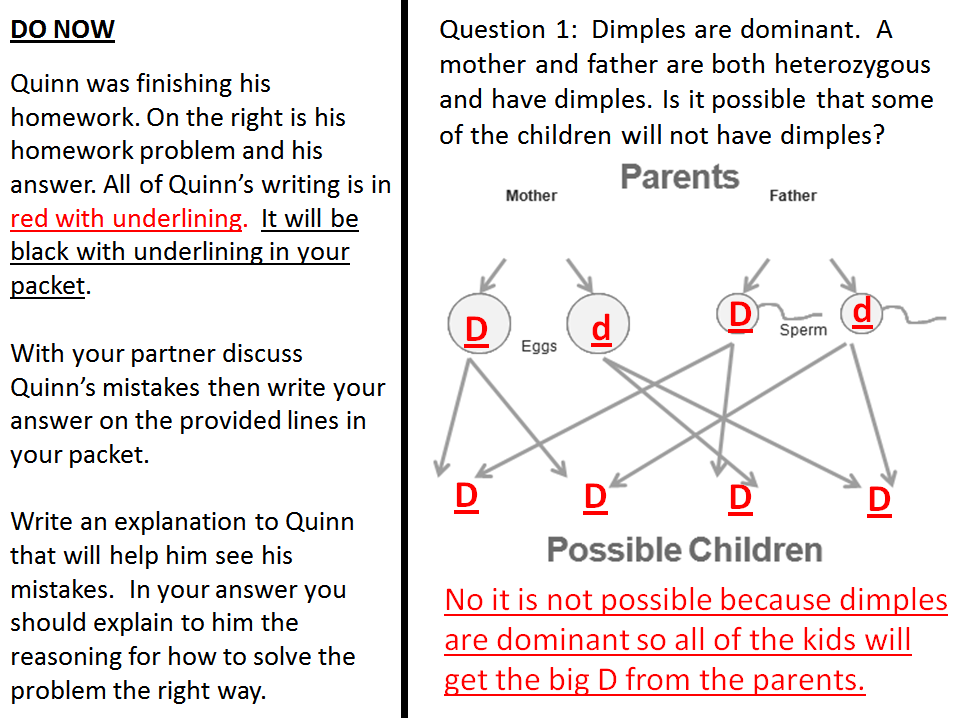
**Lesson Timeline:**

3 Days

Day 1 Genetics Terms and Line Diagrams

Day 2 Punnett Squares

Day 3 Punnett Squares



**Day 2 – Punnett Squares**

**Do Now**

Have students complete the do now which is in their packet as well as the first slide of the PowerPoint PRACCIS Genetics Lesson 5 - Day 2 & 3 Punnett Squares Introduction Class.

Homework

If homework was assigned on Day 1 then after the do now take a few minutes to answer student questions about the homework.

