

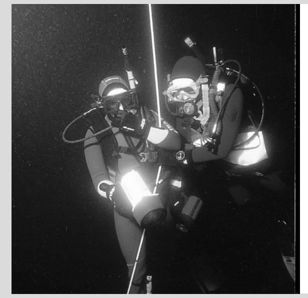

Cavern Diver
Specialty Course
Instructor Outline

PADI
padi.com

Product No. 70221 (Rev. 5/05) Version 1.05

Legend

Note to instructors:	Points for the instructor to consider that give additional qualifying information about conducting the course. Not intended to be read to students.
Note to students:	Required information. Read to students as printed.
By the end of this session, you will be able to: • Objective • Objective • Objective	Important information. Read to students. Objectives always precede individual Academic Topics and open water dives.

PADI®
Cavern Diver Specialty Course Instructor Outline

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The PADI Cavern Diver Specialty Course Instructor Outline was adapted from the 1989 NSS-CDS Instructor Manual by PADI Course Director/NSS-CDS Training Coordinator Harry Averill. The original NSS-CDS Cavern Diver Course Instructor Outline was developed by PADI Instructor/ NSS-CDS Training Chairman Joe Prosser, based on input from NSS-CDS Instructors Lamar Hires, Mark Leonard and Wes Skiles, and other members of the NSS-CDS Training Committee. Additional material for this adaptation came from PADI District Course Director/NSS-CDS Instructor Jack Rensch.

Please read this first.

Qualifying To Teach PADI Specialty Diver Courses

To apply for a Specialty Instructor rating, an individual must be certified as a PADI Underwater Instructor or higher. There are two ways to qualify to teach PADI Specialty Diver courses: 1) Attend a Specialty Instructor Training Course conducted by PADI Course Directors, or 2) apply directly to PADI.

Specialty Instructor Training Course attendance is *highly recommended* and *encouraged.* These course provide hands-on training, technique demonstrations, course marketing information, current PADI Standards information and, when applicable, Instructor-level open water training.

Application made directly to PADI requires either: 1) use of a PADI standardized Specialty Course Instructor Outline (this document) or,

2) the submission of a self-generated specialty course outline for Training and Education Department review. To speed outline approval, reduce liability exposure and ensure educational validity for your specialty courses, it is highly recommended that PADI standardized Specialty Course Instructor Outlines be used for courses they have been developed for.

The Specialty Course Instructor Application is to be used whether attending a Specialty Instructor Training Course or applying directly to PADI.

For more information on certification as a PADI Specialty Instructor, please refer to the "General Course Standards and Procedures" section of the PADI *Instructor Manual.* If you still have questions after reading this section, call your PADI Local Area Office.

Note

Prior to promoting or teaching a PADI Specialty Diver Course, written confirmation of instructor certification in that specialty must first be received from PADI.

Qualifying to teach the PADI Cavern Diver Specialty course differs from most other PADI Specialty Diver courses. In addition to the requirements previously listed, the Cavern Specialty Instructor Candidate must submit proof of certification as an "Introduction To Cave" or "Full Cave Diver" by a recognized cave diving certification agency (for example NSS-CDs, NACD, CDAA - Cave Divers Association of Australia) in addition to the experience requirement.

Also, be aware that the standards of practice for teaching Cavern Diver courses are well defined. Therefore, if you elect to teach the Cavern Diver course, you are strongly encouraged to stay abreast of current cavern diving practices, procedures and techniques, include them in your courses and adhere to them yourself.

COURSE STANDARDS AND OVERVIEW

This course is designed to be an introduction to cavern diving and to help the student diver develop the skills, knowledge and techniques necessary for cavern diving.

Prerequisites

To qualify for the Cavern Diver course, an individual must:

1. **Be certified as a PADI Advanced Open Water Diver or have a qualifying certification from another training organization.**
2. **Be 18 years of age or older.**

Instructor Supervision

Cavern Diver courses may be conducted by a Teaching status PADI Underwater Instructor (or PADI Instructor with a higher rating) who has been certified as a PADI Cavern Diving Instructor.

The maximum student diver-to-instructor ratio for open water training dives is eight students per instructor (8:1), with 2 students per instructor for penetration cavern-training dives. During penetration cavern-training dives, student divers are to be accompanied by a PADI Cavern Diving Instructor.

