General Certificate of Education   **Syllabus**
Ordinary Level
For Centres in the Maldives

FISHERIES SCIENCE 5151

For examination in November 2011

FISHERIES SCIENCE (5151)

CONTENTS

Notes

Information for Teachers

This booklet relates to examinations taken in the year printed on the cover. It is the normal practice of CIE to print and distribute a new version of this booklet each year. Centres should receive copies well in advance of them being required for teaching purposes.

Teachers who are about to teach the syllabus in this booklet for the first time should obtain and study the relevant past examination papers and Subject Reports.

Any queries relating to this booklet should be addressed to CIE Customer Services.

Nomenclature used in CIE Science Examinations

The proposals in 'Signs, Symbols and Systematics (The Association for Science Education Companion to 16-19 Science, 2000)' and the recommendations on terms, units and symbols in 'Biological Nomenclature (1989)' published by the Institute of Biology, in conjunction with the ASE, will generally be adopted. Reference should be made to the joint statement on chemical nomenclature issued by the GCE boards. In particular, the traditional names sulfate, sulfite, nitrate, nitrite, sulfurous and nitrous acids will be used in question papers.

It is intended that, in order to avoid difficulties arising out of the use of l as the symbol for litre, use of dm^3 in place of l or litre will be made.

In chemistry, full *structural formulae (displayed formulae)* in answers should show in detail both the relative placing of atoms and the number of bonds between atoms. Hence $-CONH_2$ and $-CO_2H$ are not satisfactory as full structural formulae, although either of the usual symbols for the benzene ring is acceptable.

Units, significant figures

Candidates should be aware that misuse of units and/or significant figures, i.e. failure to quote units where necessary, the inclusion of units in quantities defined as ratios or quoting answers to an inappropriate number of significant figures, is liable to be penalised.

Private candidates

Private candidates are **not** permitted to enter for the Fisheries Science O Level examination **unless** they are re-taking the examination and are carrying forward their coursework mark from the previous year.

INTRODUCTION

Fisheries Science, taught in grades 8, 9 and 10 in lower secondary schools, was developed by the Educational Development Centre of the Ministry of Education. The syllabus was introduced into Maldivian schools with the aim of providing students with a basic knowledge and understanding of the marine environment and national and international fisheries. The subject is examined by Cambridge International Examinations (CIE).

This booklet contains the revised syllabus, which was developed in 1995 to accommodate the changes that have occurred within the Maldivian fishing industry. The Fisheries Science syllabus and textbooks, introduced to the schools in the Maldives in 1987, needed to be upgraded to reflect the developments in the fishing industry. To achieve this end it was necessary to increase the scope of content of some of the material being taught.

The syllabus introduced in 1987 was based on four main themes. The themes and the period breakdown are shown below.

Themes	Grade 8	Grade 9	Grade 10
Fish Biology and Classification	10 periods	4 periods	8 periods
Ecology	10 periods	6 periods	2 periods
Fish and Nutrition	14 periods	14 periods	10 periods
Fishing Industry and Technology	4 periods	14 periods	16 periods

Note: The time allocation for each period was 35 minutes.

The content covered by each theme in the previous syllabus was extensive and a lot of material was "bundled" into the four broadly defined themes. This arrangement may lead to confusion while planning a sequence of lessons for teaching.

Each of the four themes was addressed in grades 8, 9 and 10. This meant that the students were taught some material from each theme in each grade. The problem with this approach to presenting the material was that some material had to be re-taught and a natural sequence was not readily apparent to the students.

In this revised syllabus – developed in August 1995 – the content has been divided into nine themes within a sequential framework corresponding to the layout of the textbooks Understanding Fisheries Science 1 and 2. The pattern planned follows a logical sequence to developing an appreciation of the marine environment and the fishing industry. Furthermore, the new sequence will enable students to develop an appreciation of the related general aims of the subject while providing a clear indication of when the course material is to be covered.

Progressive Practical Projects (PPP) from the Teachers Activity Workbook (TAG) (1992) and Students Activity Workbook (SAW) (1992) remain integral components of the revised Fisheries Science curriculum.

The nine themes are as follows:

Themes	Chapter
1 The Marine Environment	The Marine Environment
2 Systematics and Biodiversity	Diversity of Marine Life
3 Anatomy and Physiology	Structure and Function
4 Distribution and Abundance	Distribution and Abundance
5 Fisheries Resources	Fisheries Resources
6 Fishing Gear Technology	Fishing
7 Seafood Technology	Seafood
8 Fisheries Economics and Marketing	Economics
9 Fisheries Management	Management

The themes follow a logical sequence. The first four themes explore fish within their natural marine environment. The last five themes consider fish within the context of the fisheries industry. Each chapter in the revised Fisheries Science textbook will cover one theme as outlined in the table below.

Suggested Period Breakdown

Grade	Theme	To be covered during
8	1 The Marine Environment	First Term
	2 Systematics and Biodiversity	Second Term
	3 Anatomy and Physiology	Third Term
9	4 Distribution and Abundance	First Term
	5 Fisheries Resources	Second Term
	6 Fishing Gear Technology	Third Term
10	7 Seafood Technology	First Term
	8 Fisheries Economics and Marketing	Second Term
	9 Fisheries Management	Third Term

AIMS

The content addressed within the Fisheries Science syllabus reflects the following aims:

1. to instil in the students a sense of awareness of the intricate and delicate nature of the marine environment and its ecosystems;

2. to develop an awareness of the practices and extent of the fishing industry in the Maldives within a world context and the need for sustainable development.

To achieve the aims, students will be trained in various scientific skills and their knowledge and understanding of the marine environment and the fishing industry expanded. The students should ultimately acquire a sense of respect and responsibility for the environmental and conservational issues associated with the marine environment and the fishing industry.

The syllabus is designed to develop *awareness, skills, knowledge, understanding, appreciation* and *respect* as well as a *sense of responsibility* for the marine environment among children in Maldivian schools.

ASSESSMENT OBJECTIVES

The main purpose of Fisheries Science is to develop an awareness of the marine environment and the fishing industry. Specifically, Fisheries Science aims to develop:

1. skills in:

    1.1   science including an attitude of curiosity and inquiry;

    1.2   observation and experimentation to generate interest in the marine environment;

    1.3   data location, collection, consolidation, quantification and presentation techniques, for information on fishing and fisheries from a variety of sources;

    1.4   navigation, seamanship, the design and fabrication of gear and fishing methods.

2. knowledge and understanding of:

    2.1   the marine environment;

    2.2   the diversity of marine life;

    2.3   the structure and function of important marine organisms;

    2.4   factors that affect the distribution and abundance of marine organisms;

    2.5   the fishing industry of Maldives;

    2.6   fishing gear and technology;

    2.7   seafood technology;

    2.8   fisheries economics and marketing;

    2.9   fisheries management.