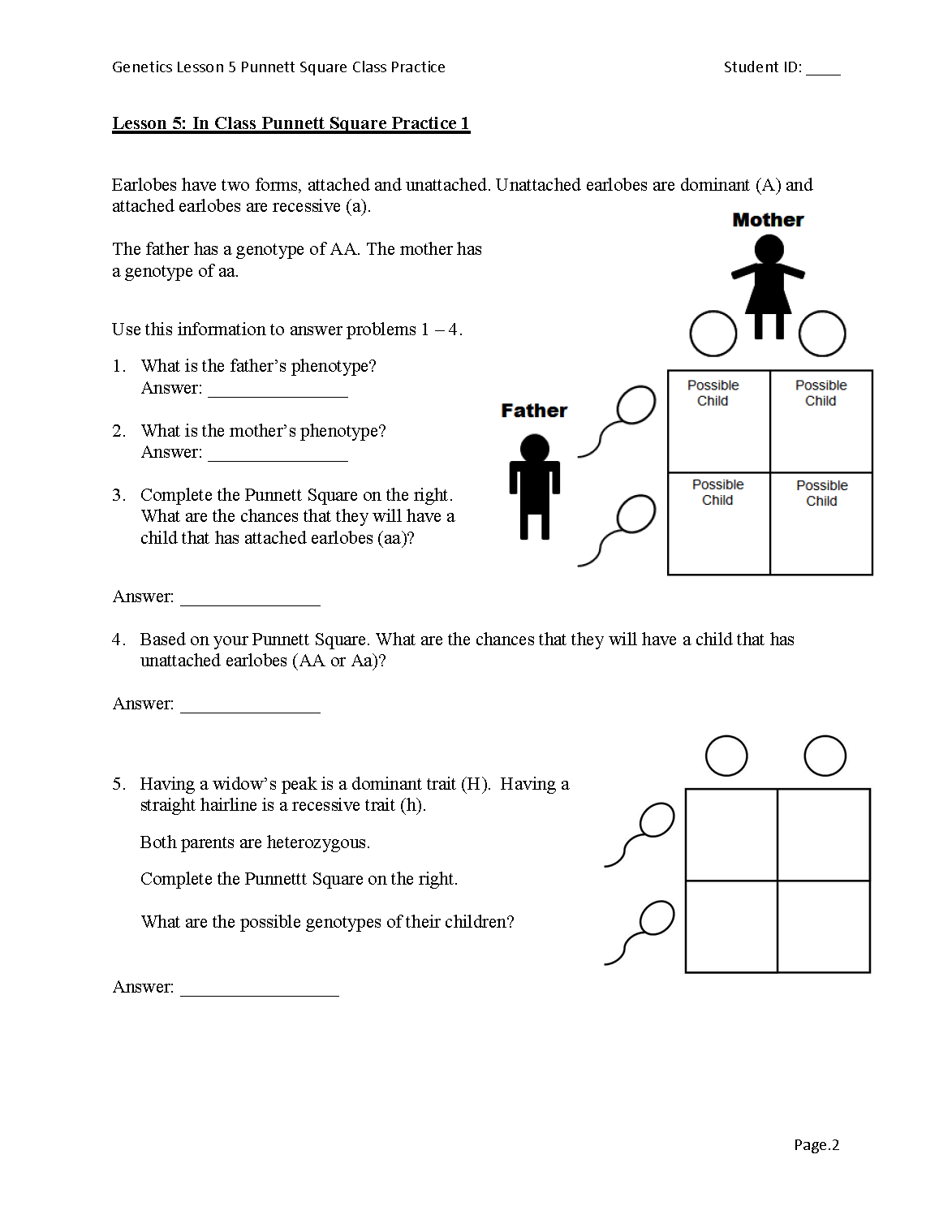
PowerPoint

After going over questions from the homework take a few minutes and walk students through the PowerPoint that introduces Punnet squares. The file is PRACCIS Genetics Lesson 5 - Day 2 & 3 Punnet Squares Introduction Class and it is the same PowerPoint that contains the do now.

Punnett Square Practice.

In this activity students learn about Punnett squares. Remind students that the value of studying genetics is in understanding how we can predict the likelihood of inheriting particular traits. Encourage students to use the terminology they learned in the previous lesson in this activity. Inform students that Punnett squares are a simple graphical way of discovering all the potential combinations of genotypes that can occur in children, given the genotypes of their parents. Students go through 10 examples, each with a different degree of scaffolding. The most scaffolded version of the Punnett Square is seen in questions 1 to 4 where it shows the mother, father, has spaces in the gametes for students to write their answers and labels each box as a potential child. As students progress through each level of the representation some of the scaffold is removed until students are ready to draw their own box and fill it in.

**Reminder:** All of lesson 5 is intended to be somewhat modular and we are very flexible in how teachers use this lesson. We provide a lot of practice problems of different types. We do not expect that you will need students to complete all problems on all worksheets. Please choose an amount of practice that you feel is appropriate for your students. This includes in-class practice as well as homework. We have suggestions for homework but please assign it and review it based on what you think is best for your students. Also, you can choose to have students work on problems individually, in pairs or in groups.



