Biology 1305 – Modern Concepts in Bioscience – ICB Textbook
Week of September 27th, 2020
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Hello everyone!! I hope you are all enjoying the Biology ICB class. Remember we continue to have group Tutoring for this class each week. If you cannot make it to Group Tutoring, also know that these resources are available to you in the tutoring center website. If you wish to attend group tutoring, make sure you reserve a spot via the tutoring center website.

Our Group Tutoring sessions will be every Tuesday from 6:00 – 7:00 PM. You can reserve a spot at https://baylor.edu/tutoring. I hope to see you there!

Last week, we went over the how cells pick and choose information and we introduced the probability rules in genetics. That resource can be found here:
https://www.baylor.edu/support_programs/index.php?id=967950

This week, we will revisit **the probability rules in the context of genetics, and start talking about how eukaryotes produce new cells.**

PROBABILITY RULES IN GENETICS

As we mentioned last week, probability rules in genetics allow you to predict genotypes of offspring based on the genotypes of the parents.

The Multiplication Rule: Key word is ***AND.*** This rule specifies that inheritance events are INDEPENDENT.

EXAMPLE: Consider a cross of two pea plants, one with genotype YY and the other with genotype yy. To produce a F1 generation. Then, consider a self-pollination of F1 to produce the F2 generation.

Let's look at Punnett Squares to have a visual representation of these crosses and their probabilities.

To get an F1 generation we cross YY and yy:

	Y	Y
y	Yy	Yy
y	Yy	Yy

YY = 0/4
Yy = 4/4 (1)
yy = 0/4

To get an F2 generation we cross Yy and Yy:

	Y	y
Y	YY	Yy
y	Yy	yy

YY = 1/4
Yy = 2/4 (1/2)
yy = 1/4

- **What is the probability that a particular F2 pea is YY?**

Here we need to know that for this to be possible, the pea must inherit Y from the pollen ***and*** also Y from the egg, yet these two events are INDEPENDENT. Because they are independent, the multiplication rule says that the probability of inheriting Y from the pollen (1/2) is multiplied by the probability of getting Y from the egg (1/2). Therefore:

$$\frac{1}{2} * \frac{1}{2} = \frac{1}{4}$$

So, the answer is: The probability of a F2 generation to be YY is 1/4 .

****There is one case in which the multiplication rule can be applied when events are not independent, but here you need to know the probability of one of the events. This is considered CONDITIONAL PROBABILITY, because one event does depend on the occurrence of another.**

The Addition Rule: Key word is ***OR*****.** This rules specifies that events being considered are MUTUALLY EXCLUSIVE, meaning they cannot occur simultaneously.

EXAMPLE: Let's use the same statement above; we have a cross of two pea plants, one with genotype YY and the other with genotype yy. To produce a F1 generation. Then, consider a self-pollination of F1 to produce the F2 generation.

- What is the probability that a particular F2 pea is homozygous?

Here the pea must inherit Y from both pollen and egg, ***or*** inherit y from both pollen and egg, but these events cannot occur simultaneously; therefore, they are mutually exclusive.
The addition rule then says that the probability of a pea being YY (1/4) is added to the probability of a pea being yy (1.4), Therefore:

$$\frac{1}{4} + \frac{1}{4} = \frac{1}{2}$$

The answer is: The probability of a F2 generation to be homozygous is 1/2.

Let's see more examples. Try solving them on your own, and check your answers at the end of the document.

1. Still considering a cross of two pea plants, one with genotype YY and the other with genotype yy to produce a F1 generation, followed by self-pollination of F1 to produce the F2 generation. What is the probability that a randomly chosen pea in an F3 generation is heterozygous is the F2 plants are self-pollinated?
2. If we start with a population of heterozygous F1 peas, what is the probability that a randomly chosen pea in the F3 generation is homozygous recessive?