Considerations for Cavern Training Dives

***Cavern diving* is defined as any dive conducted within the light zone of a cave. Cave diving is any dive conducted beyond the light zone of a cave. The *light zone* of a cave is defined as that part of the cave from which natural light illuminating the entrance is visible at all times.**

The Cavern Diver course is to include four training dives, which are to be conducted over at least two days. The minimum number of recommended hours is 24, with time being equally divided between knowledge development and actual predive preparation and water-training sessions.

The first dive is to be conducted in open water, practicing the use of lines and reels and emergency procedures. The final three dives are to be conducted in the cavern environment. Penetration-training dives are limited to within the light zone and within 40 metres/130 feet from the surface, vertical and horizontal distance included. No out-of-air drills are to be practiced in the overhead environment.

After the training dives, student divers are required to log their dives in their personal log books.

COURSE OVERVIEW

This course covers the knowledge and techniques of cavern diving and describes the dangers involved with cave diving. Cavern diving is in no way intended to provide instruction for cave diving.

To conduct a Cavern Diver course, the following is to be included:

1. **The planning, organization procedures, techniques, problems, and hazards of cavern diving**
2. **Special equipment considerations including, but not limited to: lighting, guidelines, reel handling and redundant breathing systems**
3. **Proper body position and buoyancy control, air-consumption management and emergency procedures**
4. **Information that describes the specific hazards of cavern diving should include, but not be limited to: silting, line entanglement and breakage, disorientation from permanent lines and emergency situations unique to cavern diving**

CERTIFICATION PROCEDURES

The certifying instructor obtains a Cavern Diver certification by submitting a completed, signed PIC to the appropriate PADI Office. **The instructor who conducts the student's final open water training session is to be the certifying instructor. The instructor certifying the student must insure that all certification requirements have been met.**

KEY STANDARDS

Prerequisite Certification: PADI Advanced Open Water Diver or qualifying certification
Minimum Age: 18
Recommended Course Hours: 24
Minimum Open Water Training: 4 dives on 2 days
Student-to-Instructor Ratio: 8:1, 2:1 for cavern penetration
Minimum Instructor Rating: Cavern Diver Specialty Instructor

Introductory Information
Cavern Diver Specialty Course Instructor Outline

Heading IV, in the outline "Academic Topics," provides specific information that is to be presented to students prior to the conclusion of the course. At the discretion of the instructor, the topics in this section may be "modularized" (divided into several academic presentation sessions).

Heading V, in the outline "Equipment Modification Workshop," describes a session that is to take place before students participate in any in-water activities.

Heading VI, in the outline "Land Drills," describes several dry-land exercises that are to take place before students participate in the shallow-water line drills (Dive Two) and the subsequent practice dives (Dives Three and Four).

Heading VII, on the outline "In-Water Sessions," describes several exercises for training Dives One-Four. Depending on logistics, Dives One (demonstration dive) and Two (establishing a shallow water line course) may be conducted in reverse order. Dives One and Two, however, are to be conducted prior to student practice dives, Dives Three and Four.

I. Course Overview

The purpose of the PADI Cavern Diver specialty course is to familiarize divers with the skills, knowledge, planning, organization, procedures, techniques, problems and hazards of cavern diving. The Cavern Diver course is intended to provide a safe, supervised introduction to diving in natural overhead environments. However, although the course introduces students to the myriad skills, procedures and techniques that cavern diving has in common with cave diving, the Cavern Diver course *is not* intended to provide an introduction nor enticement to cave diving.

Training should emphasize conservation, safety and enjoyment. The goals of PADI Cavern Diver training are:

A. To develop the student's practical knowledge of the cavern environment.

B. To raise the student's awareness of the need for conservation and positive landowner relations.

C. To familiarize the student with the three direct and two major contributing causes of cave and cavern diving fatalities (Accident Analysis) and how they form the basis of the safety rules around which this course and all subsequent cavern dives revolve.

Note to Instructor

It is vital that you understand the role that Accident Analysis, and the safety rules derived from it, play as the basis for all Cavern Diver training. Accident Analysis has revealed that virtually every cave and cavern diving fatality has been the direct result of one or more of the following three factors:

- *Failure to run a continuous guideline to open water.*
- *Failure to keep at least two-thirds of each diver's starting air volume in reserve to exit the cave or cavern.*
- *Diving below 40 metres/130 feet on compressed air. Additionally, the following items have been identified as major contributing factors in the vast majority of cave and cavern diving accidents:*
- *Lack of proper training (or exceeding the limits of training and experience).*
- *Inadequate number of lights.*

From this analysis has come the following rules:

1. *Do not cavern dive without the proper training. Stay within the limitations of your training when you cavern dive.*
2. *Always run a continuous guideline that links you and your buddies to a point, in open water, from which you can make a direct, uninterrupted ascent to the surface.*
3. *Always keep a minimum of two-thirds of your starting air supply in reserve. Begin your exit from the cavern as soon as you reach this predetermined limit.*
4. *Do not dive deeper than 40 metres/130 feet using compressed air. The maximum depth limit recommended for this level of training is 21 metres/70 feet.*
5. *Use at least three sources of light. For cavern diving, your primary light source is the sun, backed up by a primary and a secondary battery-powered light.*

In conducting this course, you will be most effective if you constantly establish the need to know (value) by explaining how the subject matter relates to Accident Analysis.

