Born of Blood: Fun Punns
Activity 3C - Part 3

Activity Objectives:

Using descriptive cards and large Punnett Squares, students will be able to:

- Infer how genes determine the ABO blood types
- Predict the blood types of offspring from parents of known blood types using Punnett Squares
- Demonstrate how Punnett Squares are related to genes and chromosomes

Activity Description:

Using giant *Punnett Squares*, crepe paper chromosome streamers and descriptive cards, students will work in groups of eight to explore the inheritance of ABO blood types. They will also predict the ABO blood types of offspring from various genetic crosses. Students will assume the roles of *Random Runner, Chromo-Caller, Likli' Hoods* (possible offspring), *Mom G'nome* and *Dad G'nome* as they explore the world of Punnett Squares in a kinesthetic, fun way.

Activity Background:

We are complex beings made up of thousands of characteristics (traits). The "blueprint" for all of these traits is in our chromosomes. *Chromosomes* are made of DNA (deoxyribonucleic acid) and proteins. They are found in the nucleus of every body cell, except red blood cells. Red blood cells do not contain a nucleus and therefore do not contain the chromosomes found in body cells with a nucleus. We have a total of 23 kinds of chromosomes, each with information for hundreds or thousands of traits. Each kind of human chromosome is numbered 1through 23. We inherit one of each kind of chromosome from our mother and one of each kind from our father. This means we end up with 23 *pairs* of chromosomes, for a total of 46.

Chromosomes are usually found in long, twisted strands in the nucleus, much like spaghetti twisted in a bowl. When a cell is ready to divide, the chromosomes become shorter and thicker and make copies of themselves. The two copies are held together at the center, which gives them the appearance of an "X" – at this point, they are visible under a light microscope. When a cell divides, each daughter cell gets one copy of every chromosome, or a full set of 46.

Activity Overview

CAST YOUR NET: ADVENTURES WITH BLOOD

LESSON 3
ACTIVITY 3C

The traits you have are determined by the genes in the chromosomes you inherit from your parents. A *gene* is a specific place on a chromosome that is responsible for a trait (characteristic). Every trait is controlled by at least one gene from Mom and at least one gene from Dad, thus it takes at least one gene pair to control a trait. Some genes are controlled by only one gene pair and other traits are controlled by more than one gene pair. For example, having hair on your hands is a trait controlled by a single gene pair. Eye color is a trait controlled by three gene pairs. ABO blood type is controlled by at least two gene pairs. Since half of your chromosomes come from your mother, you may have many of the same traits that she has. You may also have many traits in common with your father since half of your genetic material comes from him. With thousands of traits being controlled by the genes, keeping track of all of them becomes quite difficult. Therefore, when we look at the inheritance of traits, we usually begin by looking at one trait at a time, as we will do in this activity.

Activity Materials: (per group of 8)

- 1 copy of *Student Information Page*
- 1 copy of *Student Data Page* per student
- 1 roll red crepe paper streamer (A gene)
- 1 roll blue crepe paper streamer (B gene)
- 1 roll yellow crepe paper streamer (O gene)
- 1 roll masking tape (colored if possible)
- 1 set task cards (laminated for reuse if possible)
- 1 set of *Role Signs* with string attached (laminated for reuse if possible)
- 1 set of *Chromo-Cross Cards* (laminated if possible)
- Meter stick
- Scissors
- 4 pair disposable gloves: one from each pair labeled From Mom and one from each pair labeled From Dad
- 1 Marker

Activity Management Suggestions:

1. If possible, laminate the *Role Cards* and *Role Signs* so they can be reused.
2. Using masking tape, preferably colored, mark off three or four six-foot Punnett Squares on the floor and number each square as shown in *Figure 1* below.

