RESEARCH DIVER TRAINING PROGRAM

Lee H. Somers

MICHIGAN SEA GRANT PROGRAM

MICHU–SG–75–603
JUNE 1975

RESEARCH DIVER TRAINING PROGRAM

by

Lee H. Somers, Ph.D.

Department of Atmospheric and Oceanic Sciences
Department of Physical Education
The University of Michigan

June 1975

MICHU-SG-75-603

The Michigan Sea Grant Program

Diving technology, research and education is supported by The University of Michigan Sea Grant Program, under sponsorship of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Grant No. 04-5-158-16.

PREFACE

This publication has been prepared to provide greater insight into the special requirements associated with training research divers. It is the obligation of those who intend to perform underwater research and work tasks to prepare themselves to cope with the new and unusual demands imposed by such activities. Although few formal specialized training courses are available today, everyone who plans to engage in underwater research and work, whether expert or novice, is encouraged to seek specialized instruction.

This publication is not a comprehensive manual. The subject matter covered is too vast to permit complete coverage in a single book or course. When used in conjunction with manuals such as the *Research Diver's Manual* (Somers, Michigan Sea Grant) and other technical reports or manuals, it may serve as a program organization manual and comprehensive outline.

Numerous changes in the schedule and course procedures were based significantly on insights and knowledge gained during the 1972-73 courses.

CONTENTS

PREFACE

INTRODUCTION 1

TRAINING PREREQUISITES 2

APPLICANT EVALUATION 3

INSTRUCTION SITE 5

COURSE CONTENT 6

COURSE PROCEDURES 8

TIME FRAME 10

INSTRUCTIONAL STAFF 11

EQUIPMENT REQUIREMENTS 13

- Compressed Air System 13
- Surface-Supplied Diving Equipment 14

COMMUNICATIONS UNIT 14

- Scuba Diving Accessories for Advanced Activities 14
- Suits and Accessories 14
- Instruction Kits 14
- First Aid Equipment 14
  - Geologist Kit 15
  - Biologist Kit 16
  - Underwater Work Kit 17
  - Underwater Photography Kit 18

EMERGENCY PROCEDURES 19

TEXTS AND SUPPLEMENTARY MATERIALS 20

- Announcement Brochure 20
- Pre-Course Information Packet 20
- Course Packet 21

EVALUATION PROCEDURES 21

CERTIFICATE OF TRAINING 21

COURSE COST AND FEES 22

REFERENCES 23

APPENDICES

- Appendix I - Research Diver Course Curriculum Outline I-1
  - Topic I: Registration and Orientation I-2
  - Topic II: Open-Water Diving Procedures I-4
  - Topic III: Charging SCUBA I-6
  - Topic IV: Underwater Navigation I-7
  - Topic V: Open Water Swimming Using SCUBA I-8
  - Topic VI: Air Decompression Tables and Decompression Procedures I-9

Topic VII: LAKELAB Orientation and Long Duration Diving I-11
Topic VIII: Underwater Search Procedures I-13
Topic IX: Intermediate Class Dives with SCUBA I-14
Topic X: Surface-Supplied Diving System; Function and Nomenclature I-15
Topic XI: Surface-Supplied Diving Techniques and Procedures I-18
Topic XII: Limited Visibility and Night Diving Using SCUBA I-20
Topic XIII: Light Salvage I-21
Topic XIV: Underwater Biological and Geological Research Techniques I-22
Topic XV: Underwater Photography I-24
Topic XVI: Using Tools Underwater I-26
Topic XVII: Recompression Chamber Operation I-29
Topic XVIII: Use of Tables for Treatment of Decompression Sickness and Air Embolism .. I-30
Topic XIX: First Aid I-31
Topic XX: Seamanship I-32
Topic XXI; Physical Fitness I-33
Topic XXII: Lifesaving and Watersafety for Divers I-34
Topic XXIII: Open-Circuit SCUBA and Surface-Supplied Qualification Dives I-35
Topic XXIV: Cold Weather and Under Ice Diving I-36

Appendix II - List of Contents II-1

General Information Bulletin II-2
Pre-Course Theory Examination II-4
Letter of Acceptance II-14
Medical History and Examination Information II-15
Medical Examination Report II-17
Daily Schedule II-18
Certificate of Research Diver Training II-19
Release/Acknowledgement of Risk Form II-20

INTRODUCTION

During the past two decades a number of scientists have used underwater diving equipment and procedures to enhance scientific investigation of rivers, lakes, and oceans. A number of universities and research agencies now endorse and/or fund underwater research. Both students and established researchers are requesting training in the use of diving apparatus at many institutions. Unfortunately, only a limited number of institutions have organized programs of research diver training and supervision. Most research personnel are finding it necessary to seek diving training through recreational programs in the local university, diving shops, YMCAs or similar organizations. Although many of the recreational diver training programs are excellent for the sports enthusiast, they are generally insufficient to prepare a researcher for *working underwater*.

Recognizing the demand for specialized diver training in the scientific community, The Michigan Sea Grant Program initiated a speciality diving course aimed at better preparing scientists, technicians, and students for working underwater. Based on experience gained at The University of Michigan over the past decade it was determined that the diving scientist must be a competent underwater worker as well as a scientific observer. The research diver must be able to complete an underwater task safely, efficiently, and economically.

At present, it is virtually impossible to train every scientist, technician, and student who may use diving in his professional endeavors. The recent notoriety given underwater science by the "World of Jacques Cousteau" television series, the Tektite program, and similar glamorous activities has stimulated thousands of young people to seek education and employment in the fields of limnology and oceanography. Unfortunately, the glamour of diving is the primary motivation and these potential oceanographers frequently seek the diving education prior to the science education. It is the general consencus among scientists that it is much wiser and simpler to train a scientist to be a diver than a diver to be a scientist. As in any form of underwater work, diving is only a *tool*. This program is, therefore, aimed at the advanced undergraduate or graduate student and established scientist or technician in the various fields of marine and aquatic science and engineering.

Our experience has shown that most individuals truly interested and prepared to pursue underwater scientific investigations have already received some form of basic skin and scuba diver training. However, their diving skill, knowledge, and experience is generally limited. Consequently, the "Research Diver Training Program" was developed to provide specialized training and supervised diving experience for divers with prior basic scuba diver training and limited experience. Our intent is to initiate the transformation of the novice sport diver into a working research diver.

The program objectives are:

1. to provide supervised advanced scuba diving training and experience activities for novice divers,
2. to provide a "controlled" diving situation which would enhance the development of a "working" diver,
3. to teach proper procedures for assembling, checking, using, and maintaining surface-supplied diving apparatus,
4. to provide speciality training and exercises in underwater work and research techniques,
5. to provide an atmosphere conducive to the interchange of academic information on underwater research equipment, techniques, and procedures.

The information given in this paper is based in part on experience gained while teaching four research diver training courses in 1972 and 1973. Course content and procedures were continuously modified during this trial period in an effort to better serve the student.

TRAINING PREREQUISITES

Our experience showed that even with a limited number of course announcements to various universities and research organizations, a large number of applicants can be expected. It is necessary to establish relatively well-defined prerequisites. In order to be eligible for acceptance into The University of Michigan's program, the applicants must comply with the following:

1. Be enrolled (current, past, or following term) in an academic marine science or engineering program as an advanced undergraduate or graduate student or be employed by a marine science or engineering-oriented agency.
2. Hold a certificate of training issued upon completion of a basic scuba diving course. Acceptance of the certificate is subject to evaluation and approval by the program director.
3. Submit a diver's logbook showing that the applicant has completed a minimum of 12 open water scuba dives.
4. Submit a certificate or form showing that the applicant is medically qualified for diving; examination must be within 6 months prior to the course.
5. Submit a letter of recommendation from a representative of the applicant's college or agency.
6. Be capable of swimming 440 yards in less than 12 minutes without

swimming aids and 880 yards in 20 minutes in open water wearing mask, fins, snorkel, wet suit, and personal floatation unit (not inflated). In addition, the applicant must be capable of towing an inert skin diver 50 yards, swim 25 yards underwater, and surface dive to a depth of 10 feet and recover a 15 pound weight. These exercises are to be completed without the use of skin diving equipment.

7. Supply the following equipment (subject to inspection and approval by the program director or dive supervisor):

   A. Scuba (standard open-circuit with submersible pressure gauge).
   B. Wet suit 3/16 or 1/4 inch; complete
   C. Floatation vest or buoyancy compensator (CO_2 or air cylinder inflatable, yoke-type).
   D. Mask, fins, snorkel, knife, and weight belt.
   E. Underwater compass, depth indicator, and watch.
   F. Equipment storage box or bag.

Course directors are encouraged to screen applicants carefully. Applicants with "considerable" diving experience should be rejected or channeled into "higher-level" courses. One of the most awkward situations encountered in our training programs was the presence of a few highly experienced scientific divers who attended the course to acquire special training in only a few segments of the program. Several individuals were disappointed or uncomfortable when they realized that our program was aimed at an applicant of "novice" diving level.

APPLICANT EVALUATION

The majority of novice divers completing basic sport scuba diving courses are reasonably well trained in the *use* of scuba. However, those with a limited amount of open water diving experience may appear relatively awkward during preparation for dives and in the water. Based on both subjective and objective evaluations of novice sport divers and basic scuba diving courses, the following general deficiencies have been found in potential Great Lakes area applicants for advanced training:

1. Lack of ability in lifesaving and rescue procedure.
2. Limited knowledge of selection of diving equipment.
3. Lack of ability to properly read diving tables and compute repetitive dives.
4. Lack of awareness of the apparent limitations of automatic decompression devices commonly available to sport divers.
5. Limited knowledge of first-aid for diving related injuries.
6. Little or no knowledge of dive planning and organization.

7. Relatively poor physical condition.
8. Insufficient or incorrect training and/or practice in buoyancy compensation.
9. Limited knowledge of diving physiology.
10. Lack of familiarity with, and incorrect use of, personal diving equipment.

It is not my intent to present a completely objective list of diving candidate deficiencies in this paper. It is to caution prospective course and training directors against "blind acceptance" of novice sport divers based on anticipated diving skill and knowledge levels. When planning a program, one should take the items listed above into account and be able to recognize group or individual deficiencies and adjust the training schedule accordingly. Considerable skill and knowledge variations may be anticipated, and it is difficult to fashion a program that will be totally efficient.

Some basic sport diving course graduates lack basic watermanship ability and physical conditioning. There appears to be a philosophy in some facets of the sport diving community that a diver trained in the use of relatively sophisticated buoyancy control equipment need not be skilled in basic watermanship or concerned with maintaining a relatively high level of physical fitness. Proper buoyancy control is extremely important in safe scuba diving; however, equipment and some of the excellent buoyancy control techniques *cannot* be substituted for ability and fitness -- especially for a working diver. In evaluating diver performance with sophisticated buoyancy control equipment, the course or training director must also evaluate that individual's ability to perform with a "standard" floatation vest. Also, as with all applicants, particular attention must be given to general ability.

The watermanship ability requirement is deemed necessary for potential applicant self-evaluation prior to applying for acceptance into the program. Since the program consists of at least five days of diving with 3 to 5 dives each day and long hours of other work, good physical condition and watermanship are essential for student success and safety. Again many applicants with "certified scuba diver cards" are poor swimmers and have limited lifesaving ability. Many have been taught to rely on floatation equipment and swimming aids rather than personal skill and physical conditioning. Upon completion of the initial courses, the staff concluded that the swimming eligibility test administered at the beginning of the course should include basic skin and scuba skills rather than simply swimming exercises. Consequently, greater emphasis is placed on the evaluation of the student in a manner similar to that employed in open water at the end of a basic scuba course. This evaluation and an 880 yard swim are recommended as part of the first day program.

The possession of a "scuba diver certification card" is also no guarantee that the applicant has been examined by a physician and certified

medically qualified for diving. In fact, it appears that the majority of novice "certified scuba divers" have not submitted to a proper diver's medical examination. Many sport diving courses, especially those conducted by commercial enterprises, do not require medical examinations prior to training. Our association with large numbers of sport divers and instructors, has shown that a significant number of individuals holding "certified diver cards" have medical conditions contraindicate to diving. These conditions include:

Asthma

High or low blood pressure

Diabetic problems

Lung abnormalities

Emotional instability

A specific diver's medical examination form which includes information on diver medical requirements must be supplied to the applicant.

Although a written examination on basic diving theory was not administered at the beginning of the instructional course, it was determined from general conversation, that many of the students lacked basic knowledge of diving theory. Needless to say, only a limited amount of basic course material can be incorporated into the speciality program. It has been suggested that applicants for research diver training be required to study a designated textbook and supplementary materials prior to the course and complete a comprehensive, self-administered basic diving theory examination. This examination would be returned to the program director at least one month prior to the course. These examination results would prove beneficial in structuring the program and possibly in identifying unacceptable applicants.

In the university's program, divers with considerable experience are discouraged from enrollment. The course is oriented toward the "novice diver". Some experienced divers who need training in specific aspects of the course are enrolled and actually serve as assistants in the scuba diving portion of the program.

INSTRUCTION SITE

Shore-based programs are logistically simpler and more economical than those conducted on boats. The instruction area must have sheltered open water areas in order to avoid loss of diving days due to adverse weather. A diving platform (dock, pier, barge, or vessel) must be located where water is clear and depth is at least 10 ft. for surface supplied training. Relatively deep water (50 to 100 ft.) should be close to shore, within

easy swimming distance. The shore base must be readily accessible with sufficient area for operation of support equipment. Electricity and sanitary facilities must be available at the site. Equipment security is a consideration. An equipment storage area (building or trailer) and a field class room (building, trailer, or shelter) for lectures and dive planning during inclement weather is also necessary. Courses conducted in less suitable surroundings will probably encounter logistical difficulties. Ideally, a course should be conducted at a facility which includes permanent classrooms, dormitories, a diving locker, a pool, a pier, and other support items. In reality, at least in the Great Lakes area, the course is generally conducted in the field, far removed from such permanent facilities. Although logistically more difficult, a mobile operation is generally required.