**Day 2 – Punnett Squares**

**Page 2**

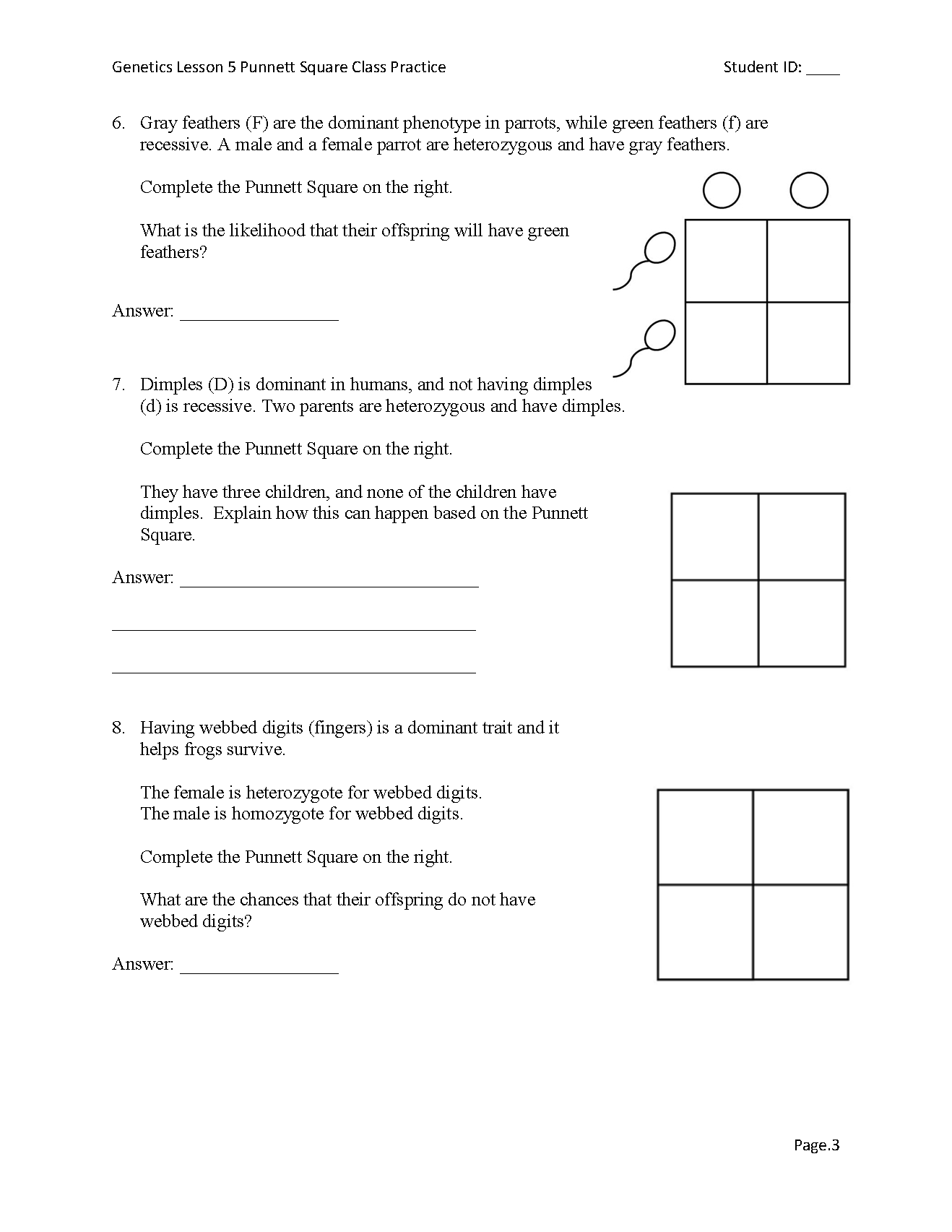
Punnett Square Practice.

**1-4:**  Students answer 4 questions in which they use a Punnett square that has a variety of scaffolds. The mother is displayed at the top with her two eggs, and the father is on the left hand side with his two sperm. You might want to do this example as a class. Students should put the two alleles from the mother and the father in the corresponding sperm and egg. Introduce how to fill in the Punnett squares by copying the row and column-head letters across or down into the empty squares, giving four combinations. The students will then determine the chance or probability of having a child with an attached earlobe based on their Punnett squares. You can have them write this as a ¼ chance or a 25% chance.

*Answers: 1) Unattached earlobes 2) Attached earlobes 3) 0% 4) 0%*

**5:** Students complete a second Punnett square on their own or in pairs. This time one of the scaffolds has been removed. The mother and father are no longer present. Students will need to know that the mother’s alleles go on the top and the fathers go on the left hand side. In this example heterozygous terminology is used to inform students that both parents have two different alleles for the given trait. Students are asked to determine the possible genotypes of their children.

*Answer: HH, Hh, Hh, hh*



**Day 2 – Punnett Squares**

**Page 3**

**6**. The same scaffold is used in this question as in question #5. Students learn that the male and female parrots are both heterozygous, similar to question #5. Students are asked to find the likelihood of offspring having green feathers.