3. appreciation of:

    3.1   the extent and variety of the exploitation of marine resources;

    3.2   the contribution of science to the modernisation and advancement of the fisheries industry;

    3.3   the importance of marine resources as a major source of nutrition to the nation;

    3.4   the importance of marine resources as a major contributor to the national economy;

    3.5   the inter-dependence and integrated nature of Fisheries Science, the fishing industry and other industries (such as tourism).

4. respect for:

    4.1   the marine environment and the importance of sustainable development;

    4.2   environmental and conservational issues.

SCHEME OF ASSESSMENT

The assessment of Fisheries Science is carried out by Cambridge International Examinations. The examination consists of two written papers and coursework.

Component	Weighting	Duration	Maximum Marks
Paper 1	40%	1 hour 30 minutes	80
Paper 2	30%	1 hour 30 minutes	60
Coursework	30%		60

Paper 1

All questions are compulsory. This paper will consist of questions that require either short or long structured answers. Approximately 50 marks will be awarded for shorter questions and 30 marks for longer questions. A short answer question will be worth three to five marks and longer questions are worth 10 to 12 marks.

Paper 2

This paper will consist of two sections, A and B. Students have to answer four questions of approximately 20 minutes each. Each question is worth 15 marks.

Section A will contain two questions, both of which are compulsory:

1. question 1 (data or information interpretation);

2. question 2 (knowledge and understanding of practical techniques).

Section B will require two essay-type questions to be answered from four questions drawn from the nine themes of the syllabus.

Coursework

All candidates entering for the O Level examination in Fisheries Science must undertake Progressive Practical Projects which are assessed by their teacher on a regular basis during the course. The coursework submitted to CIE for assessment will be a selection of work from these Progressive Practical Projects.

SUBJECT CONTENT

THEME 1 THE MARINE ENVIRONMENT

Aims

Students will be able to:

1.   describe the structure of the Earth and how the surface structures have been created;

2.   distinguish between the chemical and physical properties of seawater and the geography of oceans and seas;

3.   explain the features of monsoons and "El Niño" and the causes and effects of global warming.

Learning Outcomes

Students will be able to:

(a)   describe the structure of the Earth, i.e. core, mantle, crust;

(b)   explain the plate tectonic theory;

(c)   state the geomorphology of the marine environment, i.e. continental shelf, abyssal plain, submarine ridge, ocean trench, volcanic island, coral reef and atoll formation;

(d)   compare between fresh water and seawater environments;

(e)   outline the geographical features of oceans and seas;

(f)   analyse the chemical properties of seawater such as substances, salinity, dissolved oxygen, pH and buffering capacity, diffusion and osmosis;

(g)   describe chemical properties of seawater such as pH and salinity;

(h)   analyse the physical properties of seawater such as density, pressure, light penetration, temperature, tides and wave action, circulation and upwellings;

(i)   measure physical properties of seawater such as temperature, current, light penetration;

(j)   describe the features of monsoons;

(k)   describe the features of "El Niño";

(l)   identify the causes and effects of global warming.

Content

1.   Introduction

    1.1   Terrestrial Environments vs Aquatic Environments

    1.2   Freshwater Environments vs Saltwater Environments

    1.3   Geography of Oceans and Seas (world ocean concept, open, semi-enclosed, enclosed, channels, straits)

2.   Geomorphology

    2.1   Structure of the Earth

    2.2   Plate Tectonic Theory

2.3   Geomorphological Structures of the Marine Environment (refer to echo-sounding):

- Continental Shelf

- Abyssal Plain

- Submarine Ridges

- Ocean Trenches and Volcanic Islands

- Coral Reefs and Atoll Formation

3.   Characteristics of Seawater

3.1   Physical:

- Formation

- Density variations in seawater

- Pressure

- Light (penetration)

- Temperature (latitude and vertical stratification, i.e. thermoclines)

- Tides and Wave Action

- Circulation and Upwellings

3.2   Chemical

- Substances (elements, compounds, ions)

- Salinity

- Dissolved Oxygen

- pH and Buffering Capacity

- Diffusion and Osmosis (given chemical emphasis)

4.   Climate

4.1   Monsoons

4.2   "El Niño"

4.3   Global Warming and Climatic Change

THEME 2 SYSTEMATICS AND BIODIVERSITY

Aims

Students will be able to:

1. apply a classification system to a range of marine organisms present in the Maldives;

2. outline the diversity of plant and animal life with a particular emphasis upon marine organisms.

Learning Outcomes

Students will be able to:

(a) recall the definition of morphology;

(b) state the five animal and plant kingdoms;

(c) identify and name organisms: orders of classification of organisms, binomial nomenclature, the taxonomic keys, and dichotomous keys.

Students will be able to identify and give examples of:

(d) algae;

(e) sea grasses;

(f) porifera;

(g) cnidaria;

(h) platyhelminthes;

(i) nematodes;

(j) annelids;

(k) mollusca (gastropods, bivalves, cephalopods);

(l) crustaceans;

(m) echinodermata;

(n) chordates (prochordata, vertebrata: pisces, amphibia, reptilia, aves, and mammalia).

Content

1. Introduction
    1.1 Definition of Morphology
    1.2 Diversity of Life (five Kingdoms)
    1.3 Plant vs Animals (plant and animal phyla)
    1.4 Terrestrial Animals vs Marine
    1.5 Radial and Bilateral Symmetry
2. Common Marine Organisms
    2.1 Introduction (include a brief definition of phyla)
    2.2 Algae
    2.3 Sea Grass
    2.4 Porifera (sponges)
    2.5 Cnidaria (jelly fish, sea anemones, coral polyps)
    2.6 Platyhelminthes (flatworms)

2.7 Nematodes (round worm parasites in fish)

2.8 Mollusca

- Gastropods (snails, nudibranchs)

- Bivalves (clams, oysters, mussels)

- Cephalopods (squid, octopus, cuttlefish)

2.9 Annelids

2.10 Crustaceans (barnacles, shrimps, crabs, lobsters)

2.11 Echinodermata (sea urchins, sea cucumbers, starfish, brittlestars, featherstars)

2.12 Chordates:

- Protochordata (sea squirts)

- Vertebrata:

  (1) Pisces:

     Elasmobranchs (sharks, rays)

     Teleosts (bony fish)

  (2) Amphibians (frogs)

  (3) Reptilia (sea snakes, turtle)

  (4) Aves (tern)

  (5) Mammalia (whales, dolphins)

3. Classification of Organisms

3.1 Orders of Classification

3.2 Binomial Nomenclature

3.3 Taxonomic Keys

- Dichotomous Keys

THEME 3 ANATOMY AND PHYSIOLOGY

Aims

Students will be able to outline the main anatomical features, and their functions, of the major groups of common marine organisms found in the Maldives.

Learning Outcomes

Students will be able to explain the external and internal features and functions, life cycle, reproduction and growth patterns of:

(a) coral;

(b) giant clam;

(c) shore crab;

(d) sea cucumber;

(e) fish.