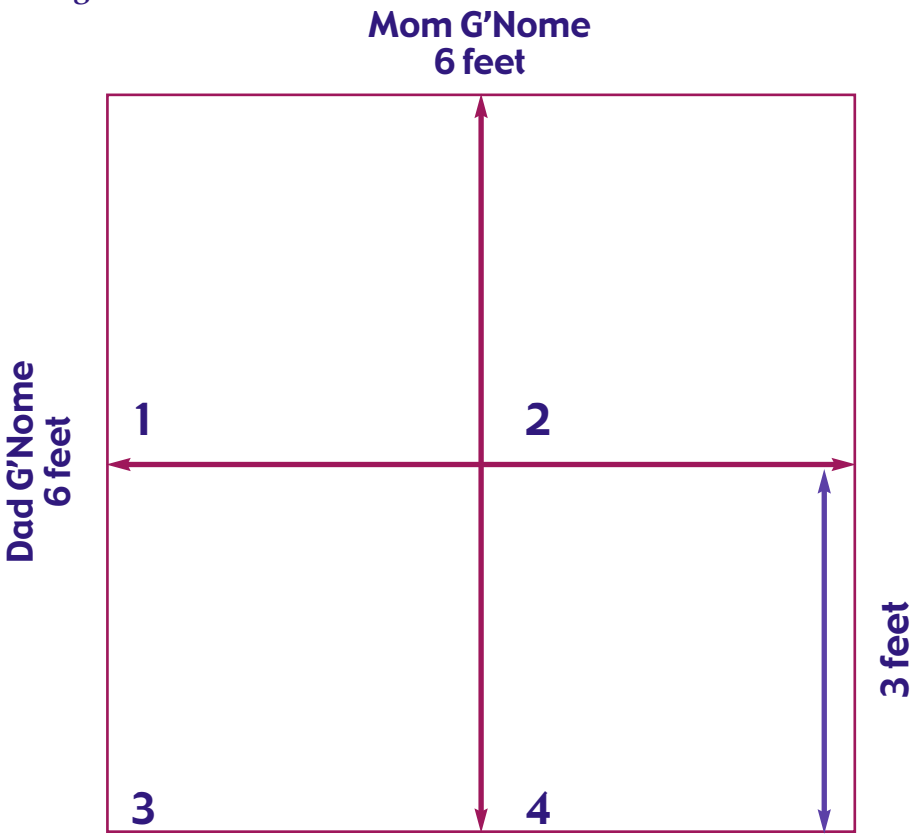


Figure 1 Dimensions for Fun-Punns

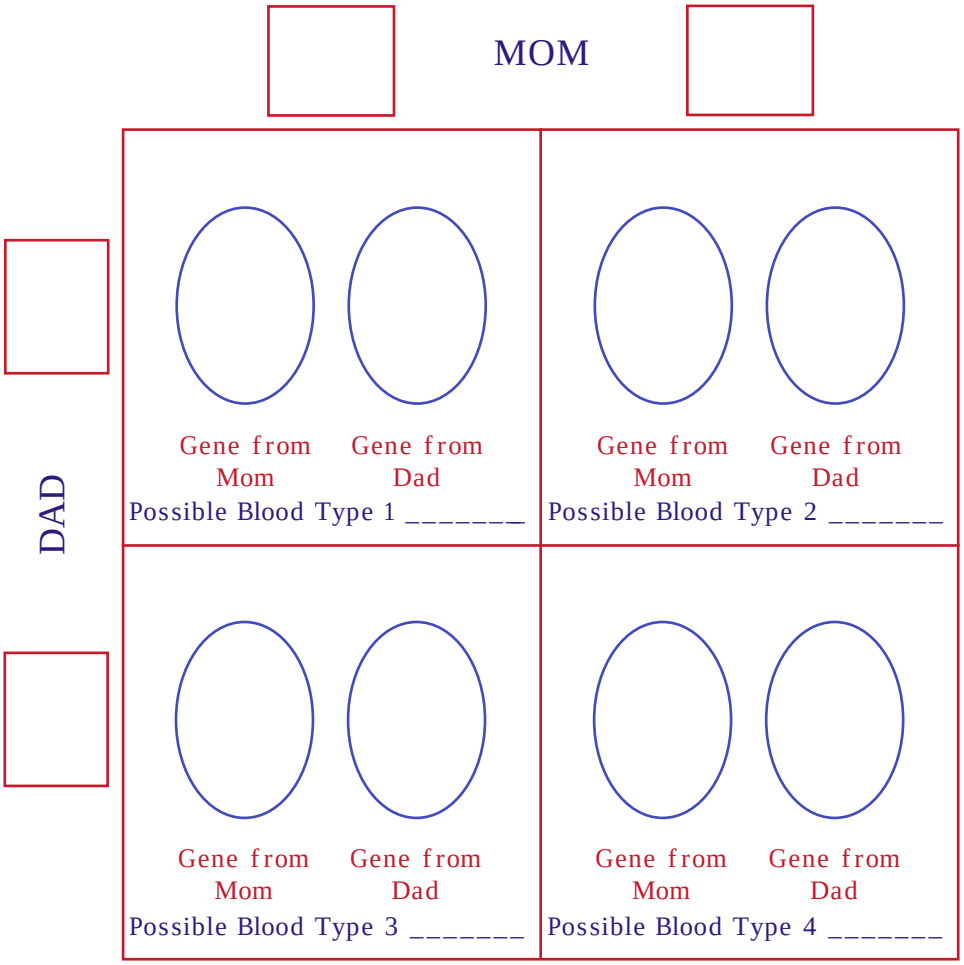
3. Divide the class into groups of 8 and review group role assignments and expected behavior. Assign each group to one of the giant Punnett Squares.
4. Cut 8 one-meter strips of crepe paper in each color per group. Each group will have 24 crepe paper chromosome strips when they finish.
5. Using a maker, make a mark 30 cm from one end of the crepe paper chromosome. Label it ABO gene. (See *Figure 2*)

Figure 2 ABO Gene

6. If the crepe paper chromosome streamer is red, label the gene A. If the streamer is blue, label the gene B and if the streamer is yellow, label the gene O.
7. Have each student choose a *Role Card* and matching *Role Sign* with string attached so they can hang the sign around their necks. Instruct students to read the *Role Card* and be sure they understand their job as described on the card.

Note: If your students have not yet learned to use Punnett Squares, you may use this example to teach them the basics.

*Traits in the offspring of two parents can be **predicted** using Punnett Squares. We will use "hairy hands" in our example since it is controlled by a single gene on the chromosome from Mom and a single gene on the chromosome from Dad. (Remember that every trait is controlled by two genes, one from Mom and one from Dad). In the case of "hairy hands", there are two forms of the "hairy hand gene". There is a dominant gene, which