

LENScience Senior Biology Seminar Series  
**Feast or Famine: Understanding Gene Expression**  
Questions and Discussion



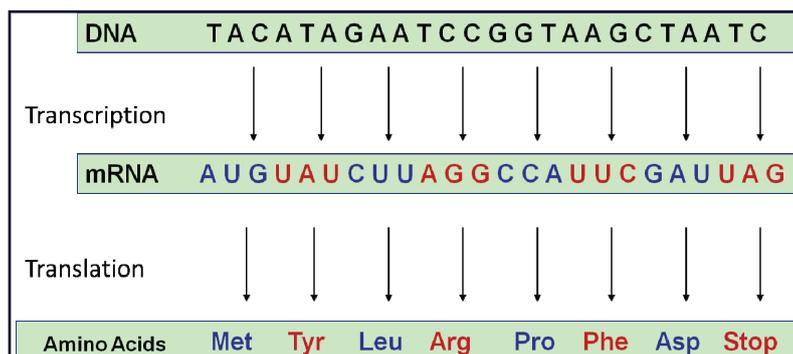
Pre-seminar School Discussion

This seminar focuses on the role of environment in gene expression. How does the environment that an individual organism experiences effect its phenotype? You are familiar with concepts of genotype and phenotype and you understand that phenotype can be influenced by environment. This seminar will help you explore both the way in which genes are turned on and off and the way in which the environment can effect molecular switches—sometimes for life. You will be introduced to the concept of epigenetics, a relatively new concept that scientists are discovering more and more about. Scientists at the Liggins Institute are investigating epigenetic gene regulation—that is how the environment interacts with the epigenome to effect the phenotype, and in particular long term health and disease outcomes in a person. The epigenome are those factors outside the genome that control which genes are turned on and off. If you like they are switches. The scientists at the Liggins Institute are interested in finding out how individuals can have quite different phenotype dependent on the environment they experience in early life.

A Review of Protein Synthesis

Use your *knowledge of Y12 Biology and the information in the seminar paper* to discuss the following questions.

1. Protein synthesis is a two stage process involving transcription and translation. Explain what happens in each stage of protein synthesis.



2. Scientists talk about coding and non-coding DNA. What do these terms mean?
3. What does the term *GENE EXPRESSION* mean?
4. Describe the relationship between DNA, RNA, and proteins and explain how mutations can impact on phenotype.
5. Describe a situation where the effect of environment on phenotype can be observed and potentially reversed if the environment changes.
6. Describe a situation where the effect of environment on phenotype can be observed and cannot be reversed if the environment changes.

## Vocabulary

Embryo	Genotype	Histone Proteins
Fetus	Phenotype	Methyl Group
Placenta	Epidemiology	Methylation
Menarche	DNA	Epigenetics
Puberty	RNA	Epigenome
Adolescence	Proteins	Epistasis
Body Mass Index	Transcription	Adaptation
Gene	Translation	Variation
Allele	Gene Expression	Natural Selection
Dominant	Gene Switch	Darwin
Recessive	Chromosome	Lamarck
		Developmental Plasticity

## Related topic—Bisphenol A

### Bio 3.2 AS 90714 vs 2 Research a Contemporary Biological Issue



Epigenetics is also linked to a current international issue that is becoming more widely known in New Zealand. Bisphenol A, a chemical found in many plastics including baby bottles, fillings that dentists use, linings for tin cans and much more has been shown to be linked with premature puberty and breast cancer.

In Canada, the use of plastics containing Bisphenol A in baby bottles has been banned. Internationally there is much debate over this issue. The New Zealand food safety authority is monitoring the situation.

Professor Ian Shaw, a toxicologist from Canterbury University and Principal Investigator for the National Research Centre for Growth and Development is an expert in this field. He is also a consultant to the NZ Food Safety Authority.

This is a contemporary biological issue for which different groups in society hold differing view points. You may wish to consider this issue for Bio 3.2.

## Recent news articles related to this topic:



Hear Professor Ian Shaw talking about this issue on Radio New Zealand, July 3, 2008.

[http://www.radionz.co.nz/audio/national/ocw/2008/07/03/plastic\\_bottles](http://www.radionz.co.nz/audio/national/ocw/2008/07/03/plastic_bottles)

Toxicologist warns of plastic baby-bottle risks The Press 12-5-08 <http://www.stuff.co.nz/national/418382>

Breast Cancer link to Plastic. Sunday Star Times 21-10-07 <http://www.stuff.co.nz/national/38640>

Dangers Lurking in Everyday Plastic Taranaki Daily News 3-6-09 <http://www.stuff.co.nz/taranaki-daily-news/features/2466806/Dangers-lurking-in-everyday-plastic>

Greens say NZ should ban plastic baby bottles 22-04-08 <http://www.stuff.co.nz/national/health/378987>



## Post Seminar Challenge Questions

1. Define the term early life nutritional environment means and discuss the potential that this environment has to impact on the health and well being of the individual. In your answer consider the following areas: early puberty; obesity; adult diseases.
2. Define oxidative stress and discuss how nutrition can contribute to minimising oxidative stress. You will need to look at resources beyond the seminar. A good place to start is [http://www.genox.com/what\\_is\\_oxidative\\_stress.html](http://www.genox.com/what_is_oxidative_stress.html) or <http://www.scienceinschool.org/2009/issue13/antioxidants>
3. It is well known that diet and lifestyle impact on health. Scientists have shown that in addition to environment during adulthood impacting on likelihood of disease, the environment that we are exposed to in the womb can alter our metabolic pathways and increase our likelihood of suffering from a number of adult diseases. Scientists are currently exploring why this happens and predict that it may be a result of epigenetic modifications in the relevant genes.

**Using the information presented in the seminar paper and your knowledge of gene expression, explain what is meant by epigenetic modification and why these modifications could potentially alter the phenotype that is expressed.**

**POST YOUR IDEAS, QUESTIONS AND SUGGESTED ANSWERS AT**  
[http://lens.auckland.ac.nz/index.php/Seminar\\_1\\_2010\\_Discussion\\_Page](http://lens.auckland.ac.nz/index.php/Seminar_1_2010_Discussion_Page)

### **Level 3 Achievement Standards linking to this seminar:**

AS 90714 Biology 3.2 Research a contemporary biological issue

AS 90715 Biology 3.3 Describe the role of DNA in relation to gene expression

### **Key Concepts from Level 3 Biology that link to this seminar:**

Below are selected objectives from the Year 13 biology programme that link to this seminar. THESE ARE NOT A FULL LIST OF THE CONCEPTS IN YOUR COURSE. You may wish to review these concepts before the seminar.

#### **Gene Expression / Genetics:**

- Describe DNA in terms of structure and function
- Describe the process of DNA replication and the role that enzymes have in this process
- Describe the process of protein synthesis and the role of DNA and enzymes in the production of proteins
- Describe the role of DNA in gene expression and the determination of phenotype
- Describe the control of gene expression at the transcriptional level in prokaryotes and eukaryotes
- Describe the role of metabolic pathways in the control of gene expression
- Explain the role of gene-gene interactions (epistasis, collaboration and polygenes) in determination of phenotype.
- Explain the potential effect of environment on expression of genes (although this is not a specific objective from the Y13 programme, understanding of this concept will allow you to understand metabolic pathways and control of gene expression—e.g. think about how the lac-operon is controlled by the presence or absence of lactose).

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