The 1972 and 1973 training programs were conducted at The Michigan Sea Grant Program's *LAKELAB* facilities in Grand Traverse Bay. *LAKELAB*, a small underwater habitat, is located about 100 ft. (30.5m) offshore from the Omena-Traverse Yacht Club (Somers, 1973). The habitat rests on a sloping sand and gravel bottom at a depth of 30 ft. (9m). At a distance of approximately 100 yds. (91.5m) offshore the bottom is primarily composed of silt and sand. Surface-supplied diving was conducted in 10-20 ft. (3 to 6m) of clear water directly off the yacht club dock. Scuba diving was based from a pebbly beach. Scuba dives to a depth of 70 ft. (21m) were easily accomplished from shore. Deeper dives, both scuba and surface-supplied, were conducted from *SEA GRANT I*, the program's 26 ft. (8m) workboat.

A 24 ft. (7.3m) office-type field trailer was used as a base of operation for program activities. The multipurpose trailer served as an office, communications center, first aid facility, workshop, and storage area. Air compressors and storage banks were contained on a 14 ft. (4.3m) flatbed trailer. Lectures and dive planning sessions were held inside or on the porch of the yacht club's main building.

All trainees were requested to live on site at a house provided by the program or in nearby commercial facilities. This significantly enhanced the teaching-learning atmosphere. Generally, a lecture or discussion was held during or immediately following breakfast and lunch. Diving was terminated in late afternoon and a lecture-discussion-relaxation hour followed at the club or house. At times, diving operations resumed at dark and continued until midnight.

COURSE CONTENT

In order to meet the needs of students from a variety of disciplines in marine science and engineering a wide range of subject matter and skills must be covered in the program. It is virtually impossible to provide instruction and field experience in all areas of research diving. The

instructors can, however, provide basic knowledge and experience in underwater work tasks and specialized diving techniques which may be adopted later by the participants for activities common to their discipline.

The course content was based in part on an evaluation of the basic scuba training programs and the anticipated proficiency level of the novice diver. Our subjective and objective findings in this area have been discussed previously. In order to determine the primary content of the course, an analysis was made of underwater research projects conducted in the Great Lakes by University of Michigan personnel over the past 10 years. The following activities are listed in order of priority:

1. General observations of biological and geological phenomena requiring detailed descriptions.
2. Underwater work tasks such as the installation of current meters, wave-force sensors, and small offshore meteorological instrumentation towers.
3. Biological and geological sample collection.
4. Underwater photography.

Taking these activities into account, it was concluded that the most important aspect of training would be the development of a safe, comfortable, and effective underwater observer. The most significant factor in developing a diver is to encourage "diving". Consequently, the program was organized to provide opportunity for each student to make three to five dives per day including night scuba dives. The students were supervised continuously, both in the water and on shore, using a student instructor ratio of 2:1 to 4:1, depending on the exercise. The staff was directed to aid the student in equipment selection, adjustment, and use; improving underwater comfort and efficiency; and developing a safe diving philosophy.

Each student received instruction in surface-supplied diving. Based on experience gained at The University of Michigan, surface-supplied diving techniques are safer and more efficient for many situations encountered in low visibility Great Lakes research diving. Most projects require only one diver underwater to complete the work; the advantages and limitations of surface-supplied diving are given by Somers (1972, 1972a). Each student received instruction and experience in diving, tending, gas panel monitoring, communications, and rigging.

Research divers are frequently required to perform underwater work tasks such as current meter installations, attachment of wave force gauges to breakwaters, recovery of lost equipment, etc. Such activities require skill in the use of simple underwater tools and project analysis and planning. Diver safety is of utmost importance. Consequently a variety of underwater work exercises were developed to provide the student with an opportunity to use underwater tools under controlled conditions and to complete relatively simple underwater work tasks. Details on underwater work will be given in future Michigan Sea Grant program publications.

Detailed outlines for each topic covered in the program are included in the Appendix. The following is a summary of the course content:

Advanced Scuba Diving: Supervised diving, air supply systems; limited visibility diving; underwater navigation.

Surface Supplied Diving: Free-flow mask, free-flow demand mask, and lightweight helmet, umbilical line assembly; communications, air supply system; operational and emergency procedures; practice dives; applications to research.

Diving Procedures: Dive planning; environmental evaluation; safety; decompression; supervision; record-keeping.

Research Techniques: Geological and biological mapping, sampling, measurements, and observations; underwater photography; data recording.

Underwater Work: Use of tools; underwater search, floatation lifting of submerged objects; equipment installation; special safety precautions.

Coldwater Diving: Diving suits; equipment problems; physiological aspects.

Habitat Diving: Scientific applications; habitat design, life-support, and operation; saturation diving.

COURSE PROCEDURES

The large number of topics and exercises listed is difficult to cover in a one-week program. Although the program was originally based on 8 hours per day of instruction plus two night dives on a total of 48 hours, approximately 55 to 60 hours of instructional and practice time are required. Naturally, both the content and time schedule must be adjusted to meet the student's needs and weather conditions. In this type of training it is not always reasonable to attempt a 12 to 15 hour per day schedule. Many students are not physically conditioned to participate in 3 to 5 hours per day of coldwater diving for a continuous 5-day period. Learning capability and attention span is reduced by fatigue and, in some cases, too much exposure to the same subject. Of even greater significance, fatigue can cultivate carelessness and lack of respect for common sense safety procedures. The staff must continuously keep the health and safety of the diver uppermost even if it involves reorganization of the schedule or elimination of some subject matter. As previously mentioned, the students are supervised on a ratio of 2:1 to 4:1 depending on the exercise. Only 10 to 15 students are accepted in a course.

Student participation is emphasized throughout the training program. Formal lectures are kept to a minumum and presented during selected time intervals which are complementary to the diving schedule.

It should be noted that, for many of the students, diving in itself

is not the prime motivation for enrollment in the course. Most researchers consider diving a "tool" with only secondary importance relative to the scientific work they are attempting to accomplish. Consequently, the staff will have to provide proper motivation to insure that the students study "the science of diving" in order to accomplish "science through diving".

The students definetly lacked prior insight in diving organization, planning, and economics. Most of them had never worked under a strict set of regulations common to universities with major diving programs. It is evident that even greater emphasis will have to be placed on these facets of diving in future programs. Every minute that is wasted by the diver in a research program is costing the "taxpayer" money. Also, some divers appear to disregard organization and the high level of safety that is required in institutional diving. The student must realize that his actions alone could influence an entire diving program for years to come in any university.

It is evident that some sport diving courses neglect sufficient information on equipment selection, use, and maintenance. More emphasis must be placed on evaluation and selection of equipment. The research personnel will frequently be in a position to purchase relatively expensive equipment and responsible for expenditure of government funds. They must be provided with criteria for the selection of durable, functional, and safe equipment. During the course, the staff inspects each item of the student's personal equipment before the entire group. They emphasize the above factors and discuss maintenance, possible safety modifications, etc. In some cases, specific items are rejected for use in the course. This evaluation also applies to the equipment furnished by the program. The staff makes an effort to acquaint the student with selection criteria, safety features, proper maintenance procedures, usage problems, poor design features, etc. This includes everything from diving helmets to hose fittings.

The selection and use of hyperbaric chambers is discussed. Ideally, it would have been best to have a chamber on site. Future plans include either a chamber on site or a visit to the university's chamber in Ann Arbor, Michigan. As safety regulations for scientific diving become more complex, it is likely that hyperbaric chambers will be required on site for major diving activities. All research divers will benefit from a better understanding of chambers and treatment procedures.

All diving is conducted in accordance with U.S. Navy Standard Air Decompression Tables. One of the more interesting experiences for the students is an appreciation for the necessity of planning repetitive dives carefully. Dive schedule calculation is supervised by the instructors. The use of decompression meters available to date is regulated in accordance with limitations of the meter based on unsatisfactory comparison with acceptable decompression tables and procedures. This topic is discussed in detail in the course.

TIME FRAME

Many universities and agencies have special departments for planning and coordinating workshops, and special courses. Such groups will be of considerable value to course directors in scheduling and time frame procedures. As a general rule the following time frame scheme has been workable:

Time Interval Prior to Course	Activity
12 months	Specify dates and location
11 months	Confirm dates and location
10 months	Complete brochure; prepare general course outline; contact prospective staff; list equipment and supplies required
9 months	Public notices of course (first mailing, magazines, etc.); initial inspection of major equipment; investigate lodging and meals
8 months	Prepare special forms, general information letters; respond to inquiries with general information letters and special application form
6 months	Public notification (second mailing); confirm staff; inspect facilities; develop daily schedule; draft all handouts and materials; finalize lodging and meal arrangements
4 months	Assemble equipment and supplies; inspect and repair gear; detail procedures and teaching schedule
2-3 months	Review applicants and send letters of acceptance; send trainee packets and manuals; collect fees; meet with staff
1 month	Site inspection; finalize all procedures; reconfirm staff; review materials returned by trainees; adjust schedule and course content (if necessary); final equipment packing and check
7-15 days	Core staff arrive at site; set up and check out equipment

Time Interval Prior to Course	Activity
2 days	Complete staff arrive, staff training; special assignments; review procedures, etc.
0 day	Course
1 month (after)	All certificates mailed, cost paid; books closed

Naturally, each organization will develop its own time frame and list of activities. The above is intended as only a guide. The necessity of very detailed scheduling and preplanning cannot be over stressed.

INSTRUCTIONAL STAFF

As in any instructional program, the staff must be skilled, experienced divers and instructors. Instructional staff members in The University of Michigan's program hold scuba instruction certificates issued by the National Association of Underwater Instructors (NAUI), Professional Association of Diving Instructors (PADI), or the Young Men's Christian Association (YMCA). Although these scuba instructor certificates are primarily based on a sport diving program, they are an initial verification of the instructors teaching and diving ability. The staff must also have training and sufficient experience in surface-supplied diving. Instructors with military deep-sea or commercial diving school training and experience are desirable. Instructors with special qualifications in seamanship, first aid, diving medicine, recompression chamber operation, and scientific diving should be included as core staff or guest instructors. The staff structure for the the Michigan program is as follows:

COURSE DIRECTOR

TRAINING DIRECTOR

Team Leader

University Instructors
Team Leader

Assistant Instructors
Guest Instructors
(May serve as team leaders)

The Course Director bears primary responsibility for site and facilities selection, local arrangements, staff selection, planning, scheduling, finances, records, communications, staff preparation, and activities supervision. Above all, he is responsible for the health and safety of both student and staff. He must maintain high level instructional and safety standards. Qualifications for this position include certification as a scuba diving instructor (current) qualified in the use of surface-supplied equipment; organizational

and management ability, capable of accepting such responsibilities; and sufficient time to handle the duties summarized above both prior to and during the course.

It is also desirable to appoint a Training Director who is directly responsible to the Course Director. In some cases he will share the responsibilities of pre-course planning and organization. His primary duties include organization and supervision of training activities, supervision of team leaders and guest instructors, insuring that all training materials and facilities are ready for the student, and general coordination of students and staff. As with the Course Director, the Training Director bears specific responsibility for the health and safety of all personnel involved in training. The Training Director must be a certified scuba instructor with qualifications in the various items of equipment being used in the course. He must exhibit mature judgment, sincerity, enthusiasm, and patience along with willingness to work closely with other staff members and students.

The use of Team Leaders for small courses is optional; however, for larger courses it is deemed desirable and, in some cases, necessary for safe and efficient operation. Team leaders are directly responsible to the Course and Training Directors. Four or more students are assigned to each Team Leader. He assists students whenever possible with both academic and personal problems. He insures that his students are on time for each function, that they are properly and sufficiently equipped, and provides motivation. Foremost, he is watchful for signs of both physical and mental stress and serves essentially as a lifeguard and supervisor for his team members. Ideally, Team Leaders should also be certified scuba instructors. Select experienced divers and guest specialists have been used as team leaders successfully. Above all, the individual must possess mature judgment, high-level diving and lifesaving ability, sincerity, enthusiasm, and patience.

The guest instructors and specialists enhance the course offerings by providing the best possible instructional talent for speciality subjects. The Course Director must use discretion in selecting these individuals to insure that their personalities and abilities are compatible with the high level of instruction and personal involvement required.

The instructional staff, in addition to the Course and Training Director, may consist of various divers employed by the university or guest instructors. A sufficient number of individuals, approved by the Course Director, are required to maintain an appropriate student instructor ratio for water work. Each member of the staff, regardless of status, teaches his speciality. The staff for the 1974 program conducted by The Michigan Sea Grant Program included:

Dr. Lee Somers - Director, Underwater Technology Laboratory, Michigan Sea Grant Program; Associate Research Oceanographer and Assistant Professor of Physical Education, The University of Michigan; and Certified NAUI Diving Instructor.

Patrick Blackburn - Instructor and Diver, Michigan Sea Grant Program and Department of Physical Education, The University of Michigan; Certified YMCA and PADI Diving Instructor.

Ronald W. Dana - Regional Diving Officer Designate, Lake Survey Center, National Oceanic and Atmospheric Administration; Certified NAUI Diving Instructor.

Charles D. Craw - Marine Technicain, Michigan Sea Grant Program; Graduate of the Coastal School of Diving; and Certified NAUI Diving Instructor.

Martin Nemiroff, M.D. - The University of Michigan Medical Center; Specialist in Diving Medicine.

Underwater Technology Laboratory Personnel - All qualified Divers and Underwater Research Specialists.

Guest Instructors - All Certified Scuba Instructors and knowledgeable in specialized aspects of diving.

EQUIPMENT REQUIREMENTS

A large amount of equipment is required in order to conduct a program of this type. Students and staff provide their own basic diving equipment including wet suit, complete scuba, weight belt, mask, fins, snorkel, personal floatation unit, watch, depth indicator, compass, knife, and an equipment bag or box. All equipment used was subject to the approval of the program director.

