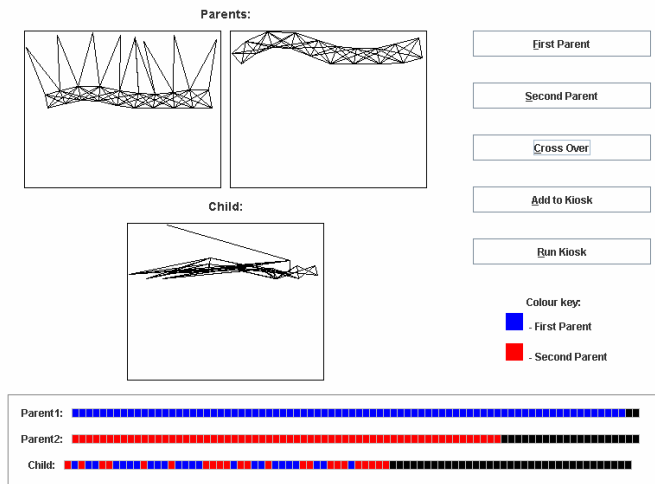


A Brief Synopsis

- **Introduction** [15 minutes]
 - Brief talk introducing pertinent issues.
 - Question and answer session, the purpose of which is to encourage pupils to think about how genes are inherited
- **Main** [25 minutes]



Pupils will use the ‘**Breeding Box**’ feature of our software and will be able to experiment with it, thereby gaining an insight into the way that an individual’s genes are inherited from both of its parents.

Pupils will report back on their findings.

Conclusion [15 minutes]

Questions and answers revisited, giving the pupils a chance to appreciate what has been learned.

Pupils will be asked to fill in a questionnaire.

- **Concurrent simulation**
 - Whilst the lesson is taking place, a simulation (or several) can be run, concurrent to, but separate from, the other activities. Progress can be monitored from time-to-time but will not require constant attention.

Key Teaching Metaphors

- **Genes** are represented as *separate units*, which together are shown in ‘*gene-bars*’ to represent an individual’s genetic code (genotype).
- A *section of this code* will correspond to a *specific part of the creature’s body*.
- The *inheritance of genes* is represented by the pattern of the *colours being passed on* in the ‘gene-bar’.
- When a Sodacreature is added to the kiosk and raced, this race can be thought of as a *race for survival*. The *quicker* a Sodacreature is, the *greater its reproductive success* is. *Failure to complete* the course can be likened to having a *lethal disease*.
- A Sodacreature represents a real-life animal or being. *Different types of Sodacreature represent different species*.

Links to the National Curriculum (based on the ‘Edexcel’ GCSE Double Award)

- explain how sexual reproduction... leads to variation in the new generation (2.07)
- recall that individuals inherit some characteristics from their father through the sperm and some from their mother through the egg (2.08)
- understand that genes are parts of chromosomes which are found within the nucleus (2.15)
- understand that the unit of inheritance is the gene, which is a section of a long chain (DNA) molecule (2.16)
- recall that some alleles cause diseases, which can be inherited (2.20)
- understand the terms...genotype and phenotype (2.23)
- describe how asexual reproduction leads to genetically identical individuals (clones) (2.27)

Lesson Plan for 'The Role of Inheritance in Evolution'

Key Teaching Points

- A creature *inherits its genetic components* from its parents. The recombination of existing genes can provide a near endless source of variation.
- The units of inheritance are known as *genes* and form part of a *chromosome*.
- Which genes are passed on from which parent is *not pre-determined* and is in fact subject to chance.
- An individual's *genotype* (coding of the genes) *determines* its *phenotype* (its appearance and performance).
- Due to the principle of inheritance, an individual will resemble each of its parents, in different aspects.
- Breeding between different species, in general, fails.

The Lesson Plan in More Detail

Preparation

Install our software on the required number of computers, which will require:

- Access to the Internet.
- 'Windows'.
- Java to be installed.

Check these issues for all machines before attempting the lesson.

The teacher should become *familiar with the software*, specifically, the '**Breeding Box**' feature. In addition, if wishing to run an on-going simulation (or more than one), then he/she should become familiar with that part, as well.

The Lesson Plan

1. *Set up an ongoing simulation*, which will last for the duration of the lesson. (It will not take up any time unless prior access to the classroom is not possible, in which case, maybe 2 minutes to set up). *This requires a computer, dedicated to the task* (could set up several of these simulations but each simulation would require a dedicated computer).
 - a. Go to the '**Planets**' feature of the software and choose to '*run a new simulation*'. Follow instructions (tool tips).
 - b. This simulation will run, unaided, using our software and the Sodarace application. Over the course of the hour, generations of Sodacreatures will compete in races. The Sodacreatures will interbreed and mutate and will evolve from one generation to the next. The progress will be recorded automatically.
 - c. *Pupils can be referred to this during the introduction.*
 - d. Periodically, between the other stages, the pupils can check the progress of the simulation (2 minutes each time).