we will call "H" and a recessive gene, which we will call "h". If the dominant and recessive gene are both inherited, the dominant gene will mask (cover) the recessive gene and the baby will have hairy hands. If the baby inherits two dominant genes, it will have hairy hands. The only way it will have hairless hands is to inherit two recessive genes, one from each parent.* Refer to **Born of Blood: Inheritance of Blood Types, Part 4**, pages 3, 4, and 5 for help in using the Punnett Squares.



BLUE = B gene RED = A gene YELLOW = O gene

Be sure to explain to students that the ABO blood group is slightly different in that there are three variations of the gene that ultimately determine which type of blood a person will have. These genes are said to be co-dominant, so one will not mask (cover up) the others. If two different genes are present, both will express themselves.

Activity References Used:

GENOME...the autobiography of a species in 23 chapters website
http://flysci.com/genome/genome_9.asp

The Human Genome Project at Sanger Centre at the Welcome Trust Genome Campus
http://www.wellcome.ac.uk/doc_WTD002945.html

Chromosomes and Genetic Mapping
http://www.woodrow.org/teachers/bi/1994/chromosomes.html

Human Genome Project
http://www.ornl.gov/sci/techresources/Human_Genome/home.shtml

National Institutes of Health
National Center for Biotechnology Information,

National Institutes of Health, Bethesda MD 20894, USA.
http://www.ncbi.nlm.nih.gov/SCIENCE96/chr.cgi?9