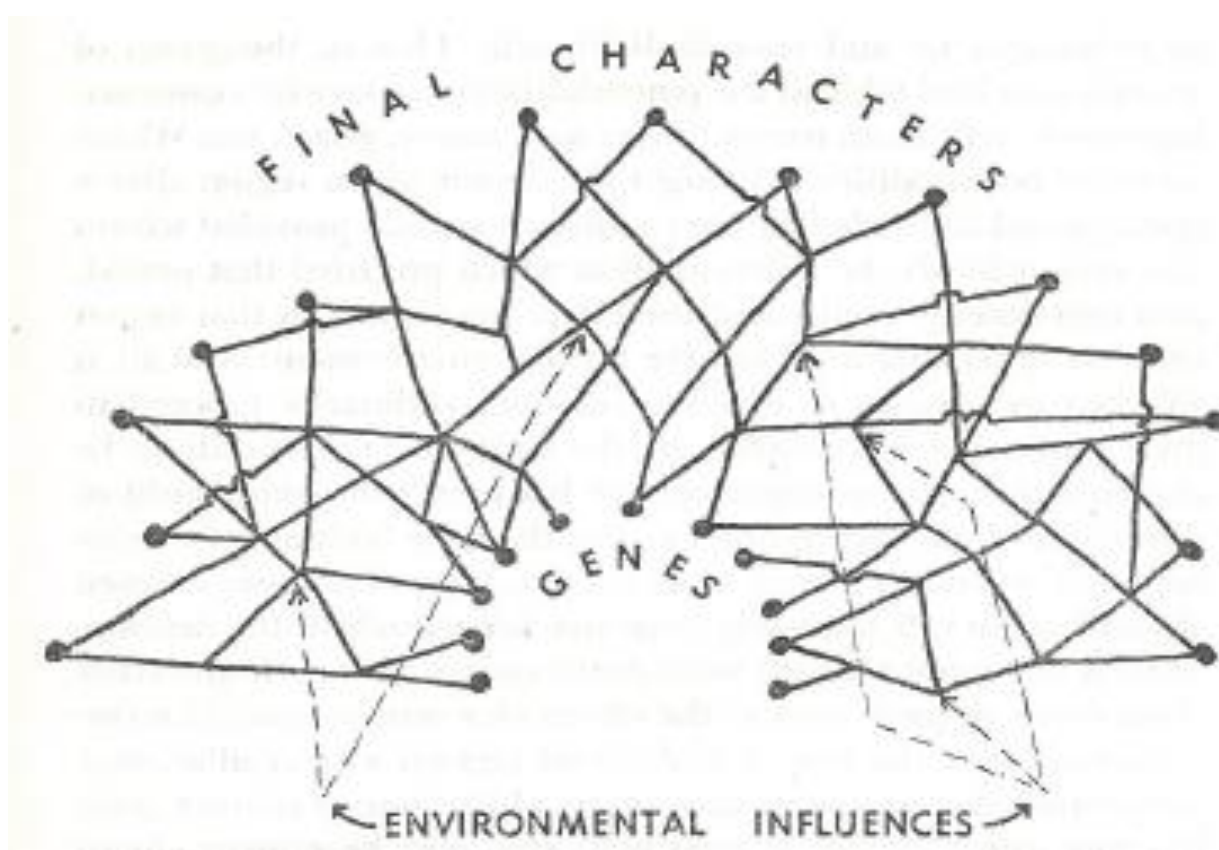


# Genetics Pedagogies Project

Annie Jamieson (A.K.Jamieson@leeds.ac.uk)

Semester 1, 2013-14



Source: Hermann J. Muller, 'Genetic Fundamentals: the Work of the Genes', in H. J. Muller, C. C. Little and Laurence H. Snyder, *Genetics, Medicine, and Man*. New York: Cornell University Press, 1947.



## **Module Aims & Objectives:**

### Aims

To provide students with a basic understanding of the principal concepts of modern genetics and of the impact and consequences of genetic developments on humans, both as individuals and society

### Objectives

On completion of the module, students should:

- i. have a basic knowledge of inheritance and gene expression in animals, especially humans, at molecular, cellular and organismal levels.
- ii. understand the importance of the interaction between genes and the environment in the development and function of organisms
- iii. be able to think critically about genetic issues in everyday life

## **Teaching Methods:**

There will be nine 1-hour lecture/seminars, starting in Week 2 (8<sup>th</sup> October). Questions and discussion are strongly encouraged in these sessions, which will be on Tuesdays at 5-6pm, in Baines Wing, Room G36.

## **Required Materials:**

All required reading materials will be supplied, either online or as photocopies.

