Name:_____ Date:_____

High Altitude and Blood Oxygen Content
A Simulation of Survival

When you travel to an area of high altitude, you are likely to suffer from hypoxia, a condition created by a diminished supply of oxygen to body tissues. At high altitudes the air is much thinner than at sea level. As a result, a person inhales fewer oxygen molecules with each breath. Symptoms of hypoxia, sometimes known as mountain sickness, include headaches, vomiting, sleeplessness, impaired thinking, and an inability to sustain long periods of physical activity. At elevations above 25,000 feet, hypoxia can kill.

Tibetan populations, less than 3000 years ago or so, developed a few mutations that allowed them to live much better at high altitude. One of those mutations is associated with being able to have a larger than average lung capacity, and another is associated with being able to bind more oxygen in the blood stream, even when the environment has very little oxygen in it, as is the case at high altitude. It has been documented that Tibetan women with a high likelihood of possessing one to two alleles for high blood-oxygen content (which is odd for normal women) had more surviving children; the higher the oxygen capacity, the lower the infant mortality. The more offspring these women have, the more frequent the allele will become in that population over time.

You will now take part in a simulation to determine your own survival based on the environment in which you live… good luck!

Simulation Activity

The class will now be randomly split into two groups. Half of the class is living in an area of Tibet, which is at a very high altitude. The other half of the class is living in the United States, in a city that is at sea level. Now each student will need to determine their genotypes and phenotypes in order to determine their survival in their assigned environment.

Determine Your Genotype

Alleles:

There are two alleles that are involved in blood oxygen content.

H: codes for hemoglobin that binds a "normal" blood oxygen content

h: codes for hemoglobin that binds a high blood oxygen content.

Genotypes:

You will flip 2 coins, one for an allele from mom and one for an allele from dad, to figure out your genotype and phenotype. Use the key below, based on the genotype you come up with, to determine your phenotype. **Heads will be "H" and tails will be "h".**

Key:

HH: Normal hemoglobin
Hh: Some normal hemoglobin and some that can bind more oxygen (carrier)
hh: All abnormal hemoglobin that can bind more oxygen at high altitude

Your genotype

Coin Flip 1 (Allele 1)	Coin Flip 2 (Allele 2)	Phenotype

Please grab an appropriate phenotype tag to hold up in the next section.

Survival

The class should get back together but keep the two groups separate. Everyone should stand up.

If you live in Tibet, your survival is based upon the following information:

HH individuals suffer from hypoxia at high altitude, thus you are unable to survive in this environment. Please sit down.

Hh individuals are able to survive a bit better at high altitude, thus you are able to survive in this environment. Keep standing and raise 2 fingers (representing your number of offspring).

hh individuals have are able to survive and reproduce, as your blood oxygen is high at this altitude. Keep standing and raise 4 fingers (representing your number of offspring).

If you live in the US, your survival is based upon the following information:

HH individuals are able to survive and reproduce. Keep standing and raise 4 fingers (representing your number of offspring).

Hh individuals are able to survive and reproduce. Keep standing and raise 4 fingers (representing your number of offspring).

hh individuals are able to survive and reproduce. Keep standing and raise 4 fingers (representing your number of offspring).

Debrief

- Look around at the survivors in each scenario.

- What phenotypes seem like they are going to be more prevalent in the next generation, and in generations to come? How do the phenotypes differ based on environment?

- Think about how the environment played a role in the survival of each genotype. How does this relate to evolution?

Note: Teacher should print these out ahead of class, making copies so that there are enough for each possible probability outcome.

Normal	Normal, Carrier	High blood-oxygen
Normal	Normal, Carrier	High blood-oxygen
Normal	Normal, Carrier	High blood-oxygen