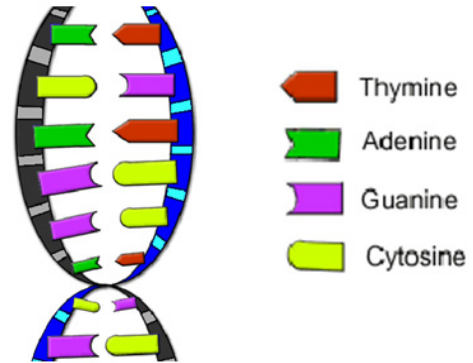# TWO-STAGE PROBABILITY (REAL LIFE)
INVESTIGATION
GENETICS

Q1. DNA (deoxyribonucleic acid) is the chemical of which all our genes are made.

DNA is composed of only 4 different types of nitrogen bases (thymine, adenine, guanine and cytosine). It is the order of these that determines the proteins that are made from DNA.

(a) From the diagram on the right, write the order of nitrogen bases shown on the left strand beginning with Adenine (green),

——————— , ————— , ————— ————— , ————— .

(b) How many possible combinations of 4 nitrogen bases can be made? Explain your reasoning.

(c) If an alien creature with only 3 nitrogen bases in its DNA was found on another planet, how many combinations of nitrogen bases could there be in the alien DNA?

Examples of proteins include muscle, hair structure, hair colour, eye colour, skin colour, haemoglobin that carries oxygen in our blood, antibodies that fight infection and so many more. These proteins determine much about our appearance.

Proteins are made of approximately 20 amino acids. The order of the amino acids determines the type of protein made.

(d) How many possible combinations of proteins can be made from 20 amino acids oif they can be used more than once?

(e) How many possible combinations of proteins can be made from 20 amino acids if they can be used only once?

Q2. Humans have 23 pairs of chromosomes. One pair of these is the sex chromosomes. Males have XY sex chromosomes. Females have XX chromosomes. The letters indicate the sex chromosome shapes.
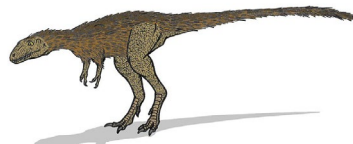

Male sperm contains either the X or the Y chromosome. Female eggs contain either one X or the other X chromosome. The table below shows the children's possible sexes.

		MOTHER'S EGG	
		X	X
FATHER'S SPERM	X	XX	XX
	Y	XY	XY

(a) As you can see, the chance of having a baby boy is 2 out of 4 or ½. What is the chance of having a baby girl?

(b) Which parent – mother or father – determines whether a child will be a boy or a girl? Explain.

Q3. Most mammals have the same sets of sex chromosomes as humans do. However, birds have the opposite – ZZ is male and ZW is female. The letters indicate the sex chromosome shapes.

(a) The first female dinosaurs appeared about 230 million years ago. They have the same sex chromosomes as birds have. Complete the table showing the offspring's sexes.

		FATHER'S SEX CELL	
		Z	W
MOTHER'S SEX CELL	Z		
	Z		

(b) What is the chance of having a baby girl dinosaur?

(c) Which parent – mother or father – determines the sex of the offspring? Explain.

(d) What else can you deduce from this information?

Q4. Often we hear about the chance of having a particular condition, illness or injury.

For example, the chance that you live in New York will be:

P (New York resident) = <u>Population of New York</u>
                      World Population

                = <u>8 million</u>
                  7 billion

                = 8/7000 or 0.0011 or 0.11%

(a) The chance of being left-handed is 1 in 4 or 25%. What then is the chance that you are a left-handed person living in New York?

(b) Research the internet to find the chance of the following conditions. The last two are for your choices.

CONDITION, ILLNESS OR INJURY	PROBABILITY AS A FRACTION	PROBABILITY AS A DECIMAL	PROBABILITY AS A PERCENTAGE
Autistic			
Allergic to peanuts			
Being attacked by a shark			

(c) If you do suffer from asthma and you live in New York, here is the website to know the forecast for both the weather and whether you will suffer from an asthma attack in the coming days.

https://www.accuweather.com/en/us/new-york-ny/10007/asthma-weather/349727

How do scientists determine this forecast? How accurate will it be?