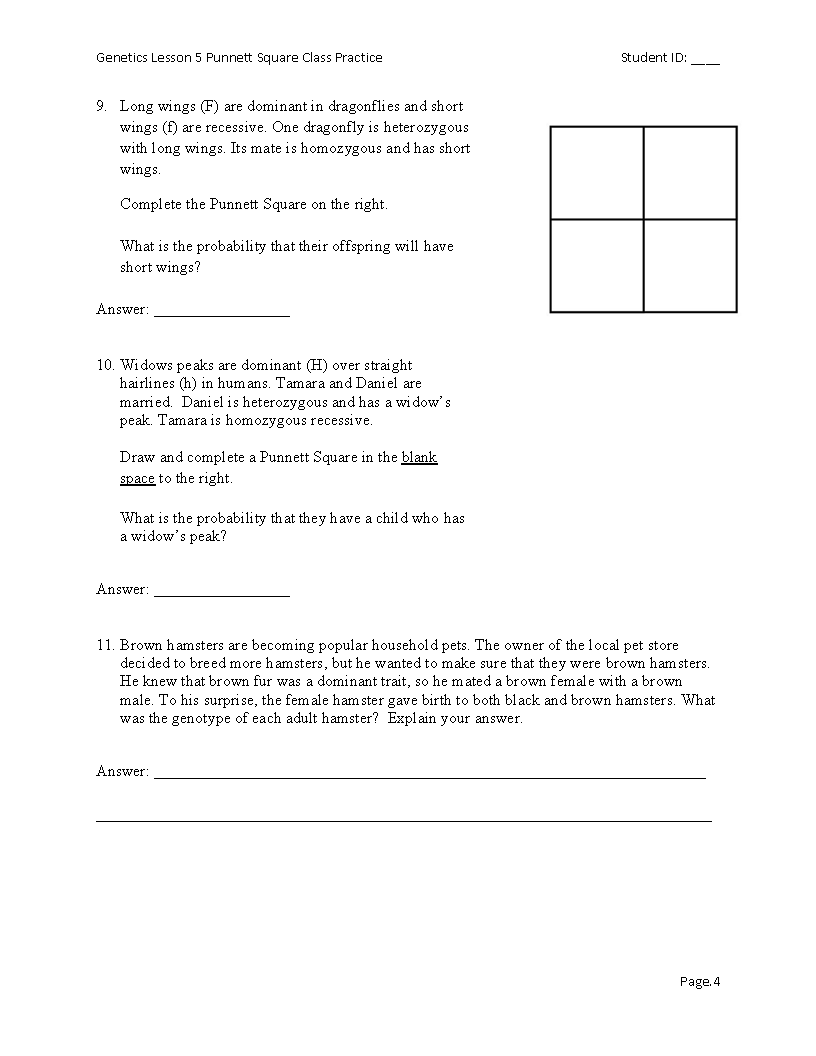
*Answer: 25%*

**7.** In this question the sperm and egg scaffold has been removed. Students are just left with the Punnett square. Students use their understanding from questions 1-6 to complete this question. This can be done individually or in pairs. Students should explain their answer using evidence from their Punnett square.

*Answer: It is possible because every time they have a child, there is a 25% chance that the child will not have dimples.*

**8.** In this question only the Punnett square is presented to the students. Students need to understand the meaning of both heterozygote and homozygote. Students determine the chance of an offspring that does not have webbed digits.

*Answer: 0%*



**Day 2 – Punnett Squares**

**Page 4**

**9**. Again, only the Punnett square is presented to the students in this problem. This problem is similar to question #8.

*Answer: 50%*

**10.** In this question, no scaffold is given to the students. Students must construct their own Punnett square.

*Answer: 50%*

***Closure***

*Use question 11 as a closure and formative assessment of student competence with Punnett squares and terminology up to this point.*

**11.** Students are given the traits of the mother, father, and their 2 offspring (hamsters). Students need to determine the genotypes of the each of the adult hamsters. Students will have to work backwards in the problem and explain how they were able to determine the genotypes of the adult hamsters. Encourage students to give support and reasoning for their answers using the terminology from this lesson.

*Answer: Could be either Bb, Bb*

Homework: Assign homework

**Lesson 5 – Introduction to Genetics Terminology and Punnett Squares**

**Unit:** Genetics

**Lesson**: 5

**Main Idea:** Inheritance Patterns, Variation, Genetic Structure and Terminology

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**Lesson Timeline:**

3 Days

Day 1 Genetics Terms and Line Diagrams

Day 2 Punnett Squares

Day 3 Punnett Squares

**Lesson 5 – Introduction to Genetics Terminology and Punnett Squares**

**Day 3 – Punnett Squares**

**Objective:** Students will be able to use Punnet Squares to make predictions about likely genotypes and phenotypes of offspring.

**Assessment:** Depending on which worksheets are being used we recommend using:

Practice 2: question 9

Practice 3: question 6

Practice 4: question 6

**Materials:**

PowerPoint: PRACCIS Genetics Lesson 5 - Day 2 & 3 Punnett Squares Introduction Class

Word Doc: PRACCIS Genetics Lesson 5 - Day 2 & 3 Punnett Square Practice Part 2 Student Packet

Word Doc: PRACCIS Genetics lesson 5 - Terms Diagrams and Punnett Squares Teacher Packet

**Do Now:** Choose a practice set and have students start working on it for their Do Now.

**Procedure:** There are more detailed instructions below.

**Closure:** This is at the teacher’s discretion. We recommend using practice 3 question 6 or practice 4 question 6. Either question can be used as the assessment and closure of day 3.

**Homework:** At the teacher’s discretion.

**Modifications:** Planned by the teacher as it fits the needs of their students.