Students will be able to:

(f) distinguish the biological differences between a pelagic and demersal fish (habitat, feeding, distribution and migration, adaptations to environment);

(g) acquire skills necessary to dissect a fish;

(h) demonstrate skills in writing field and laboratory notes.

Content

1. Coral Polyps and Coral

    1.1 External Features and Function

    1.2 Internal Features and Function

    1.3 Life Cycle, Reproduction and Growth

2. Giant Clam

    2.1 External Features and Function

    2.2 Internal Features and Function

    2.3 Life Cycle, Reproduction and Growth

3. Shore Crab (sandy or rock)

    3.1 External Features and Function

    3.2 Internal Features and Function

    3.3 Life Cycle, Reproduction and Growth

4. Sea Cucumber (beche-de-mer)

    4.1 External Features and Function

    4.2 Internal Features and Function

    4.3 Life Cycle, Reproduction and Growth

5. Fish (pelagic fish [skipjack] and a demersal fish [ray] and a comparison of the two)

   5.1   External Features and Function (form, body covering, openings, sensory organs, fins)

   5.2   Internal Features and Function (gills, circulatory system, digestive system, excretory system, swim bladder, reproductive system, musculature)

   5.3   Habitat

   5.4   Life-cycle (reproduction [external and planktonic larvae, i.e. two-part life history], spawning, growth, etc.)

   5.5   Feeding

   5.6   Distribution and Migration (sedentary vs mobile)

   5.7   Adaptations to the Environment (pressure, buoyancy, drag, shape, diffusion and osmoregulation, adaptations to specific environments)

THEME 4 DISTRIBUTION AND ABUNDANCE

Aims

Students will be able to:

1.   identify the common ecological niches of the marine environment;

2.   give examples of the adaptations of marine organisms to both abiotic and biotic factors of these ecological niches;

3.   describe the main energy flows through an ecosystem.

Learning Outcomes

Students will be able to:

(a)   recall the definition of ecology;

(b)   identify the common ecological niches and their characteristics, i.e. inter-tidal (beaches and mangroves), shallow lagoons, coral reefs, deep benthic, open ocean;

(c)   give examples of the adaptations of marine organisms to abiotic factors such as temperature, light, oxygen, salinity, wave action, current, sediment;

(d)   give examples of the adaptations of marine organisms to biotic factors such as structural, physiological, spatial, herbivore/carnivore, predator/prey, food, abundance, competition, symbiosis, shoaling;

(e)   describe the energy flow in an ecosystem; primary production, food pyramids, food chains, food webs, energy cycle, nutrient cycle;

(f)   conduct and report biological surveying and sampling of a variety of marine organisms.

Content

1.   Marine Environments:

    1.1   Intertidal (beaches and mangroves)

    1.2   Shallow Lagoons (seagrass)

    1.3   Coral Reefs

    1.4   Deep Benthic

    1.5   Open Ocean

2.   Adaptations and Behaviour of Marine Organisms in Relation to Abiotic Factors:

    2.1   Temperature

    2.2   Light (daytime, nightfall, night, daybreak, penetration, photosynthesis)

    2.3   Oxygen

    2.4   Salinity

    2.5   Wave Action

    2.6   Currents

    2.7   Sediment

3.   Adaptations and Behaviour of Marine Organisms in Relation to the Biotic Factors

    3.1   Structural Adaptations (offence and defence)

    3.2   Physiological Adaptations (camouflage, bright coloration)

    3.3   Spatial Adaptations (lagoon, reef flat, reef front, reef slope)

    3.4   Herbivores and Carnivores

3.5   Predator/Prey Relationships

3.6   Food

3.7   Number of Organisms

3.8   Competition

3.9   Symbiotic Relationships

3.10   Shoaling

4.   Energy Flow in an Ecosystem

4.1   Photosynthesis and Primary Production

4.2   Food Pyramids

4.3   Food Chains and Food Webs

4.4   The Energy Cycle

4.5   The Nutrient Cycle (includes upwellings and limits on planktonic growth)

THEME 5 FISHERIES RESOURCES

Aims

Students will be able to:

1. summarise the main international and national fisheries resources and their level of exploitation;

2. describe the factors that affect the quality and quantity of fisheries resources;

3. identify the national and international contribution of aquaculture in supplying fisheries resources.

Learning Outcomes

Students will be able to:

(a) outline the main international fisheries resources and their level of exploitation;

(b) identify the issues affecting international fisheries resources such as production, demand and exploitation;

(c) analyse the main in-shore, near-shore and off-shore national fisheries resources and their level of exploitation;

(d) describe how fishing grounds and seasons affect fisheries resources in the Maldives;

(e) recall the definition of aquaculture;

(f) outline the international fisheries resources produced from aquaculture;

(g) identify and justify the fisheries resources of the Maldives suitable for aquaculture.

Content

1. The Five Components of the Fishing Industry

    1.1 The Marine Environment and Fish Stocks

    1.2 The Fishing Operation

    1.3 Processing and Preserving Seafood

    1.4 Economics and Marketing

    1.5 Management

2. Types of Fishing Industries

    2.1 Non-Commercial and Commercial (subsistence, artisanal, domestic markets, international trade)

    2.2 Recreational (night, sport, etc.)

3. The Maldivian Fishing Industry

    3.1 Fishermen

    3.2 Fisheries resources:

    *   Off-Shore Species:

        (1) Tuna (skipjack, yellowfin, frigate, kawakawa [eastern little], big-eye)

        (2) Other Pelagics (shark, billfish, wahoo, rainbow runner, dolphin fish)

        (3) International management for pelagic species (highly migratory, shared stocks)

- Inshore Species:

  (1) Reef fish (grouper, snapper, barracuda, trevally, etc.)

  (2) Crustaceans (lobsters, shrimps)

  (3) Molluscs (giant clam, squid, oyster, *golhaa,* mother-of-pearl shell, cone shell, triton shell)

  (4) Sea Cucumber

  (5) Sharks (reef shark, deep water oily shark)

  (6) Aquarium fish (banner fish, wrasse, cardinals, goldfish, etc.)

  (7) Turtles (green, hawksbill)

  (8) Others (black coral, red coral, white coral, etc.)

  (9) Production (including the effects of modernisation, local production including current trends in utilisation)

4. World Fisheries

  4.1 Fishermen

  4.2 Fisheries Resources

  4.3 Production (including the effects of modernisation and current trends in utilisation, use of world production)

5. Aquaculture

  5.1 Culture of fish and invertebrates (including design of cages, rafts, etc.)

  5.2 Economic aspects (including wild supply vs farmed supply)

  5.3 Social aspects

  5.4 Environmental aspects

THEME 6 FISHING GEAR TECHNOLOGY

Aims

Students will be able to:

1. distinguish between traditional and modern harbours;

2. outline the main characteristics of fishing boats, and the construction of Maldivian fishing boats;

3. outline the main methods of navigation;

4. describe basic seamanship skills;

5. list the main fishing gears and methods used with particular reference to the Maldives.