Still need further help with the multiplication and addition rules? I highly recommend looking at the following videos – both are from the amazing tutors at Baylor!!!

https://www.youtube.com/watch?v=xvoVTvayJOI
https://www.youtube.com/watch?v=ODjNc3YgtNY

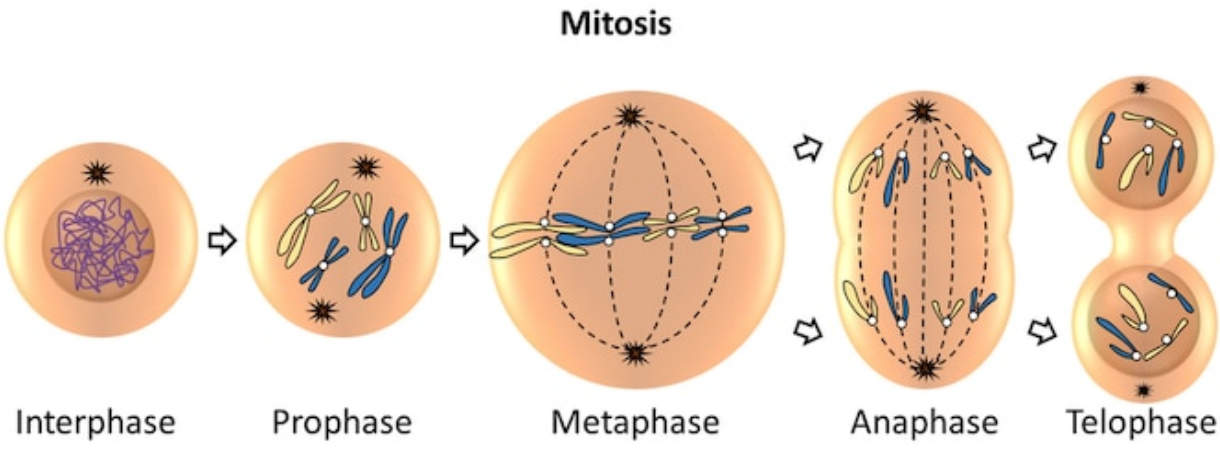
Khan Academy also has a great resource page with more examples for probability rules: Check out this here: https://www.khanacademy.org/science/high-school-biology/hs-classical-genetics/hs-introduction-to-heredity/a/probabilities-in-genetics

Do Eukaryotes produce new cells the same was as bacteria?

Recall that bacteria reproduce via **Binary Fision** and that, given they are relatively less complex given they do not have a true nucleus and membrane bound organelles, their division is more straight forward. In the case of Eukaryotes, **DNA is packed into Chromosomes**, located inside the nucleus. Thus, a different process of cell division is necessary. We call this process **MITOSIS**.

There is, however, a cycle that all eukaryotic cells go through. Mitosis is only a stage of the full cycle. See the table to the right; this shows the different stages and the average time that they take. **When G1, S and G2 are combined, they take the name of INTERPHASE**.

name	description	duration (hours)
G_1	growth and normal cellular functions	10
S	synthesis of DNA	8
G_2	growth and normal cellular functions	4
mitosis	separation of chromosomes	2



Source: Shutterstock.com

The following video covers the details of the phases in Mitosis. It's an 8-minute clip, but I'm sure it will be advantageous to understand how eukaryotic cells divide. https://www.youtube.com/watch?v=6yIwA4IHmoo

ANSWERS

1.
Probability of F2 parent being heterozygous = ½
Probability that the F2 progeny is heterozygous = ½

Multiplication Rule: ½ * ½ = ¼

In this case, we multiplied the probability of the first event (F2 heterozygote) and the probability of the second event (F3 heterozygote) **GIVEN** the first event occurred. Since one probability depends on the occurrence of another event, this is known as **CONDITIONAL PROBABILITY.**

2.
To calculate the probability of a yy in F3, we need to see that the probability of a yy pea in the F3 generation is the probability of a yy F2 parent (1/4), times the probability of a yy progeny given a yy parent (1), plus the probability of a heterozygotic F2 parent (1/2) times the probability of a yy progeny given a heterozygotic parent (1/4). Therefore,

1/4 + 1/8 = 3/8

That's it this week. Please reach out if you have any questions and don't forget to visit the Tutoring Center website for further information.