Specialized equipment was drawn from the Underwater Technology Laboratory's Diving Locker. This included the following:

COMPRESSED AIR SYSTEM:

Compressor, high pressure, diesel, 16 ft^3/min, 3500 lbs/in^2 (450 l/min, 246 kg/cm^2)

Compressor, high pressure, electric, 8.4 ft^3/min, 3200 lbs/in^2 (238 l/min, 225 kg/cm^2)

Compressor, low pressure, electric, 14 ft^3/min, 100 lbs/in^2 (396 l/min, 7 kg/cm^2)

Air storage units: 2 cradles of 6-300 ft^3 (8490 l) cylinders complete with high pressure manifolds, hoses, and accessories for scuba cylinder filling.

Volume tank-filter units for low-pressure air

Carbon monoxide test kit

Assorted spare fittings, teflon tape, and wrenches

SURFACE-SUPPLIED DIVING EQUIPMENT:

Free-flow/demand mask (2)

Free-flow mask (1)

Free-flow lightweight helmet (1)

Emergency self-contained air system

Umbilical assemblies (including air hose, pneumo hose, communication line and required fittings): 100 ft (30.5m) and 150 ft (46m) assemblies.

COMMUNICATIONS UNIT

Air control console (special unit designed by program personnel to include pneumofathometer, regulator, and redundant communicators)

Body harness (3)

Diving Station Manifold (if required)

SCUBA DIVING ACCESSORIES FOR ADVANCED ACTIVITIES

Compass boards (5)

Buoyancy compensators, assorted types (5)

Lines and Reels (4)

SUITS AND ACCESSORIES

Unisuit (2)

Air hoses and fittings for connection to umbilical assembly on scuba regulator (2 sets)

Underwear (2 pair)

Heavy socks (2 pair)

Weighted boots and/or leg weights

Protective boots

INSTRUCTION KITS

Underwater work kit (see below)

Geology kit (see below)

Biology kit (see below)

Underwater photography kit (see below)

FIRST AID EQUIPMENT

Backboard or stretcher

Oxygen inhalator with mechanical bag resuscitator

Blanket

First aid supplies

When conducting programs in relatively remote areas, the success relies highly on the source of compressed air. Consequently, two moderate capacity high-pressure compressors and a low-pressure compressor were considered as a minimum requirement. Surface-supplied equipment could be operated from a low-pressure compressor or high-pressure air storage unit. At times during the course, air utilization exceeded 35,000 standard cubic feet (99,095 l). If possible, electric compressors should be used with a gasoline or diesel backup unit. Compressors should be tested and inspected, and necessary repairs made long before the instructional program.

Major compressor repairs are difficult if not impossible in the field. A small but well-selected assortment of spare parts, special tools, lubricants, filter materials, and high pressure hoses and fittings must be included in the mobile diving locker for both compressors and diesel or gasoline engines. The manufacturer or supplier will be helpful in recommending items for particular units.

A successful program is also highly dependent upon the availability and organization of equipment required for special student projects. Such equipment is best packaged in a series of "kits". Each kit contains all necessary items required for a given project. The major kits used in this program are described below.

GEOLOGIST KIT

The tools of the underwater geologist are relatively simple with the exception of specialized devices required for a few specific projects. For training purposes, only the few following simple items are included in the kit:

1. Hammer
2. Chisel
3. Coring tube, plastic (with stoppers; lengths to be cut to desired size in the field)
4. Sample bottles, plastic, wide-mouth, (assorted 2 to 6 oz for underwater use)
5. Scale (plastic or stainless)
6. Measuring tape
7. Sample bags, plastic
8. Inclinometer
9. Slates and pencil
10. Compass and compass board (from standard equipment)
11. Lead line (30 ft)
12. Color chart (plastic covered for underwater use)
13. Hydrochloric acid (for lab use)

14. Marking pencil (label bags and samples)
15. Sextant (for above water use in locating sampling areas)
16. Buoys, buoy line, and weights or stakes (assorted)
17. Sample tray (for underwater use)
18. Field notebook
19. Hand lens
20. Tagged stakes for marking underwater locations

Certainly this does not represent a complete kit for a working geologist and each Course Director may wish to modify its contents. However, it is sufficient for student project work. As with all "kits" these items should be stowed in a separate labeled container.

BIOLOGIST KIT

Diving biologists use a variety of specialized items of equipment for specific projects. However, for training purposes only a limited amount of simple equipment is included in the kit as follows:

1. Benthos sampler (small coring device with glass or plastic jar attachment)
2. Plankton net (designed for underwater towing)
3. Small gill net
4. Plastic and glass sample bottles
5. Preservation chemicals
6. Scale
7. Hand held sampling net
8. Measuring tape (shared with geologist kit)
9. Marker buoys, line, and weight stakes (shared with geologist kit)
10. Plastic clothes pins with numbered plastic tags (for tagging plants, etc.)
11. Slates and pencil
12. Lead line
13. Compass and compass board (from standard equipment)
14. Sample dish
15. Hand lens
16. Secchi disc

As with the geologist kit, the biologist kit is by no means complete. However, it is sufficient for limited student activities. In many cases, equipment must be shared with other kits. If a large number of students are anticipated to be using the various kits at the same time, duplication of certain items is recommended.

UNDERWATER WORK KIT

This kit contains a variety of tools and items for simulated work projects. A large diameter section of pipe with eyes at each end is sbustituted for a current meter. In most cases lighter weight line, chain, metal, etc. is used for simulated exercises to facilitate handling and safety. Procedures and techniques are of prime importance, not the weight of the materials. The following items are included:

1.	Hand tools:	Crescent wrenches (8, 10, and 12 inch)
		Screw drivers (large and small)
		Sledge hammer
		Chisels, cold
		Come-along or rachet hoist (1 and 2 ton capacity)
		Nut driver set
		Hack saw and assorted spare blades
		C-clamps (assorted)
		Carpenters hammer
		Vice-grips
		Channel-lock pliers
		Grip wrenches
2.	Power tools:	Hacksaw, pneumatic (with fittings, extra blades, and lubricant)
		Power driver, high velocity (with cleaning rod, lubricant, studs, etc.)
		Wrench-drill combination, pneumatic (with fittings, sockets, drills, lubricant, etc.; optional for this program)
		Chisel, pneumatic (with fittings and assessories; optional for this course)
		Hose, low-pressure air (for operation of pneumatic tools; 50 ft. length or longer)
3.	Current Meter Exercise Equipment:	Simulated current meter (2 to 3 ft. length of 3 to 4 in. capped pipe with eyes attached to both ends)
		Anchoring unit (unless natural structure is available)
		Submerged buoy (150 to 200 lbs. buoyancy capacity)
		Chain (300 lb. capacity, 20 ft.)
		Line (1/2 in. or larger, 100 ft.)

		Shackles (12 with 300 lbs. or more capacity)
		Snap hooks (2 with 300 lbs. or more capacity)
4.	Underwater Search Exercise Equipment (2 or 3 sets):	Anchor device
		Buoy and line
		Search line on reel
		Reference line and stake anchor
		Objects for location
5.	Lifting Exercise Equipment (2 to 3 sets):	Lift bags with rigging (100 to 250 lbs. lift capacity; 3)
		Net bags heavy duty (to contain boulders for lifting; other appropriate objects may be substituted.
		Buoy and line
6.	Weather Tower Exercise Equipment:	2 or 3 - 10 ft. sections of triangular weather tower
		6 large twist anchors
		150 ft. medium-weight cable with assorted cable clamps, turn buckles, thumbles, etc, for 9 cable units
		4 - 55 gal. drums for floatation (with rigging)
		Tower weight
		Cable cutter
		Cable puller or "come-along"
7.	Miscellaneous Items:	Soft metal bar stock or angle (for cutting practice)
		Metal work bench (heavily weighted for underwater work)
		Metal plates with predrilled holes (for stud driving exercise)
		Assorted shackles, tape, chain, rope, wood, etc. (for repairs and replacement)
		Pipe puzzle

UNDERWATER PHOTOGRAPHY KIT

Only a limited amount of underwater photography equipment is made available for student project work. This includes:

Underwater camera

Strobe and accessories

Close-up extension tube or lens

Light meter

Assorted film

Each student is requested to purchase and study a basic underwater photography manual prior to attending the course and provide a roll of film for personal use. Unfortunately, the rigorous schedule does not permit detailed coverage of a large variety of equipment or practical exercises.

EMERGENCY PROCEDURES

Emergency procedures must be carefully formulated prior to conducting any type of diving operation. This is especially true when conducting diving classes. All staff members must be "qualified" in CPR, basic first-aid, and diving accident procedures. Appropriate first-aid and emergency equipment must be available. Each staff member is responsible for continuous monitoring against the development of hazardous or potential-accident situations.

At The University of Michigan, a specifically qualified "corpman" or advanced first-aider is available at the course site.

First aid supplies and equipment include:

Industrial-type first-aid kit with additional supplies for types of accidents anticipated in diving situations (environmental induced injuries, etc.).

Wool blankets

Stretcher and backboard

Oxygen inhalators

The Course Director must establish proper communication channels and determine personnel and facility requirements to contend with diving related emergencies and general medical emergencies. The following information must be available at the dive site (posted at appropriate locations) and distributed to each staff member:

Physicians (local and specific hyperbaric physicians for consultation)

Ground transportation (ambulance, station wagon, etc.)

Air transportation (U.S.C.G. helicopter, commercial air ambulance, etc.)

Air-sea rescue (U.S.C.G. radio and telephone contact).

Hyperbaric chamber (primary and alternate locations, numbers, contact personnel, etc.)

Local hospital and/or clinic

Persons to contact at the University in case of serious accident or injury

Each of these organizations or individuals should be contacted prior to the course to verify procedures, personnel, and telephone numbers. Arrangements must also be made with a local hospital, clinic, or physician to handle common medical problems that may arise during the course.

TEXTS AND SUPPLEMENTARY MATERIALS

The textbook used in the program is the *Research Diver's Manual* (Somers). With the rigorous course schedule, students have little time for study. Consequently, the text should be supplied to the student about one month prior to the course with instructions on the appropriate sections to read before arrival at the course. If hyperbaric chamber work is covered in the course, a *Hyperbaric Chamber Attendant's Handbook* (Somers and Nemiroff) is also supplied to each student. These manuals are supplemented with technical reports, handouts, and selected reprints on research diving. The students are encouraged to purchase and read the *Beginner's Guide to Underwater Photography* (Church) or *Beginning Underwater Photography* (Church and Church) prior to arrival at the course. In 1974 the manual *Cold Weather and Under Ice Scuba Diving* (Somers) is being added to the list of required reading. Since many of these students will be responsible for the development of future diving programs in various institutions, copies of *Safety Code for Underwater Diving and Hyperbaric Chamber Operation* (Somers) *Diver's Training and Record Book* (Somers) are also made available.

ANNOUNCEMENT BROCHURE

A one-page course announcement brochure (Appendix II) is distributed several months prior to the course. Generally these announcements are sent to selected institutions and agencies who have specific requirements in the area of research diver training. Unrestricted distribution of the brochure will generate an overwhelming number of unqualified applicants.

PRE-COURSE INFORMATION PACKET

Upon application for training in accordance with the instructions given in the announcement brochure, the accepted students are sent a confirmation letter. Upon receipt of a specified deposit the following items are forwarded to the student:

Course Information Sheet (Appendix II)

Diver's Medical Examination Form (Appendix II)

Written Examination (Appendix II); (self-administered and to be returned at least 2 weeks prior to the course)

Research Diver's Manual

Lodging Information

Map of Area

COURSE PACKET

The materials distributed to the student upon arrival, will vary from course to course. Each student must receive a detailed Schedule of Activities (Appendix II) for the week. In addition, The University of Michigan now provides a selection of reprints, technical reports, and other materials. Much of this material is useful as reference material for future research activities.

EVALUATION PROCEDURES

Naturally, each instructor will have his own methods of evaluating student performance and knowledge. Formal evaluation procedures are both time consuming and, in some cases, demoralizing in this type of an instructional program. Consequently, each student is continuously evaluated, both subjectively and objectively, throughout the entire program. For example, formal problems in figuring decompression schedules are replaced by actual everyday dive planning and group record keeping. A staff member simply works with each team of divers during most repetitive dive planning sessions and makes corrections or gives advice as needed. Each student rigs the surface-supplied diving equipment for operation, sets pressures, and tends divers. Mistakes are corrected immediately, and, if necessary, the student repeats the task until it is done correctly. Theoretical aspects of the course are examined through oral discussions. The student always knows exactly where he stands academically. Because of individual differences no student is ever forced to pursue an exercise which he feels is too difficult or unsafe. Students are encouraged to make sound judgements based on a self-evaluation of areas, such as ability, risk, conditions. At the end of the course the staff, generally can unanimously agree on the qualification level of each student.

CERTIFICATE OF TRAINING

As in basic scuba training, the certificate presented to the student upon successful completion of the course only designates the course was completed with a satisfactory performance and knowledge level. Qualifications in specific aspects of diving will only be accomplished with

experience. Each student has gained a higher degree of qualification in scuba; however, each is a novice in surface-supplied diving and underwater work. A sample "Certificate of Training" is included in Appendix II.

Of greater significance is the *Diver's Training and Record Book*, in which the student keeps an exact and progressive record of dives and specific training activities and experience. Upon successful completion of each specific phase, the Course or Training Director enters a training endorsement in the diver's book.

COURSE COST AND FEES

Each organization will have a specific procedure for handling fees. In general the most successful method has been to require that at least 50% of the course fee be payed no later than one month prior to the course with the remainder due on the first day of the course. All charges for books, handouts, and other course material should be included in one fee. Payment should be by money order or cashier's check, and not by personal checks. Also, no cash payments should be received in the field. Payment for lodging and meals are made directly to the vendor by the student. In cases where other than the provided facilities are to be used the trainee shall be responsible for his own reservations. Specific information must be sent to the trainee regarding this well in advance.