Learning Outcomes

Students will be able to:

(a) compare the features of traditional and modern harbours and boatyards;

(b) describe three types of boat building materials and their properties: wood, aluminium and fibreglass;

(c) outline the types of Maldivian fishing boats, their construction and recent modernisation;

(d) explain how a marine diesel engine works;

(e) summarise the features of types of navigation at sea such as traditional, celestial, meteorological and electronic;

(f) identify a variety of navigational aids such as buoy, sound, light, mariner's chart, compass, radar, radio, GPS and meteorology;

(g) describe methods of estimating depth, latitude, longitude and speed at sea;

(h) list the factors that affect navigation in the Maldives including basic Maldivian Maritime Laws and geography;

(i) state the definition of seamanship; safety at sea procedures, rope care and knot tying and boat upkeep and maintenance;

(j) outline use and types of nets such as seine net, purse seine, lampara net, beam trawl, otter trawl, lift net, cast net, gill net, drift net;

(k) compare the types of fish traps such as pots and barriers;

(l) identify the types of hooks and lines such as hand-line, pole and line, jigging line, set long-line, drifting long-line and trolling line;

(m) explain the principle of a Fish Aggregation Device (FAD);

(n) compare the methods used for bait fishing, pole and lining, hand-lining for reef fish, vertical long-lining, drift long-lining, set-lining, trolling, as well as set-lining for tiger shark;

(o) outline the methods used for cast netting, gill netting, seining, and surround netting;

(p) outline the methods used for manual gathering of sea cucumber, lobster, giant clam, aquarium fish;

(q) outline the methods used for trolling.

Content

1. Aids To Fishing

   1.1 Harbours

   1.2 Navigation (nautical charts, compass and triangulation, electronic navigation equipment: radar, sonar, VHF LORAN, GPS)

   1.3 Seamanship (knots – reef, figure of eight, clove hitch, knot of fishing hook, bowline, double sheet bend; safety at sea; meteorological equipment, record interpretation, importance to the fisherman)

   1.4 Engines (principles of diesel and petrol engines and advantages and disadvantages of each; how engines work; repairs and maintenance)

   1.5 Boats (buoyancy, gravitational force vs buoyancy force, buoyancy and density; stability; ship dynamics – streamlining, testing, hull shapes, differences in design and materials)

2. Fishing gear and methods

   2.1 Active gear (surround nets, trawl nets, lift nets, fall nets)

   2.2 Passive gear (gill nets and entangling nets, hooking devices, traps [e.g. herding coral])

   2.3 Bait fishing, diving, trapping, pole and line (off beaches and boats), hand and line (drop line, jigging, line with bait, line with lure), long lines (off beaches and boats bottom set, mid-water set, pelagic), trolling, netting (bottom, midwater and surface gill nets; drop nets; drift nets)

   2.4 Trawling, seining (beach seines, purse seines, Danish and Scottish seine) and herding

THEME 7 SEAFOOD TECHNOLOGY

Aims

Students will be able to:

1. explain the importance of fish as a food source;

2. describe how fish spoil and the implications of fish spoilage;

3. outline good fish-handling practices;

4. summarise the methods of fish processing and preservation and the end products;

5. explain the importance of quality control and its application for the production of safe and high quality seafood products.

Learning Outcomes

Students will be able to:

(a) list the four main food groups and their functions;

(b) assess the importance of a balanced diet for health;

(c) explain the importance of fish as a source of food;

(d) outline the current national and international food consumption patterns;

(e) state the definition, agents (bacteria and enzyme) and types (putrefaction, autolysis, rigor mortis and oxidation) of fish spoilage;

(f) assess the economic implications of fish spoilage;

(g) explain good, live and dead fish-handling practices such as live groupers and sashimi;

(h) state the definition and methods of fish processing such as salting, drying, smoking, canning and the characteristics of each;

(i) list the food and non-food products produced by fish processing;

(j) state the definition and methods of fish preservation such as chilling, freezing and irradiation and the characteristics of each;

(k) state the definition of seafood quality and quality control measures such as quality assessment, fish handling practices and clean-up procedures.

Content

1. Food

    1.1 Nutrition

    1.2 Energy

    1.3 Composition (lipid, protein, carbohydrate, water, minerals)

    1.4 Consumption (Maldives, world wide)

2. Fish Spoilage

    2.1 Bacteria

    2.2 Enzymes

    2.3 Autolysis

    2.4 Putrefaction

    2.5 Rancidity (ammonia as an indicator of fish spoilage)

    2.6 Rigor Mortis

    2.7 Public health

3. Handling

    3.1   Good handling

    3.2   *Sashimi*

4. Processing

    4.1   Salting

    4.2   Drying

    4.3   Smoking

    4.4   Canning

    4.5   Milling (by-products: fish meal, fish oil, fertiliser)

    4.6   Packaging

5. Preservation

    5.1   Chilling

    5.2   Freezing

    5.3   Irradiation

6. Quality

    6.1   Quality assurance

    6.2   Quality control

    6.3   Quality assessment

    6.4   Cleaning and sanitation

THEME 8 FISHERIES ECONOMICS AND MARKETING

Aims

Students will be able to outline the basic principles of economics and marketing and their application to the Maldivian fisheries industry.

Learning Outcomes

Students will be able to:

(a) state the definition and terms used in economics such as scarcity, unlimited wants, choice, opportunity cost, producers, consumers and regulators;

(b) outline the types of economic resources such as natural, human and capital;

(c) analyse the relevance of the "Tragedy of the Commons" and the Law of the Sea Convention with respect to the fisheries industry;

(d) distinguish the relationship between the fisheries and tourism industries in the Maldives;

(e) compare the public and private ownership of fisheries in the Maldives;

(f) outline the economic factors that affect aquaculture operations;

(g) describe national and international seafood production and consumption patterns;

(h) outline the factors that affect the price of seafood products such as demand, supply, equilibrium, shortages, surpluses and pricing policy;

(i) identify what a market is, how markets are developed in the Maldives and the international markets for Maldivian seafood products;

(j) state the definition of barter and its traditional use in the Maldives;

(k) state the definition of trade and the gains from trade such as specialisation and duties;

(l) outline how national and international trade occurs and the factors that influence trade such as distances, labour supply, capital, exploitation, economic growth, and contract sales;

(m) explain methods of protectionism such as tariffs, quotas, General Agreement on Tariffs and Trade, (GATT) and Convention on International Trade in Endangered Species, (CITIES).