D. To enable the student to plan and organize dives to safely explore caverns that fall within the stated limitations of Cavern Diver training and that offer conditions as good as the caverns in which the student was trained.

II. Cavern Diver Course Requirements

A. Prerequisite certification: PADI Advanced Open Water or have a qualifying certification from another training organization.

B. Minimum age requirement: 18 years.

C. Student-to-instructor ratio: 8:1. 2:1 for cavern penetration. Instructor must accompany students during any penetration. The 2:1 ratio cannot be increased by the use of certified assistants.

D. Confined water training may be added at the discretion of the instructor conducting the specialty course. As a preassessment before the course begins, a confined water session may include a scuba-skills review. The PADI Skill Evaluation or the Scuba Review program are excellent means of accomplishing this review.

Note to Instructor

Be aware that shallow-water line drills are required for this course. These drills are not to be conducted in an overhead environment. *Instead, a swimming pool or shallow, open water may be used. While a shallow, open water site provides a more realistic environment for the line drills, there may be circumstances in which such an environment is not available. In these instances, a pool may be substituted. Additionally, the instructor may choose to use a pool for preassessment and development of critical skills such as buoyancy control, body position and specialized, cavern diving propulsion techniques.*

E. Dive data

1. **Four scuba dives, plus shallow-water line drills.**
2. **Penetration-training dives are to be limited to within direct sight of the cavern exit and within 40 metres/130 feet from the surface, vertical and horizontal distance included. Visibility is to exceed 12 metres/40 feet; maximum depth during training dives is 21 metres/70 feet.**
3. **No out-of-air drills are to be introduced in the overhead environment.**

III. Student and Instructor Equipment Requirements

A. Student Equipment

1. All personal, standard diving equipment including:
   a. Mask and fins (see note on next page)
   b. Exposure suit appropriate for the local diving environment

and depth, including: hood, boots and gloves, if needed (see note on next page).

c. Weight system (see note on next page)
d. BCD with low-pressure inflator
e. Regulator with submersible pressure gauge
f. Alternate air source suitable for sharing air with other divers and which is connected directly to the diver's primary air supply (see note on next page).
g. A single diving cylinder with at least 1415 litres/50 cubic feet of air (see note on next page).
h. Complete instrumentation, including depth, time and direction (see note below).
i. Recreational Dive Planner — The Wheel or Table
j. Dive tool or knife capable of cutting guideline quickly and effectively (see note below)
k. Slate with pencil

2. Log book
3. Specialty equipment
   a. Reel and guideline — one per team required; one per diver recommended.

Note to Instructor

- *Snorkels, regulator first-stage dust caps and similar pieces of equipment that stick up, unseen, behind the diver's field of vision constitute a major guideline entanglement hazard in cavern diving. Nevertheless, there may be circumstances in which a snorkel is necessary for safety and air conservation while swimming to and from the cavern site on the surface. In such instances, the snorkel should be removed and clipped to the guideline prior to entering the cavern. A "pocket snorkel" may also be used and should be stored in a BCD or wet suit pocket.*
- *Students should be encouraged not to wear gloves.*
- *Unless required for safety in adjacent open water, the use of standard, quick-release weight belts should be discouraged. (Releasing weights would only serve to pin divers to the ceiling.) Instead, encourage students to attach weights farther up on the body so that overall trim and body position are improved.*
- *Acceptable alternate-air-sources for cavern diving include conventional octopus second stages, integrated alternate air source BCD inflators and the use of Y valves (valve which enable the use of two separate regulator first and second stages with separate on/off valves on a single tank). Self-contained alternate air sources are generally not appropriate for cavern diving in that they lack sufficient capacity to carry two-thirds of a diver's starting air volume as a reserve.*
- *It is strongly recommended that students use single cylinders of equal volume. (Smaller divers need to carry sufficient air to get both themselves and a larger, out-of-air buddy out of the cavern.)* ***Use of double cylinders is not allowed.*** *J valves should not be used.*
- *Depth and time monitoring may be accomplished through the use of electronic dive computers, although students should be encouraged to carry additional depth and time monitoring instrumentation as backup in case of computer failure.*
- *Dive knives or cutting tools should be as small as possible. They need only be capable of cutting guideline quickly and effectively; sawing or prying abilities are neither needed nor desired in the cavern environment. Knives should not be worn any where on the leg, as this constitutes a major entanglement hazard.*

b. Primary, battery-powered dive light
c. Secondary (backup), battery-powered dive light