Determining the cost of presenting a research diver training course has many variables including location, support facilities, staff requirements, equipment cost. Consequently, it is difficult to place an exact student fee on the course. The following cost estimates are given for a typical course at Omena, Michigan:

Permanent Staff Salaries and Wages (including staff benefits and indirect cost)	$2,600
Staff subsistance	300
Staff transportation	80
Supplies, trailer, rental, electrical power, etc.	220
TOTAL	$3,200

Based on cost plus 10% this type of course would cost each student (based on an enrollment of 12), $293.33 plus subsistance. Certainly this type of training is expensive. A significant portion of the cost is attributed to University indirect and staff benefit costs. The Michigan Sea Grant Program has subsidized many expenses during the developmental phase so that the course fee has been $50.00 per student.

REFERENCES

Somers, L. 1972. *Research Diver's Manual*, Ann Arbor, Mi.: Sea Grant Program, University of Michigan (TR No.16, MICHU-SG-71-212).

Somers, L. 1974. *Hyperbaric Chamber Attendant's Handbook*, Ann Arbor, Mi.: Sea Grant Program, University of Michigan (MICHU-SG-74-601).

Church, R. 1971. *Beginner's Guide to Underwater Photography*, La Jolla, Ca., Ron Church Productions.

Church, J. and C. 1972. *Beginning Underwater Photography*, Gilray, Ca., Jim and Cathy Church Photography Productions.

Somers, L. 1974. *Diver Training and Record Book*, Ann Arbor, Mi. (MICHU-SG-74-604).

APPENDIX I

RESEARCH DIVER COURSE CURRICULUM OUTLINE

This course curriculum outline is presented as a series of topics. The actual sequence of instruction may be altered at the instructor's discretion to comply with the actual course schedule. The amount of time required to complete each topic is left to the discretion of the instructor since there are a number of variables relative to student experience, class size, site logistics, etc.

TOPIC I: Registration and Orientation

A. Objectives

1. To register the student and provide him with the required materials for the course.
2. To inform the student of the objectives and regulations of the course.
3. To develop proper student appreciation and attitudes toward the training offered in the course.

B. Outline of Instruction

1. Welcome statements and introduction of staff
2. Complete registration forms and review medical forms and previous certification cards
3. Issue manuals and materials
   a. Discuss use of manual and materials
   b. Reading assignments
   c. Use of diver's log and training record
4. Objectives, purpose, and regulations of course
   a. Objectives and purpose
      (1) Training research divers
      (2) Training diving supervisors
      (3) Practical experience
   b. Course regulations
      (1) No smoking
      (2) No drinking or drug usage
      (3) No solo diving
      (4) Personal conduct
      (5) Report medical problems
   c. Instructional procedures
      (1) Lecture-discussions
      (2) Water work
   d. Area restrictions and relations with local people
   e. Qualification requirements
5. Student-instructor relationship
6. Opportunities for research divers
7. Equipment inspection
   a. Cylinder test date
   b. Regulator function
   c. SCUBA harness in good repair
   d. Lifejacket in good repair and gas inflator function
   e. Suits in good repair
   g. Other required equipment available and in good repair

8. Tour of facilities
   a. Operations van
   b. Chamber (if available)
   c. Air supply system
   d. Diving area
   e. Diving vessel

9. Stowing students equipment

TOPIC II: Open-Water Diving Procedures

A. Objectives

1. To provide the student with the basic knowledge required for planning and conducting open-water dives.

2. To establish procedures for conducting open-water dives and classes.

3. To develop standards of safety required for open-water classes.

B. Outline of Instruction

1. General overview
   a. Need for open-water instruction
   b. Instructor responsibilities
   c. Requirements for dive planning

2. Personnel (qualifications, job assignments)
   a. Student prerequisite performance
   b. Instructor-supervision
   c. Dive teams (SCUBA and surface-supplied)
   d. Course and training directors
   e. Diving supervisor

3. Preliminary dive planning
   a. General survey of task or lesson objectives
   b. Evaluation of environmental conditions
      (1) Necessity
      (2) Weather
      (3) Current and tide conditions
      (4) Ship traffic
      (5) Bottom type
   c. Selection of diving techniques
   d. Selection of divers and assigment of task
   e. Selection of equipment
   f. Fullfillment of safety precautions
      (1) Emergency plan
   g. Calculation of air requirements
   h. Calculation of air volume in partially filled cylinder
   i. Briefing personnel

4. Diving vessels
   a. Requirements of diving
   b. Charter
   c. Equipment requirements

5. Buddy system (scuba diving)
   a. Standard procedure
   b. Use of buddy line
   c. Buddies role in emergency

6. Hand signals

7. Preparation of equipment and dressing-in
   a. Required minimum equipment
   b. Lifejacket check
   c. SCUBA check
   d. Surface-supplied equipment check

8. Dive procedure (surface-supplied and SCUBA)
   a. Entry
   b. Descent
   c. Working on the bottom
      (1) Underwater navigation
   d. Ascent
   e. Post-dive

9. Special safety precautions
   a. Emergency plan

10. Special equipment requirements
   a. First aid kit
   b. Backboard
   c. Oxygen unit
   d. Spare gear

11. Evaluation of applicant (special procedures)
   a. Site selection
   b. Assistants
      (1) Selection
      (2) Task assignments and briefing
   c. Check-in and control procedures
   d. Student dive
      (1) Briefing student
      (2) Instructor-student ratio
      (3) Preventing ear problems
      (4) Evaluation (including dive plan)
         (a) SCUBA dress-in and check
         (b) Entries
         (c) Surface swimming
         (d) Skin diving
         (e) Mask clearing
         (f) Buddy breathing
         (g) Emergency ascent
         (h) Rescue
         (i) Others
         (j) Exits

12. Records
   a. Diver's logbook
   b. Instructor's records
   c. Scientific log

TOPIC III: Charging SCUBA

A. Objectives

1. To teach students the methods of charging SCUBA.
2. To provide practice in charging SCUBA.

B. Outline of Instruction

1. Types of high pressure systems
   a. High pressure electric motor driven air compressor
   b. High pressure gasoline (or diesel) driven air compressor
   c. High pressure air cylinder cascade system
2. Equipment used with high pressure systems (including maintenance)
   a. Oil separator
   b. Air filter (including filter materials)
   c. Stop valves
   d. Relief valves
   e. Pressure gauge
   f. Manifold
   g. Charging lines
   h. Pressure and temperature cut-off switches
   i. Belt drive
   j. Water bath container
3. Procedures for charging (student application)
   a. Valves
   b. Checking temperature rise
   c. Pressures
   d. DOT pressure stamped on sylinder
   e. Hydrostatic tests required
   f. Cooling cylinders
   g. Securing from charging
   h. Safety procedures

TOPIC IV: Underwater Navigation

A. Objectives

1. To familiarize students in the use of the underwater wrist compass and compass board.

2. To teach students the basic principles of underwater navigation.

3. To give students practice in the use of the underwater compass.

B. Outline of Instruction

1. Overview
   a. Requirements for underwater compass navigation

2. Orientation underwater without compass
   a. Bottom features
   b. Current
   c. Sun
   d. Man-made objects

3. Underwater swimming rate
   a. Time
   b. Number of kicks
   c. Determining swimming rate (practical exercise on measured course)

4. Underwater wrist compass
   a. Characteristics and use
   b. Arm position
   c. Swimming position

5. Compass board
   a. Characteristics and use
   b. Position

6. Navigation
   a. Pilotage
   b. Dead reckoning

7. Practical application (field exercises)
   a. Open water swimming with SCUBA (see Topic II outline)
   b. Swim 100 to 150 yeards offshore and return to starting point
   c. Swim triangular course; complete swim at pre-determined point

TOPIC V: Open Water Swimming using SCUBA

A. Objectives

1. To develop student's confidence in the use of SCUBA.
2. To increase the student's time submerged and distance covered underwater.
3. To develop student's proficiency in using the underwater compass.
4. To test the student's ability to swim submerged using SCUBA, and to maintain a compass course.

B. Outline of Instruction

1. Open water swimming with SCUBA
   a. Assemble gear
   b. Check and record cylinder pressure
   c. Mission or task briefing
   d. Don equipment
      (1) Suit
      (2) Lifejacket
      (3) Weight belt (unless using crotch strap on SCUBA)
      (4) Knife
      (5) Compass, watch and depth indicator (compass board, optional)
   e. Assemble SCUBA and mask, fins, and snorkel ready for donning
   f. Inspection of equipment
   g. Don equipment
   h. Check personal gear and buddy's gear
   i. Hook up to swim buoy
   j. Enter water
   k. Check compass point
   l. Submerge and commence swimming
   m. When reaching designated area, report to beach timer
2. Compute air consumption
3. Evaluate compass swim accuracy
4. Repeat exercise, if necessary

TOPIC VI: Air Decompression Tables and Decompression Procedures

A. Objectives

1. To instruct the student in the various methods of decompression.
2. To provide practice in the practical application of decompression tables.
3. To instruct the student in the applications and limitations of the mechanical decompression meter.

B. Outline of Instruction

1. Definition of decompression
2. Brief history of decompression table development
3. International variation in decompression tables
4. Decompression
   a. Recommend observance of "no-decompression" limits
   b. Methods
5. U.S. Navy Standard Air Decompression Tables
   a. Terminology
      (1) Depth
      (2) Bottom time
      (3) Ascent rate
      (4) Stage decompression stops
      (5) Repetitive dive
   b. No-decompression dives
   c. Repetitive dive group
   d. Surface interval credit table
   e. Repetitive dive time table
   f. Exceptional exposure table
   g. Repetitive dive worksheet
6. Rearrangement of U.S. Navy tables for sport application
   a. Advantages
   b. Examples
   c. Limitations
7. Practical application of decompression tables by use of theoretical dives
   a. Normal dives
   b. Modifying factors (cold and arduous dives)
   c. Dives made at high altitude

8. Mechanical decompression meter
   a. Description and principle of operation
   b. Practical application of decompression meter by use of theoretical dives
   c. Advantages
      (1) Variable depth dives
      (2) Multiple dive
      (3) Determining exposure relative to "no-decompression" limit
   d. Limitations
      (1) Depth and duration
      (2) Environmental conditions
      (3) Individual exertion

9. Decompression procedures
   a. With SCUBA
   b. With surface-supplied apparatus
   c. Surface decompression
   d. Interrupted or omitted decompression

10. Flying after diving

TOPIC VII: LAKELAB Orientation and Long Duration Diving

A. Objectives

1. To explain the design concept, construction, and application of the LAKELAB underwater laboratory.

2. To provide the student with the knowledge required for the operation of LAKELAB and safe diving using the facilities.

3. To gain insight into the use of underwater laboratories for scientific research.

4. To discuss saturation diving in general terms.

B. Outline of Instruction

1. Overview
   a. Small, non-saturation underwater laboratory concept
   b. Applications
   c. Advantages and limitations
   d. Economics
   e. Personnel authorization procedures

2. Design
   a. Shape
   b. Materials
   c. Viewports
   d. Entry hatch
   e. Ballast

3. Life support system
   a. Compressor
   b. Air storage cylinder units
   c. Air control
   d. Emergency system
      (1) Habitat
      (2) Shore
   e. Air supply hose
   f. Ventilation
   g. Air analysis
   h. Maintenance
   i. Records

4. Operation procedures
   a. Emergency plan (hospital, medical, etc.)
   b. Compressor operation
   c. Communication
   d. Diving team
   e. Shore personnel
   f. Radio-checks
   g. Emergencies (diver rescue, etc.)
   h. Regulations and operational restrictions

i. Personnel authorization required.
j. Records (use; science log)

5. Operations van use and maintenance

6. Physiology of long term exposure in LAKELAB
   a. Depth-time limitations
   b. Habitat depth
   c. Observe prescribed limitations
   d. Oxygen breathing

7. Recompression procedures

8. Saturation diving (generalized; may be covered in separate presentation)
   a. Define
   b. Advantages
   c. Limitations
   d. Facilities
   e. Hazards
   f. Decompression
   g. Major past operations
   h. HYDROLAB and PRINUL

TOPIC VIII: Underwater Search Procedures

A. Objectives

1. To provide a knowledge of underwater search and inspection procedures.

2. To provide practical experience in underwater search.

B. Outline of Instruction

1. Planning and organization
   a. Personnel
   b. Safety precautions
   c. Selection of method
   d. Signals

2. Search methods (applications and equipment)
   a. Tow
      (1) Bar (single boat)
      (2) Line (single boat)
      (3) Line (two boats)
   b. Grid
   c. River sweep
   d. Straight sweep
   e. Single line stream
   f. Semi-circle sweep (single arc pattern)
   g. Circling line

3. Circling line search method using SCUBA (practical exercise)
   a. Use of this method
   b. Equipment
      (1) Clump
      (2) Buoy and line (attached to clump)
      (3) Search line on reel
      (4) Reference marker (if necessary)
   c. Rigging search
   d. Briefing and planning
   e. Diver (2) enter water and swim to designated area where clump and buoy and lost object have been previously placed
   f. Connect search line
   g. Conduct circle sweep (diver and sweep interval depend on visibility)
      (1) Overlap
      (2) Reference marker
   h. Recover object and report to supervisor

4. Special conditions
   a. Under ice
   b. Caves

TOPIC IX: Intermediate Class Dives with SCUBA

A. Objectives

1. To provide the student with a knowledge of the proper procedure for making a 60 ft. dive using open-circuit SCUBA.

2. To provide practical experience in planning and making a 60 ft. dive in open-circuit SCUBA.

3. To provide practice in making a circling line search.

B. Outline of Instruction

1. Exercise or task briefing

2. Student planning session
   a. Estimate air consumption and dive duration
   b. Establish dive and search plan

3. Assemble and don equipment; check

4. Enter water and surface swim to designated area

5. Dive
   a. Buddy system
   b. Descent
   c. Circling line search
      (1) Attach search line
      (2) Search for missing object
   d. Return to surface and swim to shore (or boat)
   e. Report to dive supervisor

