Hello everyone!! We made it to the final week of tutoring resources and I hope that these documents were useful in preparation for your class’ evaluations. As you know, your final exam will be comprehensive but it is impossible to include all of the material covered this semester in a couple of pages. Thus, in this document, I will include the last concepts from week 14, looking into communication between single-celled organisms and microbiota, and provide a brief list of important topics to keep in mind when you study for your final.

First, **how do single-celled organisms communicate with one another?** Organisms like bacteria use **chemical signals** to identify members of their own species and to determine the density of the cell population. They also use chemical signals in mutualistic interactions with other species, such as the relationship between squids and the bacteria *Vibrio fischeri*. In this case, the bacteria induces bioluminescence (produce light), which helps organisms in dark environments, but *V. fischeri* does not sense darkness directly, so how do bacteria know when to produce light? The answer is by **QUORUM SENSING**, a process by which bacteria coordinate behavior by detecting cell density. In dark environments, *V. fischeri* grows to high densities and this in turn activate the expression of an enzyme called **LUCIFERASE**, the same enzyme that produces light in fireflies. Look at the figure to the right >>>>>>>>

This is a representation of the processes that activate the luciferase genes and their expression when a signal is received from an autoinducer. The autoinducer in the *V. fischeri* example is cell density. The molecules in the yellow squares correspond to the autoinducers secreted by different species of bacteria.

Now, it’s cool how bacteria uses cell density to induce bioluminescence, but **how do they sense cell density itself?** The process is similar to the bioluminescence production and also involves **QUORUM SENSING**. In this case, the secretions from bacteria work as the inducers to produce a response. See the figure to the right >>>>>>>>
Notice that in the figures above showing *E. coli* quorum sensing processes, cells display different quorum sensing behavior. The percent glucose concentration (purple; left y-axis) affects the amount of autoinducer secreted (orange bars; left y-axis) but not the number of *E. coli* cells (cell density in teal; right y-axis). As the glucose concentration drops, the autoinducer secretions start to increase in response to increased cell density. Secretions are then reduced when densities reach their highest.

Let’s now explore the **MICROBIOME**, in response to the question: **How can 50% of the body’s cells be non-human?**

In this case, we are once again talking about symbiotic processes that allow organisms to co-exist and interact in a well-established relationship. Just as squids benefit from bioluminescent bacteria, humans also depend significantly on the **MICROBIOTA**, which is the collection of unicellular organisms that live in the body but do not correspond to human cells. The **MICROBIOME** is the description of the DNA form these organisms.

There are many examples that could be mentioned about how microbiota drives many processes that were once thought to be related to the body itself, not to other organisms. **Obesity is a major issue worldwide, and it is now known that the microbiome of obese individuals is different from that of healthy individuals.** Experimentation that have “injected” biota from healthy organisms into obese individuals have shown the ability to reduce weight, and as such the scientific and medical communities are considering “microbiome transplants”.

The following video provides a more detailed description of the microbiome, and I’m sure it will give you a strong basis to understand what this is all about: [https://www.youtube.com/watch?v=VzPD009qTN4](https://www.youtube.com/watch?v=VzPD009qTN4)

**Time to Review**

As you immerse yourselves in reviewing the concepts learned in this class, don’t forget about checking out all the resources this semester. They can be found here: [https://www.baylor.edu/support_programs/index.php?id=967950](https://www.baylor.edu/support_programs/index.php?id=967950).

In the first couple of weeks of the course, you were introduced to the concept of biological information. Here you answered questions such as:

- **What is biological information**
  In the context of biology, information corresponds to all signals transmitted through different life forms, from minuscule changes in molecules to major changes at the ecosystem level.

- **What is the heritable material**
  Information that contributes to maintaining life. **REVIEW THE GRIFFITH’S EXPERIMENT**

- **How do we know proteins are not heritable material**
  **REVIEW THE HERSHEY AND CHASE EXPERIMENT WITH BACTERIOPHAGES**

- **THIS INFORMATION IS IN RESOURCE #1-**

All diagrams, tables, and external information is property of Integrating Concepts in Biology by Campbell, Heyer and Paradise, unless otherwise specified.
Other important concepts include the **CENTRAL DOGMA** of biology, where you answered questions such as: **How does DNA communicate information to the cell?** How is gene transcription regulated and how do cells make proteins. **For this, remember transcription and translation!!!**

**Transcription**: the process of converting DNA to RNA by enzyme call RNA polymerase. **Translation**: the process of converting RNA to amino acids (proteins) by ribosomes.

A very important concept to remember for your final is **PROBABILITY RULES** in genetics. Here we encounter the multiplication and addition rules.

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

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

If you need further help with the multiplication and addition rule, 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

Next, we have **MITOSIS** and **MEIOSIS**, two important processes that altogether correspond to cell division in somatic cells and gametes, respectively. Pay special attention to processes like **RECOMBINATION** and **CROSSING OVER**, **CHROMATIDS** and **CHROMOSOMES**, **HOMOLOGOUS CHROMOSOMES**.

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Next, you learned about how cells first appeared. Here you explored **how the first nucleus came to being and how a whole genome fits in a tiny nucleus**.

- DNA replication, transcription and translation in eukaryotes seem to be from archaea origin.
- Contrarily, energy harvesting genes seem to be from bacterial origin.

Also, **REVIEW THE ENDOSYMBIONT THEORY**

You may also want to check the following video that gives a nice perspective on the endosymbiotic theory: [https://www.youtube.com/watch?v=eCWkRsJyKxA](https://www.youtube.com/watch?v=eCWkRsJyKxA)

Moving on, **how does a whole genome fits inside a tiny nucleus?** In short, double strand DNA, which represents an organism’s genome, starts wrapping around histone proteins, which then take a zig-zag structure in order to pack more DNA. Then the zig-zag sequences go into loops, and finally into chromosomes. This is how DNA is packed inside a nucleus.

It would be a good idea to check out the tutoring center’s video on “from DNA to chromosomes”: [https://www.youtube.com/watch?v=o-GMkIgLzys](https://www.youtube.com/watch?v=o-GMkIgLzys)

**-THIS INFORMATION IS IN RESOURCE #9-**

Other topics you may want to check out are those related to **EVOLUTION** and its four main mechanisms, and the tenets of **NATURAL SELECTION**.

Make sure you refresh your mind about the **Stanley Miller experiment**, which goal was to mimic the abiotic conditions of the early Earth and measure if organic molecules could form from the interaction of abiotic molecules.

**-THIS INFORMATION IS IN RESOURCE #7-**

**GOOD LUCK WITH YOUR FINAL EXAM, BEST WISHES WITH THE END OF THE SEMESTER AND HAPPY HOLIDAYS! SEE YOU IN BIOLOGY II NEXT SEMESTER!!**