Genetics: Genetics is the branch of science which deals with *heredity and variation*. The *underline causes of variations* that exist for the *phenotypes* and the *way* that the differences are inherited is the science called genetics.

Heredity is the passing on of traits from parents to their offspring, either through asexual reproduction or sexual reproduction; the offspring cells or organisms acquire the genetic information of their parents.

Variation, in biology, any difference between cells, individual organisms, or groups of organisms of any species caused either by genetic differences (genotypic **variation**) or by the effect of environmental factors on the expression of the genetic potentials (phenotypic **variation**).

The underline causes of variations:
Mutation, Crossing over, Environmental factors

Ways:
Mendel's 1st and 2nd Law.

Fish: Fish is a cold blooded aquatic animal which have paired or unpaired fins for their movement and complete their respiration using gills.

or

a limbless cold-blooded vertebrate animal with gills and fins and living wholly in water.

Breeding: the mating and production of offspring by animals.

Definition of "Genetics and Fish Breeding":
It is study of heredity, variations of genes and transfer of genetic information from parents to offspring and finally produces quality larvae/fry by artificial/natural breeding program in a controlled way.

Bangladesh Agricultural University, Mymensingh

Department of Fisheries Biology and Genetics

B. Sc. Fisheries (Hons.) Level 4, Semester 1

Course No. FBG 411

Course Title: Genetics and Fish Breeding

Credit: 3

Course objectives:

The course is focused on applying genetic techniques to improve the biological potential of fish that would help increase production in the farm as well as in the wild under a given management practice. The students will learn the basic genetic and breeding principles and techniques and their applications for conservation and improvement of fish stocks.

Course contents:

1. Introduction: Overview of fish genetic resources of Bangladesh, scope and potential of genetics in aquaculture and fisheries.
2. Genetics of populations: Genetic variability in a population, gene pool and gene frequency, Hardy-Weinberg Equilibrium, factors influencing gene and genotype frequency.
3. Genetics of quantitative phenotypes: Quantitative phenotypic variation and its components, characteristics of quantitative inheritance, gene-environment interaction, environmental factors affecting productivity.

4. Selection: Heritability and selection response, basic types of selection programs, individual selection, family selection and mass selection, tandem selection, independent culling, selection index.
5. Hybridization: Types of cross breeding programme, uses of hybridization, heterosis, recurrent selection, impact of hybridization, planning of cross breeding programmes.
6. Inbreeding: Genetic effects of inbreeding and practical applications, inbreeding co-efficient and its calculation, inbreeding depression, control of inbreeding accumulation, effective breeding number and genetic drift.
7. Seed storage and genetic conservation: Cryopreservation of gametes, live and cryogenic gene banking.
8. Chromosome manipulation: Gynogenesis, androgenesis, polyploidy, sex-reversal and production of monosex populations.
9. Recent developments in genetics: Genetic engineering- applications and biosafety of GMOs.

Text books :

1. Falconer, D. S. and T. F. C. Mackay. 1996. Introduction to Quantitative Genetics (4th Edition), Longman, England. 463 pp.
2. Gjedrem, T. 2005. Selection and breeding programs in Aquaculture. Springer. 364 pp.
3. Shah, M. S. 2010. Genetics of Aquaculture and Fisheries Management. 269 pp.

4. Tave, D. 1993. Genetics for Fish Hatchery Managers (2nd Edition), Van Nostrand Reinhold, New York. 415pp.

References :

1. Best, T. M. 2007. Ecological and Genetic Implications of Aquaculture Activities. Springer. 545 pp.
2. Gjdrem, T. and M. Baranski. 2009. Selective Breeding in Aquaculture. Springer. 221 pp.
3. Hartland, D. L. and A. G. Clark. 2007. Principles of Population Genetics. 4th Edition. Sinaur and Associates, Sunderland, M.A. 652 pp.
4. Kirpichnikov, V. S. 1981. Genetic Bases of Fish Selection. Springe-Verlag, New York.
5. Mostafa, S. 1999 (ed.) Genetics in Sustainable Fisheries Management. Fishing News Books.
6. Purdom, C. E. 1992. Genetics and Fish Breeding. Chapman and Hall.
7. Reddy, P. V. G. K. 1999. Genetic Resources of the Indian Major Carps, FAO Fisheries Technical Paper No. 387.
8. Ryman, N. and F. Utter. 1987 (eds.) Population Genetics and Fishery Management. University of Washington Press Seattle and London.
9. Tave, D. 1999. Inbreeding and Broodstock Management. FAO Technical Paper No. 392.
10. Tave, D. 1995. Selective Breeding Programs for Medium-sized Fish Farms. FAO Fisheries Technical Paper No. 352, Rome. 122 pp.

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Credit: 1.5

Students shall maintain a record of everything done in the practical and field sessions in a Practical Note Book to be signed and checked by teacher(s) concerned. Viva voce test will form an essential part of the Practical Examinations.

1. Collection, length-weight measurement and frequency distribution to study quantitative phenotypes of fishes.
2. Comparison of difference in the distribution between a large and a small population.
3. Calculation of heritability and expected response from selection differential and heritability.
4. Techniques of starch gel electrophoresis and calculation of gene and genotype frequencies from allozyme data/ blood group data.
5. Study of hormonal sex-reversal using androgen and/or estrogen hormones. Feeding the fry everyday and observation.
6. Identification of sexes of juvenile fish by acetocarmine squash method to evaluate the results of sex-reversal experiments.
7. Study of chromosome manipulation techniques to produce polyploidy, gynogenetic and androgenetic fish.
8. Familiarization with cryopreservation techniques.
9. Visiting different government and privately-owned fish hatcheries to know the brood stock management practices by the hatchery operations and to learn the genetic problems currently faced by the hatchery operators and fish farmers.

References :

1. Best, T. M. 2007. Ecological and genetic implications of aquaculture activities. Springer. 545 pp.
2. Gjdrem, T. and M. Baranski. 2009. Selective Breeding in Aquaculture. Springer. 221 pp.

3. Kirpichnikov, V. S. 1981. Genetic Bases of Fish Selection. Springe-Verlag, New York.
4. Krauter, K. and M. Winey. 2012. Practical Genetics for the 21st Century. Flatworld Knowledge.
5. Lutz, C. G. 2001. Practical Genetics for Aquaculture. Fishing News Books. Blackwell Science. 235 pp.
6. Ryman, N. and F. Utter. 1987 (eds.). Population Genetics and Fishery Management. University of Washington Press Seattle and London.
7. Tave, D. 1999. Inbreeding and Broodstock Management. FAO Technical Paper No. 392.
8. Tave, D. 1995. Selective Breeding Programs for Medium-sized Fish Farms. FAO Fisheries Technical Paper No. 352, Rome. 122 pp.