TOPIC X: Surface-Supplied Diving System; Function and Nomenclature

A. Objectives

1. To teach the student the nomenclature, function and operation of the standard surface-supplied diving system.

2. To teach the student the proper procedures for checking, testing, and maintaining surface-supplied diving equipment.

3. To instill in the student a feeling of confidence and trust in the equipment.

B. Outline of Instruction

1. History and development
   a. Lightweight surface-supplied diving equipment
   b. Use and comparison with SCUBA
   c. Types of lightweight helmets and mask and their use
   d. Applications other than research diving
   e. Limitations

2. Application in research diving
   a. To perform work
      (1) Equipment installation and maintenance
      (2) Recovery of lost or damaged equipment
   b. Sampling, observation, photography, and in situ measurements
   c. Routine diving
   d. Emergency diving
   e. Damage control

3. Nomenclature, function and construction of standard surface-supplied diving equipment
   a. Free-flow/demand mask
      (1) Design criteria
      (2) Materials
      (3) Air control valve
      (4) Demand regulator
         (a) Function
         (b) Adjustment
      (5) Head harness
      (6) Hood and face seal
      (7) Microphone and earphone (including connectors)
      (8) Oral-nasal mask
      (9) Exhaust valves
      (10) Air whip
      (11) Hose connection
      (12) Non-return valve
      (13) Head protector
      (14) Emergency gas supply system

(a) Cylinder
(b) Backpack
(c) Regulator
(d) Connections and manifold

(15) Maintenance

b. Lightweight helmet
(1) Design criteria
(2) Materials
(3) Air control valve
(4) Exhaust valve
(5) Microphone and earphone (including connectors)
(6) Non-return valve
(7) Hose connection
(8) Internal purge button
(9) Neck-ring or breast-plate unit
(10) Jocking system
(11) Emergency gas supply system
(12) Recirculator for mixed-gas
(13) Maintenance

c. Umbilical assembly
(1) Gas supply hose
(a) Fittings
(2) Communications wire
(a) Connectors
(3) Pneumo hose
(4) Hot water hose
(5) Lifeline
(6) Swivel snap shackle
(a) Attachment
(7) Assembly
(8) Testing
(9) Maintenance and storage

d. Hardwire communications deck unit

e. Air supply system
(1) Compressors, low-pressure
(a) Power (diesel or electric)
(b) Capacity
(c) Filter units
(d) Maintenance
(e) Applications (diving and chamber)
(2) High-pressure cylinder system
(a) Cylinders
(b) Cradle
(c) High-pressure air line and fittings
(d) Manifold
(e) Reduction regulator
(f) Maintenance
(g) Application
(3) Air control panel
(a) Design criteria
(b) Components
Reduction regulators
Piping
Gauges (high and low pressure)
Pneumo gauge
Valves (standard and ball)

Signal devices
Case
(c) Maintenance
(d) Application

g. Accessory equipment
(1) Body harness
(2) Weight belt
(3) Weighted shoes and leg weights
(4) Knife
(5) Maintenance

h. Diving dress (selection, application, precautions, and maintenance for each)
(1) Wet suit
(2) Variable-volume dry suit
(3) Standard dry suit
(4) Hot water suit
(a) Hose
(b) Heater unit
(5) Coveralls and protective shoes

TOPIC XI: Surface-Supplied Diving Techniques and Procedures

A. Objectives

1. To teach the students correct basic diving techniques and procedures using surface-supplied diving equipment.

2. To emphasize the importance of using standard diving techniques and procedures.

3. To provide practice in assembling surface-supplied diving apparatus.

4. To provide practice in dressing and undressing a diver.

B. Outline of Instruction

1. Assembling and preparation of equipment
   a. Air supply
      (1) Compressor
      (2) Air cylinders
      (3) Air control panel
      (4) Calculating hose pressure and volume requirements
      (5) Safety check
   b. Umbilical assembly
   c. Mask or helmet
   d. Emergency system(s)
   e. Communications
   f. Diving dress and accessory equipment
   g. Chamber check

2. Diving communications
   a. Voice
   b. Line

3. Tending the diver

4. Dressing and undressing the diver
   a. Helmet
   b. Mask
   c. Variable-volume dress
   d. Closed dress (with helmet)

5. Procedures for descent
   a. Placing descent line
   b. Entering water
      (1) Ladder
      (2) Stage
   c. Descent

6. Working on bottom
   a. Task
   b. Bottom type
   c. Current
   d. Other

7. Ascent (including decompression)

8. Timing the diver

9. Record keeping

10. Safety precautions
    a. Standby diver

11. Emergency procedures
    a. Loss of communications
    b. Fouling
    c. Blow-up

12. Student practice assembly of equipment

13. Students practice dressing and undressing diver

14. Students practice use of line signals

15. Students dive

16. Disassembly and maintenance of equipment

TOPIC XII: Limited Visibility and Night Diving Using SCUBA

A. Objectives

1. To provide the student with a knowledge of proper procedure for making SCUBA dives in limited underwater visibility and at night.

2. To provide practical experience in planning and making dives in limited visibility water and at night.

3. To qualify the student in night diving for record purposes.

B. Outline of Instruction

1. Overview
   a. Purpose
   b. Buddy system

2. Limited visibility diving
   a. Basic procedure (follow outline for Open Water Swimming using SCUBA)
   b. Use of buddy line
   c. Use of compass
   d. Precautions
   e. Practical exercise

3. Night diving
   a. Basic procedure (follow outline for Open Water Swimming using SCUBA)
   b. Underwater lights
      (1) Dry cell battery type
      (2) Ni-cad battery type
      (3) Use
      (4) Maintenance
   c. Use of buddy line
   d. Use of compass
   e. Precautions
   f. Practical exercise
      (1) Attach flasher to float

TOPIC XIII: Light Salvage

A. Objectives

1. To teach the student methods for salvage of submerged objects.

2. To provide practical experience in the salvage of submerged objects.

B. Outline of Instruction

1. Overview
   a. Applications
   b. Limitations for research divers

2. Safety precautions

3. Methods of lifting (equipment and application)
   a. Winching
   b. Tide lift
   c. Flotation
      (1) Lift bags, pontoons, metal drums
      (2) Calculating lift capacity
      (3) Rigging
      (4) Air supply
      (5) Procedures

4. Buoyancy lifting of submerged object (practical exercise)
   a. Assemble equipment
      (1) Lift bag or drum
      (2) Rigging
      (3) Air supply apparatus
         (a) Surface-supplied (hose, air source, regulator, valves, etc.)
         (b) Self-contained (SCUBA cylinder, regulator, valves, etc.)
   b. Pre-dive briefing
      (1) Discuss task
      (2) Sketch
      (3) Procedures
   c. Diver descends and secures lift bag to submerged object
   d. Insert filler attachment and put small amount of air into bag
   e. Check rigging
   f. Complete filling until object starts to lift
      (1) Light object in shallow water
         (a) Diver controls fill
         (b) Surface with object
         (c) Regulate vent if so equipped and necessary
         (d) Do not get under or over object; be certain others are clear
      (2) Heavy object; deep water
         (a) Diver rigs guideline (if necessary)
         (b) Diver surfaces and leaves water
         (c) Filling controlled from surface (self-venting bags required)
   g. Tow object to shore or replace on bottom

TOPIC XIV: Underwater Biological and Geological Research Techniques

A. Objectives

1. To provide the student with a knowledge of techniques and equipment used in selected aspects of underwater biological and geological research.

2. To provide practical experience in underwater observation and sampling for research purposes.

B. Outline of Instruction

1. Overview
   a. Application of diving
   b. Advantages
   c. Limitations
   d. Economics

2. Geological research
   a. Mapping techniques
      (1) Meter tape triangulation
      (2) Plane table triangulation
      (3) Peterson wheel-meter tape method
      (4) Dumas measuring frame
      (5) Triangulation from shore stations
      (6) Wire grid method
      (7) Merifield-Rosencrantz method
      (8) Photo-mapping
      (9) Swimmer traverse line survey
   b. Sampling (techniques and equipment)
      (1) Short cores
      (2) Long cores
      (3) Rock samples (hammers, chesil, etc.)
      (4) Sediment samples
         (a) Collecting samples
         (b) Containers
         (c) Labling
      (5) Sample density
      (6) Processing and transporting samples
   c. Measurements
      (1) Strike-dip (use, design and construction of diver's inclinometer unit)
      (2) Ripple mark studies
      (3) Shear strength of sediments
      (4) Current
         (a) Flow meter devices
         (b) Drifters
         (c) Dyes (water)
         (d) Dyed sediment

3. Biological research
   a. General observation
   b. Recording observations
   c. Photography
   d. Fish behavior studies
   e. Sampling

(1) Netting fish and nektonic organisms
(2) Plankton tow (single and multilevel)
(3) Quantitative sampling of epifauna
(4) Fishrake
(5) Coring equipment for sampling infauna
(6) Suction samplers
(7) Sample container for organisms
(8) Dredge sampling using divers

4. Water sampling devices

5. Temperature measurement

6. Recording observations
   a. Slate
   b. Tape recorder (diver; self-contained)
   c. Wireless communication system
   d. Hardware communication system
   e. Applications, advantages, and limitations of above

TOPIC XV: Underwater Photography

A. Objectives

1. To provide the student with a knowledge of underwater photography techniques and equipment.

B. Outline of Instruction

1. Overview
   a. Application of photography to underwater research
   b. Only basic coverage in this course
   c. Advanced underwater photography training

2. Light underwater
   a. Reflection and refraction
   b. Absorption of color
   c. Scattering

3. Photography basics
   a. Camera mechanics
   b. Exposure
   c. F-stop
   d. Depth of field
   e. Shutter speed
   f. ASA ratings

4. Camera selection
   a. Film size
   b. Viewing and focusing
   c. Shutter mechanism
   d. Controls
      (1) F-stop
      (2) Shutter speed
      (3) Focus
      (4) Flash or strobe synchronization
   e. Lens
      (1) 35 mm
      (2) 28 mm
      (3) 21 mm
      (4) Micro
      (5) Close-up
         (a) Attachments
         (b) Extension tube
         (c) Framer
      (6) Telephoto
      (7) Fisheye
      (8) Other
      (9) Selection of lens
   f. Camera housings
      (1) Custom
      (2) Standard
      (3) Materials

g. Cameras
   (1) Nikonos
   (2) Nikon-F in housing
      (a) Giddings
      (b) Oceaneye
      (c) Other
   (3) Rolleimarin
   (4) Hasselblad

5. Nikonos system
   a. Camera discription
   b. Lens: 15 mm, 21 mm, 28 mm, 35 mm, 80 mm
   c. Close-up
      (1) Attachment lens
      (2) Extension tubes (1:1, 2:1, 3:1)
      (3) Frames
   d. Flash and strobe
   e. Filters
   f. Other accessories
   g. Advantages and limitations
   h. Caring for a flooded Nikonos

6. Available light photography
   a. Subject
   b. Film
      (1) Black and white: Tri-X, Plus-X
      (2) Color: HS, EX, KX
   c. Filters
   d. Shutter speed
   e. Estimating f-stop
   f. Pushing ASA rating and special developing

7. Artificial light photography
   a. Strobe vs bulb
   b. Synchronization
   c. Strobe selection
   d. Techniques
   e. Camera settings
   f. Caring for a flooded strobe
   g. Film

8. Turbid water photography
   a. Standard camera
   b. Special adaptations

9. Close-up photography
   a. Extension tubes
   b. 55 mm Nikor Micro
   c. Film
   d. Lighting

10. Light meters for underwater

11. Movie cameras (brief review)
   a. Super-8 vs 16 mm
   b. Housings
   c. Camera selection
   d. Lighting
   e. Techniques

12. References

TOPIC XVI: Using Tools Underwater

A. Objectives

1. To provide the student with practical experience in working underwater.
2. To provide the student with a knowledge of the use and care of tools commonly used underwater.
3. To teach the student safety precautions to be observed when using tools underwater.

B. Outline of Instruction

1. Overview
   a. Applications to research diving
   b. Selecting SCUBA or surface-supplied diving equipment
   c. Safety precautions
   d. Each student will complete following practical exercises.