Content

1. Introduction

    1.1 Economics in Everyday Life (scarcity, choice, unlimited wants, opportunity cost, production, consumption, exchange/trade)

    1.2 Economic Resources (from the sea, labour, capital, entrepreneur, effects that the fishing industry and the tourism industry have on each other)

    1.3 Economics and Fisheries (explain economic forces directing/guiding fisheries activities/investment)

    1.4 Tragedy of the Commons

2. Prices and Markets

   2.1 Local Marketing Systems (old vs new, the traditional Maldivian barter system and how technology has effected it, national and international, barter, exchange, trade)

   2.2 Price and Value

   2.3 Demand

   2.4 Supply

   2.5 Determination of Market Prices

   2.6 Effects of Changes in Supply and Demand

3. Types of Markets

   3.1 International Markets and Marketing Channels

   3.2 Private Ownership vs Public Ownership (including the current trend towards privatisation)

4. Marketing

   4.1 International Trade and Specialisation

   4.2 Gains from Trade (including specialisation, customs duties, etc.)

   4.3 Protectionism (including GATT, CITIES, etc.)

   4.4 Free Trade

THEME 9 FISHERIES MANAGEMENT

Aims

Students will be able to:

1.   outline aims and organisations involved in fisheries management;

2.   describe the various development and conservation projects in the Maldives;

3.   identify the main methods of regulating and enforcing fisheries policies;

4.   list training, education, and job opportunities in fisheries.

Learning Outcomes

Students will be able to:

(a)   state the aims of management in the fisheries industry;

(b)   identify the international, regional and national organisations involved in fisheries management;

(c)   outline the development of fisheries management policies;

(d)   explain the fisheries development projects in the Maldives such as fish aggregation devices, under-utilised resources, Mark III *dhonis*, by-products and market research;

(e)   describe the fisheries biology projects to determine maximum sustainable yields such as tuna tag-release-recapture project, gut contents analysis, age and growth, spawning periodicity, spawning season, fecundity, abundance and yield prediction;

(f)   compare coral mining with the reef re-growth project;

(g)   collect and analyse basic fisheries data using computer, statistical and graphical skills;

(h)   identify the pollution control measures for marine litter, solid waste and oil;

(i)   state the conservation measures applied to save endangered species such as turtles, sea cucumbers, giant clams, sea birds and rare shells;

(j)   describe how fisheries practices are regulated and enforced such as traditional practices, quotas, licences, boat restrictions, gear restrictions, closed seasons, closed areas and coast guard surveillance;

(k)   outline the international fisheries conventions such as the Code of Conduct on Responsible Fishing, the Convention on Biodiversity, the Small Island Development Statement;

(l)   describe the fisheries training and education programmes in the Maldives such as the Reef Awareness Program; teacher workshops and educational institutions, fisheries extension officer training and educational radio programs;

(m)   list jobs available within the fisheries industry; fisheries biology, fishing operations, fishing gear technology, seafood technology, business and marketing, fisheries education, administration and management.

Content

1. Management and the aims of management

    1.1 Introduction (Tragedy of the Commons, "infinite" resource belief)

    1.2 Organisations involved in fisheries management (and the way they interact at all levels):

    - National (Fisheries Related Ministries and Other Bodies)

    - Regional

        (1) Indo-Pacific Tuna Programme (IPTP)

        (2) Bay of Bengal Programme (BOBP)

        (3) Indian Ocean Fisheries Commission (IOFC)

    - International

        (1) United Nations (UN)

        (2) Food and Agriculture Organisation (FAO)

        (3) Convention on International Trade in Endangered Species (CITIES)

    1.3 Development and Conservation of Marine Resources

    1.4 Regulation and Enforcement

    1.5 Training and Education

2. Development

    2.1 Fish Aggregation Devices (FADs)

    2.2 Under-utilised resources

    2.3 By-products

    2.4 Market Research (overseas markets, quality assurance schemes)

3. Conservation

    3.1 Fisheries Biology: (e.g. tuna tag-release-recapture project)

    - analysis of gut contents

    - determining age and growth in temperate and tropical species

    - spawning periodicity and season, fecundity of fishes

    - sustainable development (abundance, yield prediction, MSY, MEY, CPUE, need for good data, over-fishing)

    - sampling techniques (stratified and random)

    - coral mining and reef re-growth

    - pollution (marine litter, solid waste management, oil, etc.)

    - endangered species (turtles, sea birds, rare shells)

4. Development of Management Policy (including continual feedback to research areas and pressure from user groups)

5. Regulation

    5.1 Traditional Practices, e.g. not removing sharks from tuna schools

    5.2 Quotas

    5.3 Licenses

    5.4 Number of boats and boat restrictions

    5.5 Gear restrictions

5.6   Closed seasons

5.7   Closed areas

5.8   International Conventions (and how these new ideas become laws)

    (a)   Code of Conduct on Responsible Fishing

    (b)   Convention on Biodiversity

    (c)   Small Island Development Statement

6.   Enforcement

6.1   Fisheries Officers and Patrol Boats

6.2   Foreign Fishing and Exclusive Economic Zones

7.   Training and Education

7.1   Reef Awareness Program

7.2   Contributions to Teacher Workshops and Educational Institutions

7.3   The role of extension officers

7.4   The role of educational radio

8.   Careers

8.1   Fisherman

8.2   Process Worker or Engineer

8.3   Business (private production and marketing operations)

8.4   Research (Fisheries Biologist, Fishing Gear Technologist, Seafood Technologist, Fisheries Economist)

8.5   Education

8.6   Management

9.   Epilogue (greed and over exploitation makes management difficult)

PROGRESSIVE PRACTICAL PROJECTS AND COURSEWORK

Practical work to be undertaken

All candidates entering for the O Level examination in Fisheries Science must undertake Progressive Practical Projects which are assessed by their teacher on a regular basis during the course.

The practical work will cover two equally weighted areas:

1. Field work and visits (accurate and comprehensive accounts);

2. Laboratory work:

    1.1 Make and record accurate observations;

    1.2 Plan and conduct simple experiments.

Categories of practical work

The practical skills to be assessed are grouped into three categories, A, B and C, and a fourth category D which requires submission of written work. The allocation of marks within each category is given below.

Category A	
Making and Recording Accurate Observations	**Marks**
(i) drawing of biological material	5
(ii) comparison of biological material	5
(iii) measurements with apparatus	5
	Total 15
Category B	
Performing Experiments and Interpreting the Results	**Marks**
(i) procedure and use of apparatus	5
(ii) record of results	5
(iii) interpretation of results	5
	Total 15
Category C	
Designing and Evaluating an Experiment	**Marks**
(i) plan of investigation	5
(ii) evaluation of experiment	5
	Total 10
Category D	
Written Work	**Marks**
(i) descriptive account of a field trip or visit	10
(ii) essay	10
	Total 20
	Maximum Total Marks 60

Within the scheme some assessment in categories A, B and C may be made informally during normal teaching while others may be suited to a more formal situation, such as a practical test. Assessment may be made at any time but it is suggested that, where appropriate, it should be carried out during the second half of the course.

Selection and authentication of coursework for submission to CIE

In each grade a number of activities are required as part of the Fisheries Science course, but not necessarily for inclusion in the coursework file submitted to CIE. The practical work included in the coursework file is at the discretion of the teacher and can be taken from the Fisheries Science Teacher Activity Guide, other textbooks or be of the teacher's own design.