Links to the National Curriculum Specific to this Simulation

- explain how sexual reproduction... leads to variation in the new generation (2.07)
- recall that some alleles cause diseases, which can be inherited (2.20)
- understand how adaptations such as...allow survival in particular environmental conditions (2.31)
- describe how new species may evolve from variants which are better adapted to their environment (2.34)
- explain how natural selection can lead to evolution or extinction of species (2.36)

2. *Introduction and Question and Answer Session* (15 minutes).

Introduction... Explain the following:

- a. Coded information giving details of a creature's physical and functional attributes is held in molecules known as **genes** (DNA, etc.). Like beads, genes are strung along what is known as a **chromosome**.
- b. **Genes are the units of inheritance** from parents to offspring and that each one will store details about a different highly specific part of the body.
- c. Considered as a whole, this genetic information is known as a creature's **genotype**.
- d. The genotype determines an individual's appearance and performance, its **phenotype**.
- e. Each offspring inherits its genes from its parents but **which genes are inherited from which parent is not pre-determined**. For this reason, offspring of the same parents will differ.
- f. Due to this inheritance, offspring resemble their parents.
- g. Furthermore, there will be a greater disparity between more distantly related individuals than closely related ones.
- h. The recombination of existing genes can provide an almost endless source of variation. With asexual reproduction, and therefore no recombination, the offspring will be clones of the parent (no variation).
- i. Although genes are passed on independently of each other, it is how well they interact that will determine the success of the phenotype. In turn, this success determines the reproductive success of the individual.
- j. There is variation within a species and still greater variation between species. Is interbreeding possible?
- k. **How to use our software and the Sodarace Kiosk**, explaining that the pupil should use the '**Breeding Box**' (and how this should be done).

Question and Answer part: open-ended questions, many of which can be repeated at the end to see what has been learnt. For example:

- l. What is the mechanism of passing on hereditary information?
- m. How can this mechanism ensure similarity between members of the same species?
- n. How does variation amongst a species arise?
- o. Are there random elements regarding the inheritance of genetic information?
- p. What is meant by genotype/phenotype?

Please read page 4...

Lesson Plan for 'The Role of Inheritance in Evolution'

'Main' (25 minutes including the feedback session)

This will require the use of computers dedicated to the task. Pupils could work in groups. Pupils will be asked to:

- a. **Use the 'Breeding Box'**, whereby they will be able to choose two existing Sodacreatures and breed them to produce a new Sodacreature.
- b. Pupils will see graphical representations of the genes of both parents.
- c. Pupils will see that the **genes have been represented as distinct units** that together form a chromosome.
- d. Pupils will be able to see **which genes have been inherited from which parent and that this is not a pre-determined process**.
- e. Pupils can experiment with interbreeding many different combinations of creatures.
- f. Pupils will be able to use the **'Sodarace Kiosk'** software to see how successful the new Sodacreature is and compare its performance with that of its parents.
- g. Pupils will be able to see that **not all crossovers are beneficial**.
- h. Pupils will be able to observe that the **recombination of existing genes provides a nearly endless source of variation**.
- a. Pupils will be able to experiment with the hybridisation, noting that this will lead to unsuccessful Sodacreatures (probably).

Feedback Session (5 – 10 minutes)

- a. Each group/pupil will report their findings and compare experiences.
- b. Pupils can enter a debate on the various aspects encountered.

4. **2nd Question and answer session + Questionnaire** (15 minutes)

- a. Similar questions to those posed earlier, an opportunity for reflecting upon what has been learnt.
- b. Open forum. Pupils can ask questions about the inheritance of genes, Sodarace and our software, etc.
- c. Hand out questionnaire during the final Q & A session. The questionnaire should include questions such as:
 - i. Have the pupils learnt about the inheritance of genes and its role in evolution? (If so, what?)
 - ii. Has the software been beneficial in this respect?
 - iii. Has the software been fun?
 - iv. Was it easy to use?
 - v. Any improvements/issues?

5. **Following Up.**

- a. At a later opportunity, keen pupils should be able to use the parts of the software that they did not use during the hour lesson.
- b. This will give them more opportunity to compare mutation with recombination and to notice the different ways in which they work.
- c. They should be able to understand that variation is random but that the more suitable variations will achieve more reproductive success and that this represents the process of **Natural Selection**.
- d. Pupils can run longer simulations (as in part 1). This will make it very clear that selective pressure can give rise to better-adapted creatures without having a 'grand designer'.
- e. **One of the other lesson plans can be followed.**