2. Nomenclature and use of tools
   a. Hand tools
      (1) Screw driver
      (2) Nut driver
      (3) Sledge hammer
      (4) Chisel
      (5) Hacksaw
      (6) Wrenches
      (7) Special adaptations
      (8) Lanyard
      (9) Tool bag
   b. Pneumatic tools (and/or hydraulic tools)
      (1) Drill
      (2) Saws
      (3) Grinder
      (4) Hammer
      (5) Chipping gun and chisel
      (6) Wrench
   c. Special tools
      (1) High-velocity stud-driver
      (2) Oxy-arc cutting
      (3) Arc welding
      (4) Come-along
   d. Special preparation of tools and materials
   e. Special safety precautions
   f. Maintenance of tools used underwater (general and specific)

3. Hacksaw job (practical exercise)
   a. Select submerged structure for work area or place work bench on bottom
   b. Diver enters water with hacksaw, angle iron and C-clamp
   c. Cut one-inch piece off end of angle iron, remove C-clamp, and return to surface with tools and materials

4. Submerged instrument package installation (practical exercise)
   a. Instrument package mooring unit is placed underwater prior to student entry.
      (1) Anchor
      (2) Line or chain to instrument "blank" (safety chain)
      (3) Submerged float (at least 100 lb. buoyancy)
   b. Pre-dive planning
      (1) Sketch of unit
      (2) Step-by-step procedure
      (3) Assemble, and prepare, tools, instruments, and hardware
   c. Diver enters water with come-along
   d. Secure come-along above and below "blank"
   e. Call for (or surface for) instrument package
   f. Position package and shackle to top ring (leave safety line in place until completion)
   g. Draw lower attachment ring into position using come-along and secure with package shackle
   h. Release come-along and remove
   i. Remove "blank"
   j. Inform instructor; inspection
   k. Remove instrument package
      (1) Reverse procedure
      (2) Replace safety chain
   l. Safety precautions

5. Box assembly (practical exercise)
   a. Assemble tools and materials
   b. Secure all pieces of wood together with light line
   c. Descend and place wood under bench or other structure to prevent it from floating away
   d. Nail sides together
   e. Nail on ends of box

6. Pneumatic hacksaw job (practical exercise)
   a. Assemble materials
   b. Hook-up pneumatic hacksaw
   c. Diver enters water with pneumatic hacksaw, angle iron and C-clamp
   d. Attach angle arm to bench or other structure with C-clamp
   e. Cut one-inch piece off end of angle iron, remove C-clamp, and return to surface with tools and materials
   f. Saw maintenance and blade replacement
   g. Safety precautions

7. High-velocity stud-driver (practical exercise)
   a. Pre-dive planning and briefing
      (1) Job description
      (2) Safety precautions
      (3) Handling a misfire
   b. Assemble tools and materials
   c. Place submerged work assembly on the bottom
   d. Diver enters water with stud driver, two threaded studs, centering disc, C-clamp, pre-drilled steel plate, two nuts, and wrench
   e. Secure steel plate to submerged work assembly with C-clamp
   f. Using centering disc, drive threaded studs through pre-drilled holes and secure with nuts
   g. Signal completion of task; inspection

8. Cutting studs with sledge hammer and chisel (practical exercise)
   a. Immediately after completing work with stud driver
   b. Procedure for holding chisel and swing hand sledge underwater
   c. Remove bolts from stud and remove steel plate; send to surface
   d. Cut stud from plate surface with sledge and chisel
   e. Smooth plate surface after removing studs

9. Weather tower installation (practical exercise)
   a. Assemble unit on land (tower, cables, etc.)
   b. Predetermine water depth and exact location
   c. Sketch site, tower, and anchor configuration; brief team
   d. Install anchors (twist or block type) in double assembly
   e. Locate pivot point and secure floatation units
   f. Float tower into place, secure cables nearest waterline.
   g. Release end floats and pivot into place; secure
   h. Flood central floats
   i. Secure all cable, tighten turn buckles

TOPIC XVII: Recompression Chamber Operation

A. Objectives

1. To provide the student with a knowledge of the characteristics of a recompression chamber.

2. To provide for practical operation of the recompression chamber by the students.

3. To acquaint students with the basic principles of recompression and use of treatment tables.

B. Outline of Instruction

1. Types of recompression chambers
   a. Two lock
   b. One lock
   c. Portable

2. Air supply for chamber
   a. Capacity
   b. Pressures and depths
   c. Ventilation
   d. Supply and exhaust valves
   e. Gauges

3. Lighting

4. Communications

5. Precautions in the use of chamber
   a. Lighting
   b. Doors
   c. Fire prevention
   d. Maintenance
      (1) Fire proof materials
      (2) Oxygen manifolds
      (3) Accessories
   e. Ventilation
   f. Oxygen use
      (1) Overboard dump
      (2) Ventilation
   g. Cleaning chamber and paint

6. Practical use of chamber
   a. Practice maintaining steady rate of ascent
   b. Use of man lock, treatment lock and medical lock
   c. Reading treatment tables
   d. Simulated treatment using oxygen
   e. Precautions
   f. Records

7. Surface decompression procedures

TOPIC XVIII: Use of Tables for Treatment of Decompression Sickness and Air Embolism

A. Objectives

1. To teach the student the proper use of treatment tables.
2. To provide the student with necessary knowledge for assisting medical personnel in treating diving accidents.
3. To provide practical experience in the selection and use of treatment tables.

B. Outline of Instruction

1. Medical diagnosis and first aid prior to treatment
2. Roll of diver in assisting physician
3. Standard treatment tables (Table 1-30)
   a. Table 1
   b. Table 1A
   c. Table 2
   d. Table 2A
   e. Table 3
   f. Table 4
4. Minimal recompression, oxygen breathing tables (Table 1-31)
   a. Table 5
   b. Table6
   c. Table 5A
   d. Table 6A
5. Recurrences
   a. During treatment
   b. After treatment
6. Review case histories. Select cases which illustrate diagnosis and both proper and improper selection and use of treatment tables
7. Practical application of treatment tables through use of hypothetical cases with varying symptoms

TOPIC XIX: First Aid

A. Objectives

1. To provide the student with a basic understanding of first aid procedures for diving related accidents.

2. To review the student's understanding of other first aid procedures.

B. Outline of Instruction

1. Overview
   a. Role of first aider
   b. Necessity for first aid training

2. Shock

3. Artificial resperation
   a. Drowning
   b. CPR

4. Air embolism and other lung related injuries
   a. Recognization
   b. First aid

5. Decompression sickness
   a. Recognization
   b. First aid

6. Basic first aid
   a. Bleeding
   b. Burns
   c. Minor wounds

7. First aid equipment and supplies
   a. First aid kit
   b. Oxygen unit
   c. Backboard
   d. Blanket

8. Transporting the victim

TOPIC XX: Seamanship

A. Objectives

1. To provide the student with a knowledge of use of rope.

2. To provide the student with an introduction to small boat operations.

B. Outline of Instruction

1. Type of rope

2. Knots commonly use in diving and boating
   a. Application
   b. Strength
   c. Safety factors

3. Splices
   a. Application
   b. Strength
   c. Safety factors

4. Wire rope
   a. Application
   b. Strength
   c. Safety factors

5. Chain

6. Shackles

7. Small boat description
   a. Nautical terminology
   b. U.S.C.G. required equipment and regulations

8. Small boat operation
   a. Mechanics
   b. Rules of the road
   c. Mooring and anchoring

TOPIC XXI: Physical Fitness

A. Objectives

1. To provide the student with a basic understanding of fitness and conditioning.

2. To acquaint the student with a simple method of developing and maintaining an acceptable level of physical fitness.

B. Outline of Instruction

1. Overview
   a. Fitness status of general public
   b. Necessity of fitness for diving

2. Physical fitness
   a. Define
   b. Measure
   c. Why maintain fitness?
   d. Physical stress
   e. Stress and the diver
      (1) Anxiety
      (2) Lack of skill
      (3) Inefficient movement
      (4) Inefficient heart
      (5) Hyperventilation
      (6) Overweight
      (7) Equipment resistance
      (8) Breathing resistance
      (9) Cold water
      (10) Work output
   f. Oxygen utilization
   g. Training effects
   h. Methods of conditioning
      (1) Circuit training
      (2) Exercise programs
      (3) Aerobics conditioning procedure
   i. Evaluation of fitness (practical)
      (1) 12 - minute test (aerobics program)
      (2) 1.5 mile run

3. Smoking and fitness

4. Physical fitness in diving classes

TOPIC XXII: Lifesaving and Watersafety for Divers

A. Objectives

1. To determine students lifesaving proficiency, and improve both swimming and lifesaving skills.

2. To instruct the student in special techniques of lifesaving as applied to skin and SCUBA diving.

3. To develop the student's confidence in his ability and his equipment.

B. Outline of Instruction

1. Brief review of major basic lifesaving skills and philosophy

2. Surface rescue techniques for skin and SCUBA diving
   a. Use of floats
   b. Approach
   c. Assist
   d. Weight belt removal and buoyancy device inflation
   e. Carries and towing

3. Recovery of a submerged unconscious victim
   a. Skin diver
   b. SCUBA diver (prevention of air embolism)

4. Deep and shallow water artificial respiration (mouth-to-mouth)
   a. Use of floats
   b. Without floatation
   c. While towing
   d. Aids (snorkel, etc.)
   e. Wading
   f. Single and multiple rescues

5. Role of personal floatation equipment (inflatable lifejacket, etc.)
   a. Pre-dive checks ; lifejacket malfunction
   b. Emphasize daily and periodic maintenance
   c. Wearing and adjustment of the lifejacket
   d. Rescue and towing methods

6. Recognizing and handling potential panic situations
   a. Hyperventilation syndrome
   b. Hyperpnea - exhaustion syndrome

7. Handling in-water injuries

TOPIC XXIII: Open-circuit SCUBA and Surface-Supplied Qualification Dives

A. Objectives

1. To provide the student with a knowledge of the proper procedures for making a 130 ft. dive using open-circuit SCUBA and/or surface-supplied equipment.

2. To provide practical experience in planning and making a 130 ft. dive using open-circuit SCUBA and/or surface-supplied equipment.

3. To qualify the student in a deep dive for record purposes.

B. Outline of Instruction

1. Briefing

2. Student planning session
   a. Estimate air consumption and dive duration
   b. Establish dive plan

3. Assemble and don equipment; check

4. Enter water and prepare to descend

5. Dive (130 ft., actual or simulated)
   a. Buddy system
   b. Descent
   c. Buoyancy compensation
   d. Circling line search (SCUBA)
      (1) Attach search line
      (2) Circular sweep
   e. Ascent with actual or simulated decompression stop

6. Compute repetitive dive

7. Second dive following same procedures
   a. Ascent with actual or simulated decompression stop

8. Report to dive supervisor and evaluation of dives

TOPIC XXIV: Cold Weather and Under Ice Diving

A. Objectives

1. To provide the student with the basic knowledge required for planning and conducting cold weather diving operations.

2. To acquaint the student with the various types of equipment used in cold weather diving including evaluation and selection, use, potential malfunctions, and maintenance.

3. To develop standards of safety required for conducting cold weather diving operations.

B. Outline of Instruction

1. Overview
   a. Diving in cold weather
   b. Under ice diving
   c. Special problems

2. Physiological aspects of cold
   a. Heat loss
   b. Stress
   c. Hypothermia
   d. Frost-bite
   e. Other

3. Personnel qualifications

4. Equipment
   a. General requirements
   b. Handling basic equipment
   c. Scuba
      (1) Regulator selection
      (2) Regulator malfunctions
      (3) Auxillary breathing system
      (4) Safety precautions
   d. Protective suits
      (1) Wet type
      (2) Dry type
      (3) Hot water type
      (4) Safety precautions
   e. Accessory equipment
      (1) Buoyancy compensator
      (2) Gauges
   f. Special equipment
      (1) Harness
      (2) Safety lines
   g. Other
      (1) Cameras
      (2) Compressors
      (3) Communication
      (4) Lighting

5. Procedures
   a. Planning and organization
      (1) Personnel requirements
      (2) Site selection
      (3) Facilities
      (4) Safety
   b. Personnel protection
      (1) Tenders and above water personnel
   c. Equipment selection
      (1) Personal
      (2) Group
   d. Site selection
      (1) Cutting holes in ice
      (2) Safety on ice
      (3) Shelters
   e. Under the ice
   f. Warming the diver

6. Training for under ice dives

APPENDIX II

GENERAL INFORMATION BULLETIN

PRE–COURSE THEORY EXAMINATION

LETTER OF ACCEPTANCE

MEDICAL HISTORY AND EXAMINATION INFORMATION

MEDICAL EXAMINATION REPORT

DAILY SCHEDULE

CERTIFICATE OF RESEARCH DIVER TRAINING

RELEASE/ACKNOWLEDGEMENT OF RISK FORM

THE UNIVERSITY OF MICHIGAN SEA GRANT PROGRAM
UNDERWATER TECHNOLOGY LABORATORY

RESEARCH DIVER TRAINING COURSE: 1974
GENERAL INFORMATION BULLETIN

DATES: July 22-27 or August 5-10

LOCATION: Omena-Traverse Yatch Club, Omena, Michigan

REGISTRATION: Will begin at 9:00 a.m., Monday at the Yatch Club

ROOM AND BOARD: Arrangements have been made to house some students at the Sunset Lodge in Omena or nearby motels or lodges. At motels and lodges individual can anticpate a $6 to $12 per day rate for rooms (double occupancy). Camping facilities are available at nearby state, county, or private campgrounds. Final housing arrangements will be made on an individual basis. Breakfast and lunch foods may be obtained at a local market in Omena. A refrigerator and limited cooking facilities are available at the Sunset Lodge staff house. Evening meals may be obtained at resturants in Northport or Leeland.

DURATION: The course will officially begin at registration on Monday morning and end the following Friday evening. During the course, classes will begin at 9 a.m. and run very late. All of your attention will be focused on the course activities, so you should not plan to spend any time away from the course.

CLOTHING AND WEATHER: Classes will be informal and casual dress is appropriate. Temperatures will be approximately 75-80° for daytime and in the 60-70° range at night. Foul weather gear and a wool sweater or coat is recommended for possible rainy weather.

EQUIPMENT: Equipment requirements are listed on the enclosed course announcements. For those who do not have a complete set of equipment, or not desiring to carry cylinders and weights on aircraft, arrangements for equipment rental may be made with SCUBA NORTH, 13709 W. Bay Shore Drive, Traverse City, Michigan, 49684; phone (616) 947-2520.

COURSE FEE:

The course fee is $50.00 made payable to The University of Michigan Sea Grant Program. The entire fee may be sent to the Michigan Sea Grant Office in advance or a required deposit of $20 may be sent in advance and the balance paid at registration (check and money order - NO CASH). Prepayments will be refunded only if the course director is notified two weeks or more prior to the course starting date. In such cases, all payment with the exception of $10 (retained for manual, materials, and handling cost) will be refunded.

MATERIALS:

A course manual and various handouts are included in the course fee. Each student is requested to obtain a copy of the *Beginner's Guide to Underwater Photography* by Ron Church or *Beginning Underwater Photography* by Jim and Cathy Church; these booklets are generally available at your local dive shop. *Cold Weather and Under Sea Scuba Diving* by Lee H. Somers may be purchased from the National Association of Underwater Instructors, 22809 Barton Road, Grand Terrace, California, 92324; or at registration (approximate cost: $3.95). This book is required reading. Other optional manuals and technical reports will be available through the Michigan Sea Grant Program at registration.

Each student is requested to provide a roll of TRI-X, 135-36 black and white film for underwater photography practice. Additional rolls may be used at the students option.

