Adaptation to Environmental Change lecture notes, learning objectives and final review lecture. If you can answer the practice questions at the end of each week, then you are guaranteed to do well.

Adaptation to Environmental Change

BZ2008 Semester 2 2016 TSV

James Cook University

CONTENTS

Lecture 2: Natural selection and adaptation

Natural selection

- Differential success of individuals within a population
- Interactions with the environment are the selective agents
- Two conditions are required
- Variation in a characteristic - must be heritable
- Variation leads to differences in survival and reproduction among individuals through environmental interactions

Adaptation

- A heritable trait that maintains or increases the fitness of an organism under a given set of environmental conditions
- Can be behavioural, morphological, or physiological
- The study of adaptation is key to understanding the distribution and abundance of species

Fitness

- The proportionate contribution made by an individual to future generations relative to other individuals in the same population
- In a environment with a given set of environmental conditions, individuals with characteristics that confer higher rates of survival and reproduction have more offspring
- Those characteristics are more frequent in the next generation

DNA

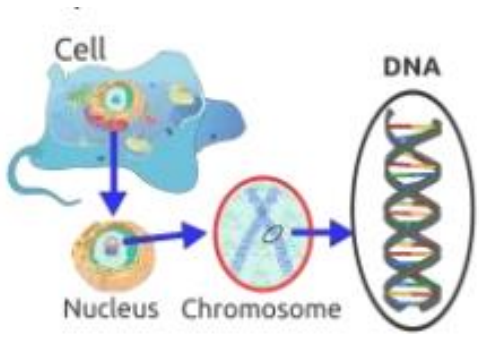
- Provides the blueprint for the construction of an organism
- DNA encodes the genetic information that is transmitted from parent to offspring
- A DNA molecule contains genes

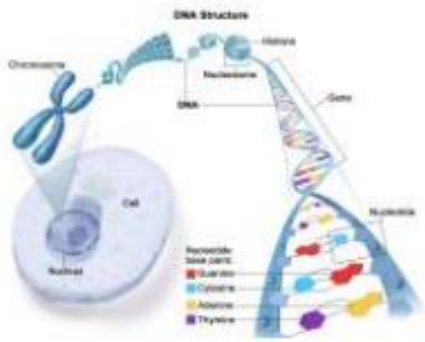
Genome

- all the DNA in a cell

Gene

- Encodes the information needed to produce an RNA molecule
- This is usually messenger RNA, which results in the synthesis of a protein





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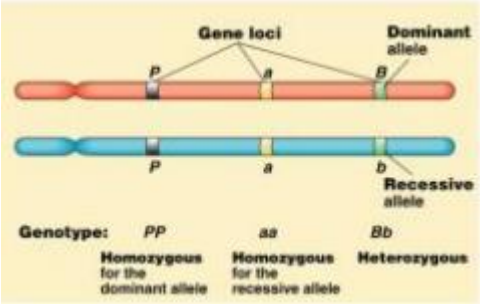

- Alternative forms of the same gene
- Most multicellular organisms are diploid
- They have two copies of each chromosome, therefore two copies of each gene
- homozygous - two copies are the same
- heterozygous - two copies are different

Genotype – The genotypic information of an individual

Phenotype

- The physical appearance of an individual
- Environmental factors that influence phenotype – Temperature, precipitation, sunlight, and predation. This is known as phenotypic plasticity

Phenotypic Plasticity

- The ability of one genotype to produce more than one phenotype when exposed to different environments
- e.g. some organisms change colour due to temperature
- Plants show many examples of phenotypic plasticity for instance, in different light environments lab experiments with plants that had the same genotype:
- Low light – 20% available PAR, less biomass; more photosynthetic leaf area, large, thin leaves; few branches
- High light – 100% PAR, narrow leaves on many more branches, developmental plasticity – these phenotypic changes cannot be reversed
- The body colour of many insects is affected by the temperature during development
- Insects from cooler climates are darker and darker colour absorbs more solar radiation
- Warmer body compensates for cooler temperatures

Acclimation

- Phenotypic plasticity in response to current environmental conditions that is reversible
- e.g. Seasonal changes in temperature tolerance in fish
- Fish have upper and lower limits to temperatures they can tolerate these change as water temperature change.

Different types of natural selection

1. **Directional selection** - the distribution of phenotypes shifts towards one end of the distribution. example: light and dark coloured peppered moths during Industrial Revolution in nineteenth-century England
2. **Stabilizing selection** - mean phenotype has higher fitness than phenotypes at either end of distribution Birth weight in human babies – those with very high or very low birth weights have lower survival and therefore lower fitness