It is recommended that Grade 8 be used for developing basic skills and not to be treated as a stage to select contributions to the coursework. In Grade 9 students can approach the activities with more confidence and a greater sense of enquiry and the teacher can begin to select activities. Grade 10 should contribute the major share to the coursework.

The coursework file submitted to CIE for each student should contain the following:

2 pieces of work covering Category A(i) – Drawings

2 pieces of work covering Category A(ii) – Comparisons

2 pieces of work covering Category A(iii) – Measurements

2 pieces of work covering all of Category B – Performing Experiments and Interpreting the Results

1 piece of work covering all of Category C – Designing and Evaluating an Experiment

1 piece of work in Category D(i) – Descriptive Account of a Field Trip or Visit

1 piece of work in Category D(ii) – Essay

This is a **maximum** of eleven separate pieces of work. However, it is likely that some pieces of work will be assessed in more than one area, in which case fewer than eleven separate pieces of work would be submitted. For example, it is likely that some pieces of work containing drawings may also include comparisons, and that the measurements may be made in the context of an experiment in Category B.

All work submitted in the coursework file must be the candidate's own work. It is therefore essential that all of the work submitted has been carried out under the direct supervision of the teacher. It is not acceptable to submit work that the candidate has completed as homework, or to submit work on which candidates have worked collaboratively.

All of the pieces of work submitted in the coursework file must be handwritten. Each piece of work must include the candidate's name and the date when the work was done. Candidates should be advised that copying large sections from textbooks or other sources is not acceptable, and that the sources of all quotations must be given.

Storage of coursework

During the course, candidates should not be permitted to take home their Coursework. The Fisheries Sciences teaching staff, at the Centre, will be responsible for the security of all candidates' Coursework. The Coursework should be retained securely within the Centre at all times.

Marking the coursework

The work submitted in the coursework file must have been marked by the Fisheries Science teacher, according to the marking criteria in this syllabus document. The work should be initialled and dated by the teacher when marked.

Recording the marks for each candidate

When the selection of work for submission has been made, the teacher should complete the Coursework File Contents Form. This form indicates to the moderators which pieces of work are to be assessed in which categories. The teacher should sign the Coursework File Contents Form to confirm that all of the work submitted in the coursework file is the candidate's own and has been carried out in supervised time. A photocopiable version of the form is included at the back of this booklet.

The marks for each piece of work should then be recorded on the Individual Candidate Record Card. The teacher should sign this form. A photocopiable version of the form is included at the back of this booklet.

Internal moderation of the coursework

All of the coursework files from a Centre must be internally moderated by the same person. The purpose of internal moderation is to ensure that different teachers in the Centre have marked consistently and to the same standard. The internal moderator is likely to be one of the teachers who has marked and supervised some of the work.

The original teachers' marks and the internally moderated marks should be recorded on the Coursework Assessment Summary Form. Both the internal moderator and the school principal should sign this form. A photocopiable version of the form is included at the back of this booklet.

Submission and external moderation of the coursework

Each coursework file should include all the work to be assessed, the Coursework File Contents Form, and the Individual Candidate Record Card. No additional work should be included.

The coursework files for each candidate from the Centre, together with the Coursework Assessment Summary Form, should be sent to the Department of Public Examinations by 1st September in the year of the examination. The Department for Public Examinations will forward the materials to CIE for external moderation.

GUIDANCE AND MARKING CRITERIA FOR COURSEWORK

Category A: Making and Recording Accurate Observations

Exercises in this category are intended to be small-scale operations.

Direct observations and comparisons should be made on a range of biological material and specimens. Candidates should show their ability to recognise features of biological relevance and to record and communicate the findings in an appropriate manner.

Observations

The observations made should be recorded by means of

(i)   drawings made directly from biological specimens   **(5 marks)**

(ii) descriptions or tabulations of similarities or differences   **(5 marks)**

Candidates should be encouraged to use a hand lens where appropriate, and at least one exercise must involve the use of a microscope or equivalent.

Drawings of biological material should usually occupy about half a page and the biologically important aspects of specimens clearly shown. Credit should be given for evidence of accurate observation of the specimen by the candidate. No credit should be given for the copying of textbook drawings. The scale should be indicated either in terms of magnification or by a statement of actual size. Emphasis should be on the quality of drawing rather than on the labelling of features, particularly where the observations are made on unfamiliar material.

In making comparisons of biological material, it is expected that about five features will be chosen to include both similarities and differences. The choice of features should reflect some awareness of their biological significance. Statements made should relate to features observed on the specimens and should not be based solely on theoretical knowledge. The comparative observations may be presented in a variety of ways, such as by written description, in a table, or by means of diagrams with suitable annotations or notes.

Measurements

Measurements should be made with a variety of simple laboratory apparatus.

Assessment should be made of the ability to:

(iii) make accurate measurements and records of mass, length, volume of a liquid, time and temperature   **(5 marks)**

Measurements may be made as an exercise in their own right or as part of an experiment in Category B. The apparatus used should permit measurements to be made to the nearest 0.5 g, 0.1 cm (1.0 mm), 0.5 cm^3, 1.0 s and 0.5 °C.

Marking Criteria for Category A(i): Drawing of biological material

High standard – 5 marks

Drawing large enough to show relevant details and scale correctly given.

Correct relative proportions or correct numbers of distinctive features.

Drawings neat, lines clear and distinctive.

Mid standard – 3 marks

Drawing large enough to show relevant details expected and scale approximately correct.

Proportions or numbers of features approximately correct.

Drawings generally tidy.

Low standard – 1 mark

Drawings small and scale poorly recorded.

Proportions or number of features bear some resemblance to the specimen.

Drawings completed but lines sketchy.

Marking Criteria for Category A(ii): Comparison of biological material

High standard – 5 marks

Suitable features selected, relevant points clearly identified.

Chosen features accurately described in a suitable form.

At least four similarities or differences recognised.

Mid standard – 3 marks

Usually selects suitable features.

Chosen features described reasonably well.

About three similarities or differences recognised.

Low standard – 1 mark

Chooses suitable features with difficulty.

Chosen features poorly described.

At least one similarity or difference recognised.

Marking Criteria for Category A(iii): Measurements with apparatus

High standard – 5 marks

All measurements accurate, recorded with appropriate units.

Mid standard – 3 marks

About half of the measurements accurate, recorded with appropriate units.

Low standard – 1 mark

At least two measurements accurately recorded.

Category B: Performing Experiments and Interpreting the Results

An experiment in this category should give the opportunity for candidates to work safely, to show their ability to understand and implement procedural instructions, to handle apparatus or equipment in an appropriate manner, and to record and interpret the results obtained from conducting the experiment.