READING ASSIGNMENTS:

Since the course is based primarily on practical exercise and little time is available for study, students are requested to read the following portions of the *Research Diver's Manual* and must be prepared to apply the information in the field:

Section 1.0
Section 3.9-3.11
Section 4.1-4.3
Section 6.8-6.10
Section 7 (NOTE: memorize hand signals)
Section 8.3-8.4

In addition, those who find the pre-course theory examination awkward should read the remaining sections of the manual. Please read the underwater photography book prior to arrival at the course.

PRE-COURSE THEORY EXAMINATION:

Please complete the attached basic diving theory and philosophy examination and return it to the course director at least two weeks prior to arrival at the course. The results of this test will be helpful in preparing course lectures and individual specialized instruction sessions. Please do not seek aid or use a textbook except where table usage is indicated.

Name _____

RESEARCH DIVER TRAINING COURSE

THE UNIVERSITY OF MICHIGAN SEA GRANT PROGRAM

PRE-COURSE THEORY EXAMINATION

This is a self-administered basic diving theory and philosophy examination. Each course attendee is requested to complete and return this examination to the Course Director at least two weeks prior to the course. The results of the examination will be used as a partial basis of developing lectures and individual special instruction sessions. Please complete the examination without aid from other individuals or manuals.

1. Decongestants and nasal sprays may be obtained and safely used by:
   (a) consulting your local druggist and following his advice.
   (b) selecting a nasal spray "off the shelf" which you have used in the past to relieve nasal congestion and following the instructions on the label.
   (c) borrowing a friend's "special decongestant" sold by diving shops and using in accordance with instructions on the label.
   (d) consulting a physician familiar with the problems of diving and obtaining a prescription for an appropriate solution with instructions for use.

2. Presciption decongestants need not be used on a trial basis prior to diving. (a) True (b) False

3. Theoretically, at what stage of a deep dive (80 ft) will a breathhold diver (no scuba) lose consciousness?
   (a) At 80 ft.
   (b) Between 80 ft and 40 ft.
   (c) Between 30 ft. and the surface.
   (d) He won't, providing that he starts his ascent before he starts to lose consciousness!

4. Hyperventilation in breathhold diving (no scuba) should:
   (a) never be used.
   (b) be used extensively to prolong safe underwater breathholding.
   (c) be used with discretion and common sense.
   (d) be considered as insignificant from a standpoint of safety.

5. The maximum allowable carbon monoxide content for scuba diving breathing media is: (a) 100 ppm (b) 10 ppm (c) 25 to 50 ppm (d) 50-75 ppm

6. Once an individual has completed a nitrogen tolerance test and determined the depth at which the nitrogen in compressed air starts to affect him (her), then it is assumed that they may always dive to that depth without anticipating problems from nitrogen narcosis.
   (a) True (b) False

7. Aseptic bone necrosis frequently results from, among other things,
   (a) breathing excessive quantities of carbon monoxide.
   (b) breathing pure oxygen following the dive.
   (c) inadequate decompression.
   (d) prolonged dives using "skip" or "controlled" breathing techniques.

8. Decompression tables are calculated to include persons of <u>all</u> ages, body types, and levels of condition and are therefore considered "safe" without modification or special "reading" for all sport divers and sport diving activities. (a) True (b) False

9. Alcoholic beverages, if consumed in small quantities prior to a dive, have no effects on the diver. (a) True (b) False

10. Pain in the legs or the other parts of the body following a deep dive need not be treated and will go away with no ill effects in a few days.
(a) True (b) False

11. If you suspect that your buddy is suffering from decompression sickness and a recompression chamber is not available at or near the dive site, the recommended procedure is to first:
(a) send the victim back down to 165 ft and decompress according to treatment tables in your manual.
(b) send the victim to a depth of 30 ft, place him in a head down position and call a physician.
(c) administer first aid for shock, administer pure oxygen, obtain medical attention, and transport to a chamber.
(d) put the victim in your car and drive directly to the nearest chamber.

12. A preventative measure often used to reduce the possibility of recurring external ear infection in susceptible divers is:
(a) swab out the ears with a clean cloth or cotton swab.
(b) shake your head from side to side; then bend over, pinch the nostrils shut and blow gently
(c) dry the ears out by putting a few drops of alcohol solution in each ear and letting it run out.
(d) use a dab of grease or vaseline in each ear before diving.
(e) to be sure that all "wax" is removed from the ear prior to diving.

13. A diver makes his first dive for the day to a depth of 40 ft and uses only one cylinder of air (standard 70). About one hour after surfacing he complains of pain in his right shoulder. What is your action as a diving buddy?
(a) Assume that the diver is victim of decompression sickness and initiate immediate action to obtain medical services and recompress the diver.
(b) Have the diver lie down and take measures to prevent the on-set of shock.
(c) Assume that the diver is suffering from a "pulled" muscle and simply observe for the onset of other symptoms.

14. A scuba diver who is brought to the surface unconscious or loses consciousness within 24 hours after reaching the surface (from unknown causes) must be:
(a) taken to a hospital for observation.
(b) be considered as a victim of air embolism (or decompression sickness) and arrangements made for medically supervised recompression.
(c) restricted from diving activity for 48 hours.
(d) reprimanded for diving while intoxicated.

15. A diver has apparently suffered an air embolism. He is semi-conscious. You have been diving at 40 ft in Lake Superior and the nearest recompression chamber is several hours away. Your best procedure would be to:
(a) submerge the diver (and two attendants) to a depth of 165 ft and surface him in accordance with the US Navy's treatment table.
(b) submerge the diver (and two attendants) to a depth of 40 ft and surface him in accordance with the US Navy's treatment table.
(c) have him admitted to the nearest hospital for treatment and observation by a doctor.
(d) administer first aid for shock (with body on 15° incline), contact a physician, explain situation, and aid in acquiring transportation to a recompression chamber.

16. A non-breathing diver who has apparently been subjected to a high concentration of carbon monoxide should be:
(a) given mouth-to-mouth artificial respiration.
(b) given mouth-to-mouth artifical respiration, and sent home to rest after revival.
(c) given mouth-to-mouth artifical respiration, followed by oxygen when he regains breathing.
(d) given mouth-to-mouth artifical respiration, followed by oxygen when he regains breathing and immediately transported to a medical facility for further treatment and/or observation.

17. CO_2 toxicity can only occur when using a closed circuit scuba and diving helmet or mask. (a) True (b) False

18. A scuba diver is noted to have a bloody nose and mucus discharge following ascent. What condition is he most likely suffering from (one answer only)? (a) air embolism (b) thoracic squeeze (c) ear squeeze (d) ruptured ear drum (e) sinus squeeze

19. Unconsciousness in breathholding dives is generally the direct result of: (a) carbon dioxide buildup (b) nitrogen narcosis (c) hypoxia (d) hyperventilation (e) will power

20. An itchy rash on the skin following a working dive to 130 ft for a bottom time of 10 minutes (no decompression) may be considered an indication of: (a) decompression sickness (b) mediastinal emphasema (c) carbon monoxide poisoning (d) dry suit squeeze (e) wet suit fungus

21. In an emergency, nothing is more important than stopping rapid loss of blood and only artificial respiration is more important than control of even moderate bleeding. (a) True (b) False

22. While practicing with scuba in a swimming pool, your buddy collapses and loses consciousness 2 or 3 minutes after leaving the water. You must assume he has suffered and ____ and take appropriate action. (a) heart attack (b) delayed drowning (c) air embolism (d) fainting spell.

23. Carotid sinus reflex can be caused by: (a) hyperventilation (b) skip breathing (c) too tight of wet suit collar and/or hood (d) too tight of mask

24. A diver has completed his first working dive of the day at a depth of 130 ft in cold water. He used a standard decompression meter (of the type available in most diving shops in 1972) and worked up to nearly the "no decompression" limit as indicated by the meter prior to surfacing. The diver is "certain" that the meter indicated that he was safe to surface without a decompression stop. Also, the meter has recently been tested in accordance with the manufacture's recommendations. About 30 minutes after the dive the diver complains of pain in his right knee; over the next hour this pain intensifies and spreads. What type of injury is this diver probably suffering from? What is the basis for your diagnosis? What is your action, if any, as a diving buddy or diving supervisor?

25. Based on the literature available in manuals, instruction books, periodicals, etc., are there any limitations that must be observed when using a standard decompression (of type mentioned in 24) meter to determine safe diving limits?

26. Is it considered "safe" to make three or four "no-decompression" repetitive dives to a depth of 80 ft over a 6 hour period using a standard (as in 24) decompression meter? Why or why not?

27. The prescribed rate of ascent (in feet per minute) for sport divers using standard U.S. Navy Decompression Tables (air) is:
(a) 60 (b) 25 (c) 75 (d) 100 (e) 40

28. Repetitive dives are successive dives made within ___ hours following a previous dive. (a) 12 (b) 24 (c) 18 (d) 6

29. When using decompression tables, always read the ___ depth and time relative to the actual dive depth and time. (a) exact or next greater (b) exact (c) exact or next less

30. Bottom time (for purposes of using decompression tables) is defined as the elapsed time from:
(a) beginning of descent to start of ascent
(b) when the diver reaches bottom until he starts ascent
(c) beginning of descent until the diver leaves the deepest part of his dive
(d) beginning of descent until the diver reaches the surface at the end of the dive

31. For purposes of figuring decompression for a dive to a depth of 91 feet with a descent time of 2 minutes and time spent on bottom of 39 minutes, what decompression table schedule is used? (a) 90 ft/50 min (b) 91 ft/43 min (c) 100 ft/40 min (d) 100 ft/50 min (e) 90 ft/40 min

32. The repetitive dive tables use a minimum surface interval of:
(a) 2 minutes (b) 5 minutes (c) 10 minutes (d) 25 minutes

33. You have been working at a depth of 120 ft for 25 minutes when you suddenly realize that your air supply is almost depleted. You ascent directly to the surface without making decompression stops. There are extra scuba and divers on board your diving vessel, however the nearest recompression chamber is about 100 miles away. At the end of the ascent you have no adverse symptom. What do you consider as the most appropriate action to be taken in this situation?

34. You and your buddy are required to take a number of 6-foot core samples at a depth of 90 feet. The water temperature is 41°F and you are wearing a 1/4-inch wet suit. The device used to hammer the core tube into a relatively hard bottom weighs about 50 lbs. (underwater). You are using twin 100 cf scuba cylinders. After working hard for 27 minutes bottom time, you complete your operation and signal the topside personnel to haul up all cores and equipment. What is your ascent procedure? Specify total ascent time required (you may use standard decompression tables for only this question).

35. Based on your basic diving training and experience, what amount of weight would you wear for a dive to 66 feet, using a standard single 70 cf steel cylinder scuba, 1/4-inch wet suit, and standard buoyancy compensator? What is the basis for your answer?

36. "Skip" or "controlled" breathing (long periods of voluntary breathholding in breathing cycle) when using open-circuit scuba can result in:
(a) CO poisoning (b) CO_2 poisoning (c) hypoxia (d) nitrogen narcosis (e) has no adverse effects on the human body

37. A "Standard 71.2" scuba steel cylinder with a hydrostatic test date of "4-69+" has a rated capacity of about ___ ft^3 at 2250 lbs/in^2.
(a) 71.2 (b) 70 (c) 72 (d) 65

38. A diver is at 60 feet. Near the end of the dive he feels breathing restriction, reaches back to activate his reserve mechanism and finds that the reserve rod has already been pulled. He should signal his buddy and:
(a) drop his mouthpiece and free ascend
(b) buddy breathe
(c) retain his mouthpiece and rapidly ascend, exhaling continuously
(d) retain his mouthpiece, begin controlled ascent, and breathe slowly and lightly
(e) other _____

39. Calculate the volume of air (in standard cubic feet) in a double 71.2 ft^3 scuba (rated pressure 2250 lbs/in^2; hydrostatic test dates 5-60+, 4-66, 4-70) when the underwater pressure gauge reads 1000 lbs/in^2.

40. Calculate the volume of air (in standard cubic feet) in a 71.2 ft^3 scuba (rated pressure 3000 lbs/in^2; hydrostatic test date 7-73) when the underwater pressure gauge reads 2600 lbs/in^2.

41. Theoretically, how many standard cubic feet of air must the diver have in his scuba for a dive to 66 feet with a bottom time of 20 minutes at heavy work actively level in 40° F water (wearing a standard wet suit)?

42. The non-adjustable spring-loaded low-pressure air warning device (sometimes called a J-valve reserve) on a standard 71.2 ft^3 cylinder warns the diver when he has approximately ____ ft^3 of air remaining.
(a) 21 (b) 14 (c) 9 (d) 12 (e) 5

43. How does a diver best gauge his rate of ascent? (a) follow smallest bubbles (b) watch and depth gauge (c) shot line (d) decompression meter

44. The "no decompression" limit for a dive to 92 feet is ____ minutes. (Do not consult tables).
(a) 15 (b) 20 (c) 25 (d) 30 (e) 10

45. The "no-decompression limit" for a dive to 55 feet is ____ minutes. (Do not consult tables).
(a) 70 (b) 60 (c) 30 (d) 100

46. The U.S. Navy (as of Winter 1973) has approved the use of single-hose regulators for under ice and extremely cold water use. (a) True (b) False

47. A greenish or turquoise accumulation on the regulator filter screen indicates:
(a) that there is fresh water in the cylinder.
(b) contamination of the cylinder's interior by charcoal from the compressor.
(c) salt water has come into contact with the filter.
(d) carbon monoxide in the air supply.

48. A reddish-brown accumulation on the filter screen of your regulator is an indication that:
(a) there is fresh water inside the cylinder.
(b) the inside of the cylinder has been contaminated by charcoal dust from the compressor.
(c) there is salt water in the cylinder.
(d) there are impurities in the air supply that are of little or no concern to the diver since they have been filtered out.

49. What type of reserve or low pressure warning mechanism would you chose for your personal scuba?

50. What do you consider as a reasonable depth limit for sport divers using standard open-circuit scuba in waters of the type found in the Great Lakes Area? Let us assume that the diver has made about 30 open water dives in the area.

