

Name: _____ Date: _____ Per: _____

This article has been adapted from a scientific paper in the journal Biotechnology for Biofuels.¹

Gene regulatory networks are an important component of understanding how our genotypes (DNA) codes for our phenotypes (traits). Specifically, transcriptional regulatory networks—or processes that control the frequency of transcription (DNA coding for RNA)—are important to understanding how genes are expressed in an organism.

The environment that an organism is in and any changes that may occur to that environment have an impact on the way that genes are expressed. Certain environments may encourage a gene to increase one function (called “**upregulation**”) or decrease a function (called “**downregulation**”).

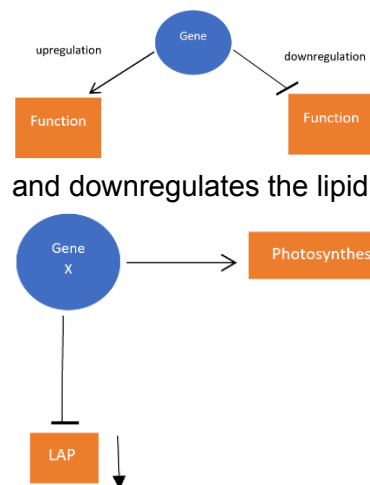


Figure 1 (on the left) includes a key (above) and a network (below) showing the normal functioning of “gene X” that upregulates photosynthesis in green algae, when grown in normal environments (sunlight, nutrient, and carbon dioxide availability), and downregulates the lipid accumulation phenotype (LAP). Green algae cells will normally produce very little lipid when provided with normal environments. When green algae are stressed, and they have limited nutrients—such as limited phosphorus or nitrogen in their environment, they will often build up a supply of lipid and prioritize storing energy instead of photosynthesizing. This can cause a change in the color of the algae.

1. Predict what you think will happen when the expression of gene X decreases. How will this impact the rate of photosynthesis? of lipid production?
2. What would be one example of a change in environment for green algae that may lead to a change in the way algae cells express their genotypes?

¹ ALG de Lomana, et. al. “Transcriptional program for nitrogen starvation-induced lipid accumulation in *Chlamydomonas reinhardtii*.” *Biotechnology for Biofuels* (2015) 8:207.

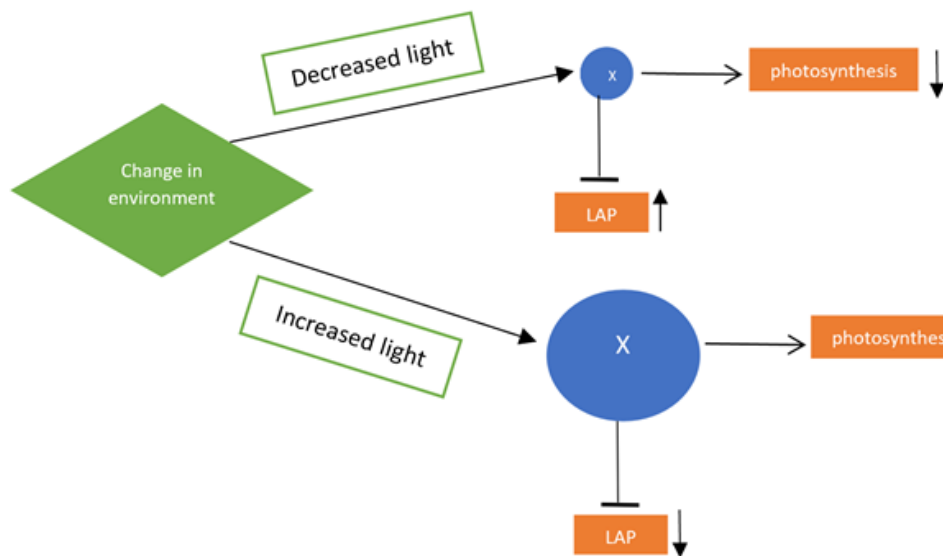
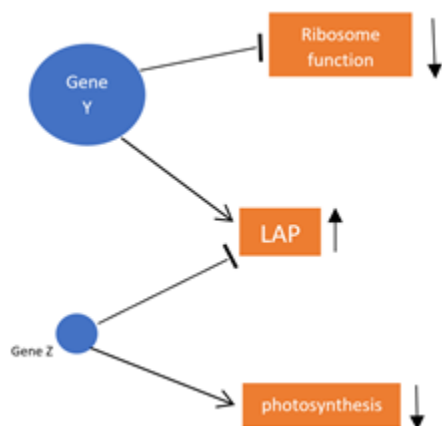


Figure 2 (to the left) shows the effects of a change in environment on the same gene. Gene X either increases in expression (represented by size) or decreases based on the change in environment—which in turn impacts the function of that gene (rate of photosynthesis and lipid accumulation phenotype)

3. Explain why you think a change in light concentration would have the shown effect on gene X. Use your previous knowledge of photosynthesis.

4. In the gene regulatory network below, notice how one mini network can have an effect on another. Also note that the decreased size of the gene circle indicates low gene expression vs. larger gene circles indicate high expression. a) What connects these two genes? (reference previous figures). b) If gene Y inhibits ribosomal function (causing it to decrease), why do you think that would lead to an increase in lipid accumulation phenotype?



6. Describe how your gene regulatory network might connect to another one. For example, one environmental influence may cause changes in gene expression in multiple genes

Jigsaw Activity: Venn Diagram

Rejoin your original group. You now have experts on each of 4 articles. Together, you will complete the Venn Diagram below relating the 4 topics. Ask each member of your group what the title and key points were from their article and fill them in to each corner of the diagram. As you notice common features, copy the points or draw arrows linking statements to the overlap sections (ignore the triple overlaps). Try and have at least 1 point for each area of overlap between pairs. If writing doesn't fit in the overlap spaces, just number them and include a list below. At the end, develop a statement that summarizes the common theme of the 4 articles and fill it into the center.