For each experiment performed, assessments should be made of the ability to:

(i)   correctly use the apparatus or equipment, follow the instructions provided, and work safely
(5 marks)

(ii) record accurate readings or observations as the experiment proceeds and present these in a suitable form **(5 marks)**

(iii) draw inferences and interpret the results obtained from the experiment and make comments as appropriate **(5 marks)**

The experiments could be selected from various experiments and practical investigations given in the syllabus. However, if desired, one experiment could be a more open biological investigation which may involve a situation or material less familiar to the candidate and which may be carried out in the laboratory or in the field.

In carrying out these experiments certain candidates may require some assistance, perhaps to assemble apparatus or to organise the way the results are recorded. The teacher may give assistance to candidates if appropriate, because otherwise such candidates would not have the opportunity to draw inferences and interpret the results as required in (iii). When such help is given, the candidate should be given fewer marks for the relevant section of the assessment. The teacher should also make a note on the candidate's work of the help given, so that the reasons for the marks awarded are clear to moderators.

The candidate's account of the experiment should normally include a description of the methods used or the instructions followed, although no credit will be given for this part of the work. The presentation of the results and any discussion following the experiment should be clearly separated from the details of the procedure.

Marking Criteria for Category B(i): Procedure and use of apparatus

High standard – 5 marks

Carries out procedure for the experiment without assistance.

Works in an organised way with proper safety precautions.

Handles apparatus competently.

Mid standard – 3 marks

Some guidance needed in carrying out the experiment.

Works in a reasonably organised way.

Usually successful in setting up and using the apparatus.

Shows awareness of safety precautions, but is sometimes careless.

Low standard – 1 mark

Cannot carry out the experiment without constant supervision.

Can use simple apparatus but needs help with complex apparatus.

Uses safety precautions when reminded.

Marking Criteria for Category B(ii): Record of results

High standard – 5 marks

Record of results or observations complete.

Results or observations accurate and appropriate to the equipment or method used for the experiment.

Clear presentation.

Good use of tables, graphs, histograms or illustrations as appropriate.

Mid standard – 3 marks

Most results or observations recorded.

Results or observations usually accurate.

Overall presentation clear, needs prompting to adopt appropriate method.

Low standard – 1 mark

Some results or observations recorded.

Results or observations occasionally accurate.

Presents results in a suitable manner only with assistance.

Marking Criteria for Category B(iii): Interpretation of results

High standard – 5 marks

Conclusions concisely stated.

Clear understanding of inferences to be drawn.

Careful explanation of the results, including references to controls.

Useful comments on limitations of methods or indications of the wider significance of the results.

Mid standard – 3 marks

Conclusions stated simply.

Some explanation of results.

Limited discussion of the significance of the results in relation to the method used.

Low standard – 1 mark

Suitable conclusions drawn with assistance.

Attempts to explain results but limited understanding of their significance.

Category C: Designing and Evaluating an Experiment

In this category, candidates should have the opportunity to design an experiment or investigation and to evaluate and criticise it once they have carried it out.

The experiment or investigation should be more open than those carried out for Category B, but should relate to practical work or the collection of data or information that is carried out by the candidate in the laboratory or in the field. The situation or material investigated should be closely related to the biological principles included in the syllabus.

The design and evaluation in this category may, if desired, relate to practical work which is performed but not itself assessed, or alternatively it may be linked to a more open biological investigation which is done as one of the assessed experiments for Category B.

The design of the experiment or investigation should include a statement of the aim, problem or hypothesis; some explanation of the method or technique chosen; and a list of the apparatus or procedure required.

In evaluating, candidates could, for example, be asked to criticise or comment constructively on:

- the limitations of the methods and the procedures;

- the accuracy of the results and the validity of the conclusions;

- the significance of unexpected results;

and to make suggestions for:

- improvements in the experimental design;

- further work.

Assessments should be made of:

(i)   the statement of the hypothesis to be investigated and the details of how the investigation would be carried out   **(5 marks)**

(ii)   comments on and criticisms of the experiment or investigation which has been performed by the candidate   **(5 marks)**

As in Category B, candidates may be given assistance if necessary at different stages, particularly in drawing up the plan of the investigation, but fewer marks should be awarded for sections where help was given. When marking the work, the teacher should indicate where help was given in order to make the reasons for awarding the marks clear to moderators.

For Category C, it should be emphasised that these are intended to be small-scale investigations. The investigations should not be treated as projects and the hypothesis to be investigated is not expected to be unique for each individual. It would be acceptable for several individuals to investigate the same hypothesis, although each individual must work independently in formulating the plan and in evaluating the investigation that has been carried out.

Marking Criteria for Category C(i): Plan of investigation

High standard – 5 marks

Formulates a hypothesis and clearly explains the biological aims of the investigation in relation to the hypothesis.

Appropriate method chosen, techniques clearly understood and explained.

Consideration given to validity in terms of number of samples, or need for repetition, or controls as appropriate.

Proposed procedure workable, well set out and could be easily followed.

Mid standard – 3 marks

Translates a stated hypothesis into biological aims with limited assistance.

Selects suitable methods and techniques with some assistance.

Shows some awareness of the means by which validity can be achieved.

Some steps in the procedure explained.

Low standard – 1 mark

Formulates overall plan of investigation only with assistance.

Proposes suitable methods only with guidance.

Limited attempt to use reasonable number of samples, or to repeat observations, or to include controls.

Marking Criteria for Category C(ii): Evaluation of experiment

High standard – 5 marks

Clear awareness of the limitations of the methods or of weaknesses in the procedure.

Constructive suggestions for the improvement of the methods or refining of the hypothesis.

Useful suggestions for possible further work.

Mid standard – 3 marks

Indicates understanding that there may be limitations in the methods chosen or that the procedures could be varied or improved.

Have some ideas for improvement.

Some attempt to indicate possibilities for extending the study.

Low standard – 1 mark

Limitations of the methods or procedures adopted appreciated with guidance.

Suggests alternative methods or improvement in relation to aims only with assistance.

Limited awareness of implications of investigation in relation to further work.

Category D: Written Work

In this category, candidates are required to submit two pieces of work, produced during the course:

(i)   one descriptive account of a field trip or visit   **(10 marks)**

(ii) one essay   **(10 marks)**

The work for (i) should be based upon field trips or visits made as part of the course. The descriptive account should give evidence of first-hand experience and scientific understanding of the topic discussed and candidates should show the ability to write a comprehensive and accurate description of the field trip or visit.

For (ii), the essay title will be set by the teacher and should relate to any topic within the syllabus. The essay should give an opportunity for the candidates to show their ability to discuss an issue or handle an argument and to present a coherent essay on the subject matter.

Marking Criteria for Category D(i): Descriptive account of a field trip or visit

Qualities to be assessed	*Maximum marks*
Coverage of topic comprehensive in relation to visit made; material relevant	**3 marks**
Accuracy of material including its scientific content	**3 marks**
Evidence of first-hand experience	**2 marks**
Presentation, including use of illustrations where appropriate	**2 marks**

Marking Criteria for Category D(ii): Essay

Qualities to be assessed	*Maximum marks*
Coverage comprehensive in relation to the topic; material relevant	**3 marks**
Accuracy of material including its scientific content	**3 marks**
Effective argument or interpretation of topic	**2 marks**
Presentation, including use of illustrations where appropriate	**2 marks**

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Please read the instructions printed overleaf before completing this form.