51. You are diving at 60 feet with standard scuba, a 1/4-inch wet suit and one of the large model buoyancy compensators with inflation hose attached to your regulator first stage. Your job is to locate and recover a small sampler which weighs about 30 lbs. underwater. You locate the sampler. What is your procedure for taking the sampler to the surface?

52. On the standard CO_2 buoyancy vest the CO_2 cylinders and inflator mechanism should be inspected for proper function:
(a) following every dive. (b) prior to every dive.
(c) once every 3 months. (d) once every year.

53. In accordance with instructions given on U.S. Navy decompression tables, if an ascending diver is delayed (slowed below normal rate) in ascent rate between a 90 and 70 foot depth, he should:
(a) increase the bottom time by the difference between the time used in the ascent and the time that should have been used at the prescribed rate and decompress accordingly for the new bottom time.
(b) increase the first decompression stop by the difference between the time used in ascent and the time that should have been used at the prescribed rate.
(c) stop 10 minutes at 10 feet.
(d) speed up the rest of the ascent so he reaches the surface within the allotted time at the prescribed rate.

54. When planning a series of repetitive dives, it is best to plan the ___ dive first. (a) shallowest (b) deepest (c) intermediate depth (d) farthest to shore

55. You should personally disassemble and clean your entire regulator:
(a) every 6 months (b) annually (c) every 5 years (d) never

56. A plus sign after the hydrostatic test date on a cylinder indicates that:
(a) the cylinder is manufactured using high grade material
(b) it may be filled to 5% over rated pressure
(c) it may be filled to 10% over rated pressure
(d) it may be filled to 2400 psi

57. A scuba air cylinder must be hydrostatically tested every:
(a) 5 yr (b) 2 yr (c) 3 yr (d) 7 yr

58. The compressed air in a standard 71.2 cu ft tank with 10% overload weighs approximately: (a) 3 lbs (b) 6 lbs (c) 7 lbs (d) 9 lbs (e) 5 lbs

59. The inside of a steel scuba cylinder should be inspected internally for rust and corrosion at least once: (a) every 3 months (b) every year (c) every 3 years (d) every 5 years

60. Depth indicators should be calibrated or checked against an accurate standard: (a) at least once a year or following shock or abuse. (b) every month (c) every 2 years (d) never since they are calibrated at the factory and cannot be damagned.

I hereby certify that I have received no aid in writing this examination.

_____
Students signature.

SEA GRANT PROGRAM • The University of Michigan
1101 North University Building • Ann Arbor • Michigan 48104
Phone 313/763-1437

Your application for the University Sea Grant Program's Advanced Research Diver Training Course has been approved for _____. Please complete the enclosed and submit them prior to your arrival at Omena, Michigan. You must have a diver's medical examination within 6 months of the course date. If you have a current diver's medical examination on file with your organization, please forward a copy by mail or bring it with you to the course. You will be rejected if you do not have a diver's medical examination.

If you need accommodations and have not arranged for them personally, please contact us. We will acquire the lowest cost accommodations possible. Please remember that Northern Michigan is a summer vacation area and living costs are relatively high. We are attempting to acquire a large house for the course personnel in order to reduce cost.

Omena is a small town on the west side of Traverse Bay's west arm. Please consult a Michigan highway map for the exact location. We plan to start the course at 9 a.m., Monday and complete instruction at 8 p.m. on Friday. Please schedule arrival for Sunday afternoon or Monday morning. When you arrive at Omena, go to staff house at the Sunset Lodge on Sunday or The Yatch Club on Monday. A map is attached.

If you have any questions or are forced to cancel your application, please contact us immediately.

Sincerely,

Lee H. Somers

Lee H. Somers, Ph.D.
Course Director

THE UNIVERSITY OF MICHIGAN
DIVING SAFETY COMMITTEE

Medical History and Examination Information

TO APPLICANT AND PHYSICIAN:

In order to participate in training (or employment) activities involving diving with surface-supplied diving equipment, self-contained underwater breathing apparatus, or pressurization in a hyperbaric chamber, you must pass a special medical examination. To aid the physician you are requested to complete this medical questionaire. Please bear in mind that diving involves a number of unusual medical considerations. The main ones are as follows:

Diving involves heavy exertion. (A diver must be in good general health, be free of cardiovascular and respiratory disease, and have good exercise tolerance.)

All body air spaces must equalize pressure readily. (Ears and sinus pathology may impar equalization or be aggravated by pressure. Obstructive lung disease may cause catastrophic accidents on ascent.)

Even momentary impairment of consciousness underwater may result in death. (A diver must not be syncope, epileptic episodes, diabetic problems, etc.)

Lack of emotional stability seriously endangers not only the diver but also his/her companions. (Evidence of neurotic trends, recklessness, accident-proneness, panicky behavior, or questionable motivation for diving should be evaluated.)

MEDICAL HISTORY:

Name:_____ Age:_____yrs. Sex:_____

Address:_____ Telephone(A/C)_____

Height:_____ft._____in. Weight:_____lbs. Student No.:_____

(If answers to the following questions require explanation, use the space labeled "Remarks," giving the number of the question.)

1. Have you had previous experience in diving? Yes___No___ Have you done any flying? Yes___No___ If so, did you often have trouble equalizing pressure in your ears or sinuses? Yes___No___ Can you go to the bottom of a swimming pool without having discomfort in ears or sinuses? Yes___No___

2. Do you participate regularly in active sports? Yes___No___ If so, specify what sport(s). If not indicate what exercise you normally obtain._____
_____.

3. Have you ever been rejected for service or employment for medical reasons? Yes___No___ *(If "Yes," explain in Remarks or discuss with doctor.)*

4. When was your last physical examination? Month_____ Year_____

5. When was your last chest x-ray? Month_____ Year_____

6. Have you ever had an electrocardiogram? Yes___No___ An electroencephalogram (brain wave study)? Yes___ No___

(Check the blank if you have, or ever have had, any of the following. Explain under "Remarks," giving dates and other pertinent information; or discuss with the doctor.)

7. Frequent colds or sore throat ___
8. Hay fever or sinus trouble ___
9. Trouble breathing through nose (other than during colds) ___
10. Painful or running ear, mastoid trouble, broken eardrum ___
11. Asthma or shortness of breath after moderate excercise ___
12. Chest pain or persistent cough ___
13. Spells of fast, irregular, or pounding heartbeat ___
14. High or low blood pressure ___
15. Any kind of "heart trouble" ___
16. Frequent upset stomach, heartburn, or indigestion; peptic ulcer ___
17. Frequent diarrhea. Blood in stools ___
18. Belly or back ache lasting more than a day or two ___
19. Kidney or bladder disease; blood, sugar, or albumin in urine ___
20. Syphillis or gonorrhea ___
21. Broken bone, serious sprain or strain, dislocated joint ___
22. Rheumatism, arthritis, or other joint trouble ___
23. Severe or frequent headaches ___
24. Head injury causing unconsciousness ___
25. Dizzy spells, fainting spells or fits ___
26. Trouble sleeping, frequent nightmares, or sleepwalking ___
27. Nervous breakdown or periods of marked depression ___
28. Dislike for closed-in spaces, large open places, or high places ___
29. Any neurological condition ___
30. Train, sea, or air sickness ___
31. Alcoholism, or any drug or narcotic habit (including regular use of sleeping pills, stimulants, etc.) ___
32. Recent gain or loss of weight or appetite ___
33. Jaundice or hepatitis ___
34. Tuberculosis ___
35. Diabetes ___
36. Rheumatic fever ___
37. Any serious accident, injury, or illness not mentioned above *(Describe under "Remarks," giving dates.)* ___

REMARKS

I certify that I have not withheld any information and that the above is accurate to the best of my knowledge.

Date:_____ Signature:_____

Suggested additional examination procedures (at physician's discretion):

Routine: Chest x-ray, urinalysis, wbc, hematocrit.

Divers over 40: Electro cardiogram with step test.

Questional Respiratory Status: Lung volume, timed vital capacity.

Inoculations: Recommend routine immunizations for tetanus, typhoid, diptheria, small pox, poliomyelitis.

SEA GRANT PROGRAM • The University of Michigan
1101 North University Building • Ann Arbor • Michigan 48104
Phone 313/763-1437

CERTIFICATE OF RESEARCH DIVER TRAINING

This is to certify that _____ has completed successfully a Research Diver Training Course sponsored by The Michigan Sea Grant Program at Omena, Michigan from _____ to _____, 197_. The course included approximately 50 hours of instruction and practical exercises in underwater navigation, limited visibility and night diving, search and light salvage, surface-supplied diving (KMB-8, Aquadyne, and Desco mask; Aquadyne helmet), Unisuit, underwater research techniques, underwater work, basic seamanship, diver first aid, and habitat diving. For details on course content, consult Research Diver Training Program (MICHU-SG-74-600) by Lee H. Somers.

Date:

Certified By:

_____

Course Director

Lee H. Somers, Ph.D.
Diving Coordinator
The University of Michigan

ASSUMPTION OF RISK AND WAIVER

University of Michigan
Diving Safety Committee

COURSE OR ACTIVITY: _____

DATE(S): _____ LOCATION: _____

I, the undersigned, do hereby certify that I have successfully completed a training course in skin and SCUBA diving as indicated by the attached certificate of training. I do also acknowledge that I am fully aware of the nature of skin and SCUBA diving activity with specific reference to the fact that diving involves a high level of physical exertion and that pressure changes on the body can cause serious injury if various respiratory abnormalities, cardiac abnormalities, or conditions which result in unconsciousness are present or were present in the past. I hereby certify that, to my knowledge, I have no medical problems that are inconsistent with high level physical exertion and the specific requirement related to skin and SCUBA diving activity. I further acknowledge that I am aware of the potential marine life and physical hazards involved with diving in waters of the above location and that I openly accept these risks.

I hereby acknowledge that I have read the above paragraph and for and in consideration of permitting me to enroll in and participate in diving acitivites sponsored by The University of Michigan, the City of Ann Arbor, County of Washtenaw, and State Of Michigan, beginning on the ____ day of _____, 19___ the undersigned hereby assumes the risks of said activity and voluntarily releases, discharges, waives and relinquishes any and all actions or causes of action for personal injury, property damage or wrongful death occurring to him/herself arising as a result of engaging or receiving instructions in said activity or any activities incidental thereto wherever or however the same may occur and for whatever period said activities or instruction may continue, or other causes inherent in the diving activity after having been placed on notice of said dangers and assuming the risks thereof, and the Undersigned does for him/herself, his/her heirs, executors, administrators and assigns hereby release, waive, discharge and relinquish forever any action or causes of action, aforesaid, which may hereafter arise for him/herself and for his/her estate, and agrees that under no circumstances will he/she or his/her heirs, executors, administrators and/or assigns prosecute, present any claim for personal injury, property damage or wrongful death against The University of Michigan or any of its officers, agents, servants, or employees for any of said causes of action, whether the same shall arise by the negligence of any of said persons, or otherwise. IT IS THE INTENTION OF _____ BY THIS INSTRUMENT, TO EXEMPT AND RELIEVE THE UNIVERSITY OF MICHIGAN FROM LIABILITY FOR PERSONAL INJURY, PROPERTY DAMAGE OR WRONGFUL DEATH CAUSED BY NEGLIGENCE OR OTHER CAUSES INHERENT IN THE DIVING ACTIVITY AFTER HAVING BEEN PLACED ON NOTICE OF SAID DANGERS AND ASSUMING THE RISKS THEREOF.

RESEARCH DIVER TRAINING COURSE
THE UNIVERSITY OF MICHIGAN SEA GRANT PROGRAM

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
9:00	Registration & Orientation	Diving Procedures II	Research Diving II	Research Diving III	Deep Diving
9:30					
10:00	Diving Procedures I	Underwater Search (Team A)* Light Salvage (Team B)*	Surface-Supplied Diving*	Underwater Work & Research Projects (Team A)* Surface-Supplied Diving & Habitat Diving (Team B)*	Seamanship II Deep Qualification Dives (Team B)* Coldwater Suits (Team A)*
10:30					
11:00	Evaluation Dives & Buoyancy Compensation*	Underwater Search (Team B)* Light Salvage (Team A)*			
11:30					
12:00	Charging Scuba	Lunch	Lunch		
12:30					
1:00	Lunch	Introduction To Surface-Supplied Diving	Underwater Work I	Lunch	Lunch
1:30					
2:00	Lifesaving	Surface-Supplied Diving*	Underwater Work & Research Projects*	Seamanship I	Recompression Chambers
2:30					
3:00	Underwater Navigation*			Underwater Work & Research Projects (Team B)* Surface-Supplied Diving & Habitat Diving (Team A)*	Deep Qualification Dives (Team A)* Coldwater Suits (Team B)*
3:30					
4:00					
4:30					
5:00	Lakelab Orientation & Dive*	Underwater Photography	Physical Fitness		
5:30			Coldwater Diving		
6:00		Dinner		First Aid & Treatment for Diving Accidents	Stow Equipment
6:30	Research Diving I		Dinner		
7:00				Dinner	Group Discussion
7:30		Limited Visibility & Night Diving			
8:00	Dinner		Night Collecting & Observation Dives*		
8:30		Night Dive*		Night Habitat Dives*	GRADUATION DINNER

*Diving Exercise
Note: If a recompression chamber is available at or near the sight, a 6th day will be included for special chamber attendant's course.

The Undersigned for him/herself, his/her heirs, executors, and assigns agrees that in the event that any claim for personal injury, property damage, or wrongful death shall be prosecuted against The University of Michigan, he/she indemnify and save and hold harmless the same The University of Michigan from any and all claims or causes of action by whomever or wherever made or presented for personal injuries, property damage or wrongful death. The undersigned acknowledges that he/she has read the foregoing instrument and has been fully and completely advised of the potential dangers incidental to engaging in the activity of skin and/or scuba diving and is fully aware of the legal consequences of signing the within instrument.

WITNESS: _____ _____

_____
Signature of Student

DATED: _____

_____
Signature of Parent or Guardian
where applicable