## **Attendance:**

Obviously, this course is voluntary and extra-curricular, therefore attendance is not subject to the usual School regulations. However, the £100 payment and certificate of participation are dependent on your satisfactory participation in all of the activities, so that I can collect suitable data for the research study. The activities are as follows:

- Complete a questionnaire both before and after the set of lectures (this will be available online and will take about 30 minutes to complete)
- Attend nine weekly 1-hour lectures with related reading as preparation and participate in discussion where appropriate
- Complete online activities in Blackboard as required to complement the lectures - for example, short quizzes, blog entries etc.



- Take a multiple choice test at the end of the lectures to test your knowledge of the subject

If you do not complete all of the activities, the decision as to whether to give you payment lies with me. I am very keen to see all of you complete the course and I will be very reasonable in cases where you are unable to attend a lecture or complete an activity for good reason but it is very important that you contact me as soon as possible if this situation arises.

### **Private Study:**

I expect that the required reading and online activities should take you around 1 hour per week – if you find that it is taking you significantly longer than this, please let me know. Of course, if you want spend more time on additional reading, posting on the blog etc. - and you have that time to spare - please do!

### **Assessment:**

There will be an online, multiple-choice test at the end of this course. In order not to interfere with your examinations for credit-bearing modules, the test will be administered after the end of the January 2014 exam period (specific dates TBC).

### **Module Outline:**

#### **Lecture 1 (8<sup>th</sup> October): What is genetics?**

A broad introduction to the course, including:

- The questions raised by biological inheritance
- What is the environment?
- Inheritance and the environment
- Essential terminology for the course

#### **Lecture 2 (15<sup>th</sup> October): Basic development**

The important of development in understanding inheritance, including:

- How do we get from a single cell to a multi-celled, differentiated organism?
- How do cells containing the same basic genetic material develop into a wide range of cells-types?
- Environmental influence, contingency and chance in development.



**Lecture 3 (22<sup>nd</sup> October): How does it all work? (How genes are expressed 1)**

An introduction to the basic “mechanics” of DNA, including:

- DNA structure (and its consequences)
- Molecular processes associated with gene expression: replication, transcription, translation
- The Genetic Code
- Gene regulation

**Lecture 4 (29<sup>th</sup> October): How does it all work? (How genes are expressed 2)**

A review of how changes in any of the processes covered in lecture 3 can affect the ways in which a gene is expressed, including:

- Mutations
- Replication errors
- Mutagens and their effects (chemical, radiation)
- Transposition
- Epigenetics

**Lecture 5 (5<sup>th</sup> November): Chromosomes, linkage and genetic maps**

How DNA is packaged into chromosomes, the structure of the genome at the chromosomal level and how this allows genetic mapping, including:

- Mitosis and meiosis
- Chromosomes and karyotypes
- Linkage and recombination (linkage distances and recombination frequencies)
- Changes in chromosome structure and number

**Lecture 6 (12<sup>th</sup> November): Sex determination and sex-linkage**

This lecture will show how even such an apparently straightforward trait as sex is, in fact, much more complicated, including:

- Genotypic sex determination
- Environmental sex determination
- Human sex-determination
- X-inactivation



**Lecture 7 (19<sup>th</sup> November): Patterns of inheritance**

This lecture will show how, in some cases, observed patterns of inheritance can help us to understand and predict how traits are inherited, including:

- Model organisms: engineered systems for studying inheritance
  - Qualities of good model organisms/ limitations
- Dominance and recessiveness
- Use of pedigrees in studying inheritance
- Modes of inheritance
  - Autosomal dominant/recessive
  - Y-linked
  - X-linked dominant/recessive

**Lecture 8 (26<sup>th</sup> November): Factors affecting patterns of inheritance**

A detailed analysis, including a case study of molecular mechanisms (PKU) showing how the relationship between genotype and phenotype is not always straightforward, how phenotypes are produced by a combination of genes and environment, and how variable the results of this interaction can be:

- PKU in humans
- Pleiotropy
- Penetrance
- Expressivity
- Epistasis
- Lethal mutations
- Locus heterogeneity
- Imprinted genes

**Lecture 9 (10 December): What does it all mean?**

In this final lecture we will consider the social and ethical aspects and consequences of the course material, including:

- Genetics to genomics
  - Human Genome Project: potential and consequences
  - Comparative genomics: relationships between amount of DNA/number of genes and complexity
- Genetic testing: techniques and ethics
- “a gene for”...autism? Homosexuality? etc.
- Implications for individuals/ society
- Problems of genetic determinism



### **Resources & Reading List:**

A list of internet resources and books you may find interesting for supplemental reading will be available on Blackboard

### **Getting Help:**

If you have any queries or difficulties regarding this course, please let me know as soon as possible (you can speak with me after lectures, or e-mail to arrange an appointment to come and see me). It is particularly important that this extra-curricular course should not interfere in any way with your credit-bearing studies so, if you feel there may be any danger of this happening, please speak with me right away and we will try to find a solution.