Born of Blood:
Craft Stick Chromosomes
Activity 3C - Part 1

Activity Overview

CAST YOUR NET: ADVENTURES WITH BLOOD

Activity Objectives:

Using wooden craft stick chromosomes, students will be able to:

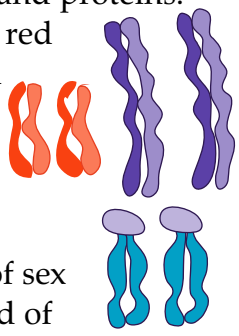
- Define critical attributes of human chromosomes
- Match homologous chromosomes to make a human karyotype
- Demonstrate how traits are encoded in genes found on our chromosomes

Activity Description:

Working in groups of eight, students will be given six *Craft Stick Chromosomes* from a set of 46. Since chromosomes exist in pairs within our cells, someone else in the group has a chromosome that will "match" and create a chromosome pair. Students must define critical attributes of their chromosomes as they look for "matching" chromosomes. When each student finds their six "matches", they use the *Chromosome Key Card* to number their chromosome pairs. Students will then create a karyotype of their *Craft Stick Chromosomes* by arranging them in sequential pairs. Once students understand that chromosomes have identifying characteristics, they are ready to map a few specific genes on a chromosome and create a large, mapped model of a chromosome. When all of the large chromosomes are completed, the classroom will become a giant nucleus with a complete set of 46 chromosomes.

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 24 *different* chromosomes, each with information for hundreds or thousands of traits. Each kind of human chromosome is numbered 1 through 22 (*autosomes*) plus a unique pair of sex chromosomes called X and Y. We inherit one of each kind of autosome from our mother and one of each kind from our father. We also inherit either an X or a Y from our fathers (*males have 1 X and 1 Y chromosome*) and one X chromosome from our mothers (*females have 2 X chromosomes*). This means we end up with 23 *pairs* of chromosomes, for a total of 46.