Centre Number						Centre Name		November	**2**	**0**	**1**	**1**
Candidate Number						Candidate Name		Teaching Group/Set				

Title of piece of work	Categories in which the piece of work is to be assessed (please tick)						
	A(i)	A(ii)	A(iii)	B	C	D(i)	D(ii)
Number of ticks in each column	2	2	2	2	1	1	1

I certify that all of the work submitted in the Coursework File is the candidate's own work and has been carried out under supervision.
Signed (teacher):

INSTRUCTIONS FOR COMPLETING THE COURSEWORK FILE CONTENTS FORM

1.   Complete the information at the head of the form. One form is required for each candidate.

2.   Select the pieces of work to be included in the candidate's Coursework File.

3.   For each piece of work in the Coursework File, write down the title in the appropriate space. Indicate with ticks the categories in which the piece of work is to be assessed.

4.   Check that the number of ticks in each column is correct.

5.   There should be a maximum of **eleven** pieces of work in the file. If any piece of work has been assessed in more than one category, then there will be fewer than eleven pieces of work in the file.

6.   Sign the form to confirm that all of the work submitted is the candidate's own and that all of it has been done under the supervision of a teacher.

7.   If you have any comments for the moderators about the selection of pieces of work, write them in the box below.

Comments

WMS684   **OL/FISC/CW/C/11**

FISHERIES SCIENCE 5151
Individual Candidate Record Card
GCE O LEVEL

Please read the instructions printed overleaf before completing this form.

Centre Number					Centre Name	
Candidate Number					Candidate Name	
November	**2**	**0**	**1**	**1**	Teaching Group/Set	

CATEGORY A **Making and Recording Accurate Observations**		Max marks	Marks		
			Piece 1	Piece 2	Average
(i)	**Drawing of biological material**	5			
(ii)	**Comparison of biological material**	5			
(iii)	**Measurements with apparatus**	5			
TOTAL MARK FOR CATEGORY A					

CATEGORY B **Performing Experiments and Interpreting the Results**		Max marks	Marks		
			Piece 1	Piece 2	Average
(i)	**Procedure and use of apparatus**	5			
(ii)	**Record of results**	5			
(iii)	**Interpretation of results**	5			
TOTAL MARK FOR CATEGORY B					

CATEGORY C **Designing and Evaluating an Experiment**		Max marks	Marks Piece 1
(i)	**Plan of investigation**	5	
(ii)	**Evaluation of experiment**	5	
TOTAL MARK FOR CATEGORY C			

CATEGORY D **Written Work**			Max marks	Marks Piece 1
(i)	**Descriptive account of a field trip or visit**	**Coverage**	3	
		Accuracy	3	
		Experience	2	
		Presentation	2	
(ii)	**Essay**	**Coverage**	3	
		Accuracy	3	
		Interpretation	2	
		Presentation	2	
TOTAL MARK FOR CATEGORY D				

FINAL TOTAL MARK	**Maximum 60 marks**	
Teacher's signature:		

INSTRUCTIONS FOR COMPLETING INDIVIDUAL CANDIDATE RECORD CARDS

1. Complete the information at the head of the form.

2. Mark the coursework for each candidate according to the marking criteria listed in the syllabus.

3. Enter the marks for each piece of work in the appropriate spaces. Use only **whole numbers** of marks.

4. For Category A and Category B, calculate the average mark for each section. Half marks should be rounded **up** to the nearest whole number.

5. Complete the total marks for each category, and calculate the final total mark for the candidate.

6. Sign the form.

7. Transfer the marks to the Coursework Assessment Summary Form in accordance with the instructions given on that document.

8. **It is essential that the marks of candidates from different teaching groups within each Centre are moderated internally.** This means that the marks awarded to all candidates within a Centre must be brought to a common standard by the teacher responsible for co-ordinating the internal assessment (i.e. the internal moderator) and a single valid and reliable set of marks should be produced which reflects the relative attainment of all the candidates in the Coursework component at the Centre. The outcome of internal moderation, in terms of the internally moderated total mark, must be recorded on the Coursework Assessment Summary Form.

9. Retain all pieces of assessed coursework, Coursework File Contents Forms and Individual Candidate Record Cards as these will be required for external moderation.

WMS685   **OL/FISC/CW/I/11**

Please read the instructions printed overleaf before completing this form.

Centre Number					Centre Name		November	2 0 1 1

Candidate Number	Candidate Name	Teaching Group/Set	**Category A** Making and Recording Accurate Observations (max 15)	**Category B** Performing Experiments and Interpreting the Results (max 15)	**Category C** Designing and Evaluating an Experiment (max 10)	**Category D** Written Work (max 20)	**Total Mark** (max 60)	**Internally Moderated Mark** (max 60)

Name of internal moderator		Signature		Date					
Name of school principal		Signature		Date					

A   INSTRUCTIONS FOR COMPLETING COURSEWORK ASSESSMENT SUMMARY FORMS

1   Complete the information at the head of the form.

2   List the candidates in an order that will allow ease of transfer of information to a computer-printed Coursework mark sheet MS1 at a later stage (i.e. in candidate index number order, where this is known; see item B.1 below). Show the teaching group or set for each candidate. The initials of the teacher may be used to indicate the group or set.

3   Transfer each candidate's marks from his or her Individual Candidate Record Card to this form as follows:

   (a)   Enter the marks initially awarded for each of Categories A, B, C, and D in the appropriate column (i.e. before moderation took place).

   (b)   In the column headed 'Total Mark', enter the total mark awarded before internal moderation took place.

   (c)   In the column headed 'Internally Moderated Mark', enter the total mark awarded *after* internal moderation took place.

4   Both the internal moderator and the school principal should check the form and complete and sign the bottom portion.

5   Retain a copy of the Coursework Assessment Summary Form.

B   PROCEDURES FOR EXTERNAL MODERATION

1   Cambridge International Examinations (CIE) sends a computer-printed coursework mark sheet MS1 to each Centre in early October for the November examination) showing the names and index numbers of each candidate. Transfer the total internally moderated mark for each candidate from the Coursework Assessment Summary Form to the computer-printed coursework mark sheet MS1. The top copy of the computer-printed coursework mark sheet MS1 must be despatched in the specially provided envelope to arrive as soon as possible at CIE but no later than 31 October.

2   All of the candidates' coursework files (including the assessed pieces of work, the Coursework File Contents Form and the Individual Candidate Record Card), together with the Coursework Assessment Summary Form, must be submitted to the Department of Public Examinations in Malé by 1st September. The DPE will forward the coursework to CIE for external moderation. Send, with the coursework, any information as to how internal moderation was carried out.

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