LESSON 3
ACTIVITY 3C

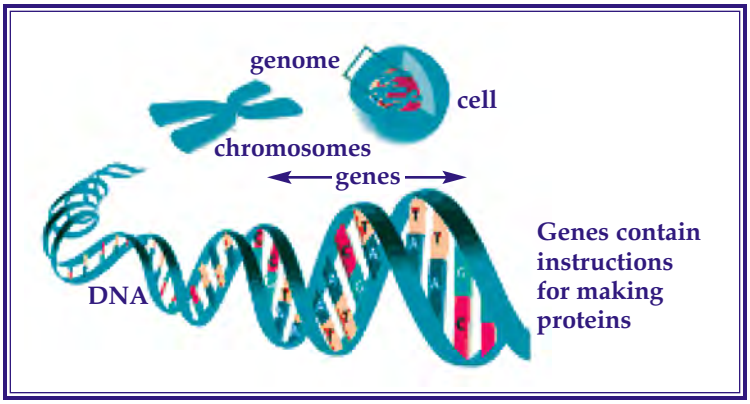
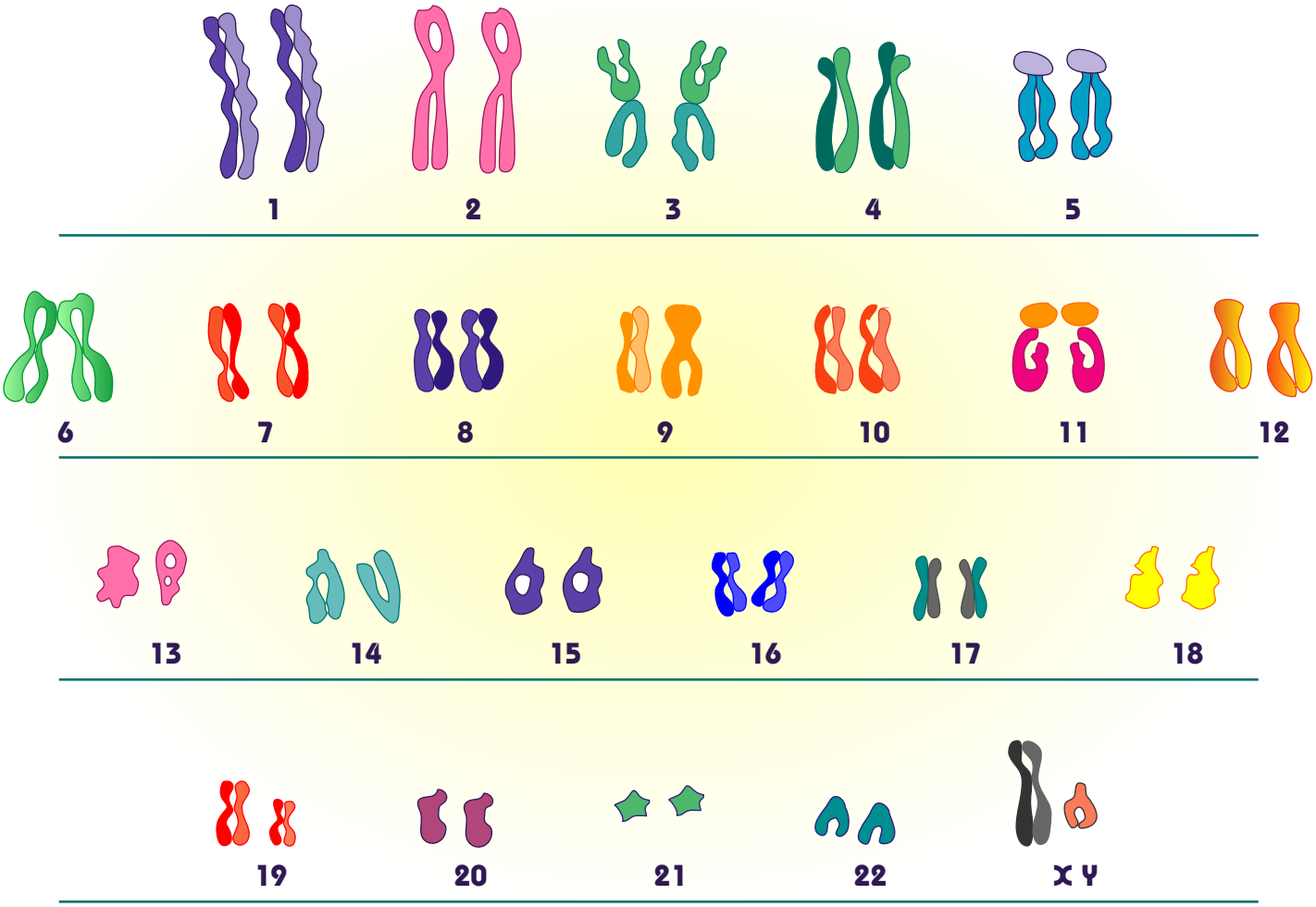


Figure 1 Chromosomes and Genes

image credit: U.S. Department of Energy Human Genome Program, http://www.ornl.gov/hgmis

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 (*centromere*), 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. These chromosomes can be matched and numbered to create human karyotypes, see *Figure 2 Human Karytope*.

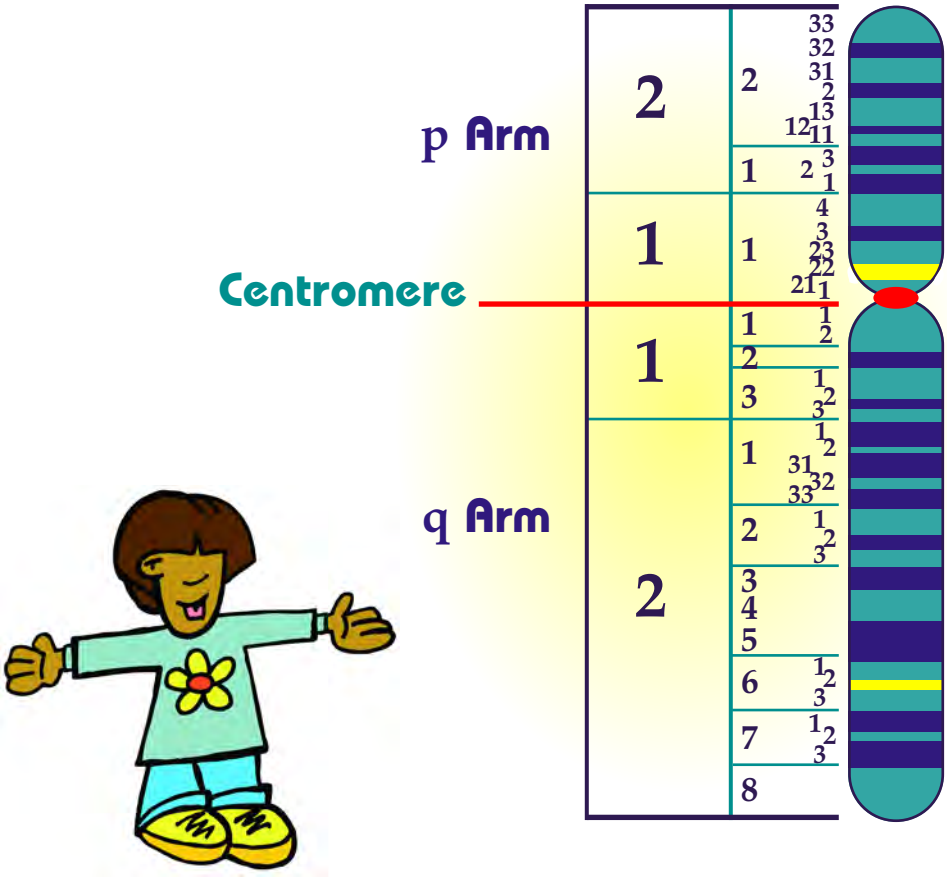
Figure 2 Human Karyotype



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 determines 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 traits are controlled by only one gene pair (*monogenic*) and other traits are controlled by more than one gene pair (*polygenic*). 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.

Thickened chromosomes have unique identifiers that are useful in studying human chromosomes and the genes on those chromosomes. *Centromere position* and *banding pattern* on chromosomes are specific to individual chromosomes and can be used to specifically identify one chromosome from another. Each chromosome is divided into two parts by the *centromere*, shown in red on each chromosome model. The short part of the chromosome is called the *p Arm* and the long arm is called the *q Arm*. Each band on a chromosome is numbered and thus provided a location marker geneticists use to map *genes* along a chromosome. Diagrams of each chromosome with numbered bands are called *ideograms*, see Figure 3 below.

Figure 3 Chromosome X Ideogram



Activity Materials:

- 1 copy of *Student Information Page* per group
- 1 copy of *Student Data Page* per student
- 1 set of *Chromosome Patterns* per group
- 24 slim craft sticks in assorted colors per group of 4
- 1 Metric ruler per student
- Scissors
- Colored markers
- Glue Sticks

Activity Management Suggestions:

1. Review group skills with students
2. Review basic definitions of genes and chromosomes
3. If students use scissors to cut the sticks, they should wear safety goggles and take care that pieces of the craft sticks do not fly across the room, causing injury to themselves or their classmates.
4. For a change of pace, consider taking students outside as they assemble their *Chromosome Model Karyotypes*.

Activity References Used:

Online Mendelian Inheritance in Man website:
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?CMD=search&DB=omim

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
http://www.ncbi.nlm.nih.gov/

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

Genome News Network Website
http://www.genomenewsnetwork.org/resources/whats_a_genome/Chp1_1_1.shtml#genome1