B. Instructor equipment

1. All required student equipment, plus:
    a. Y valve or double-cylinders with dual-valve manifold or separate K valves
    b. Three battery-powered lights
    c. Primary reel and personal safety reel

Note to Instructor

At the present time, the prevailing standard of practice is for Cavern Diver Specialty Instructors to conduct the course while wearing Full Cave equipment. This, of course, is only recommended if the instructor has Full Cave certification and is a regulation that is enforced at many sites.

2. Safety equipment
    a. First aid supplies and equipment. Recommended: first-aid kit, Pocket Mask and oxygen.
    b. Emergency decompression air cylinder (clipped to line at cavern entrance)
3. Materials that may be used to teach this course
    a. General PADI materials and training aids:
        - Giant Recreational Dive Planner — the Wheel and Tables
        - Log Book (Adventure Log recommended.)
        - Student Record File
        - Student Folder
        - Dive Roster
    b. PADI reference materials
        - *The Encyclopedia of Recreational Diving*
    c. PADI recognition materials:
        - PIC envelopes
        - Specialty Diver wall certificates
        - Cavern Diver specialty chevrons

IV. Academic Topics

The following is an actual presentation outline. Directions to, or comments for, the instructor are enclosed in [brackets].

A. Introductions, course overview and welcome to the course

1. Staff introductions
    a. [Introduce yourself and your assistants.]
    b. [Have students introduce themselves and explain why they're interested in cavern diving — break the ice and encourage a relaxed atmosphere.]

2. Course goals
   a. The goals of the course are:
      - To develop your practical knowledge of the cavern environment.
      - To raise your awareness of the need for conservation and positive landowner relations.
      - To familiarize you with the three direct and two major contributing causes of cave and cavern diving fatalities ("Accident Analysis") and how they form the basis of the safety rules around which this course and all subsequent cavern dives revolve.
      - To enable you to plan and organize dives to safely explore caverns that fall within the stated limitations of Cavern Diver training and that offer conditions as good as the caverns in which you were trained.
   b. The Cavern Diver course, however, is in no way intended to provide instruction for cave diving. [Discussed in depth throughout the course; elaborate at this point only if necessary.]
3. Course overview
   a. Classroom presentations. [Remind students that academic information may also be given during land drills and predive briefings. If additional classroom sessions are planned, give dates, times and locations.] There will be _________ (number) classroom presentations during the course. The classroom (academic) presentations in the Cavern Diver course covers:
      - Conservation/landowner relations
      - General terminology and geology
      - Types of caves and their formations/entrance descriptions
      - Silt, chemicals, gases, and related terminology
      - Hazards of the environment
      - General and special equipment considerations for cavern diving
      - Line use
      - Anti-silting techniques in cavern diving
      - Communications underwater
      - Psychological considerations for cavern diving
      - Stress factors, sources, and effects in cavern diving
      - Cavern diving procedures
      - Accident analysis
      - Emergency procedures
   b. Equipment-modification workshop. This will be conducted prior to the first water session and will enable you to make the minor modifications necessary to adapt your open water diving equipment for cavern diving.

c. Pool sessions. [Pool sessions are generally not included in the Cavern Diver course. If they are, it is usually to cover a review of basic skills and to help students develop the specialized buoyancy-control, body-position and propulsion techniques used in cavern diving. If the course is to include pool sessions, give date, time and location.]

d. Land drills. [Give date, time and location. Land drills are generally conducted prior to any water work and are to take place before any shallow-water line drills or practice cavern dives; however, if dictated by logistical considerations, they may take place after the demonstration dive.] Land drills provide the opportunity to:
   - Learn and practice basic guideline and reel use, emergency procedures and other cavern diving skills prior to having to practice and apply them in the water.

e. Shallow-water line drills. [Give date, time and location. Shallow-water line drills are generally conducted after the demonstration dive (to take advantage of the reserve air left in students' tanks after the *demo* dive and to maintain a dive profile that moves from deep to shallow); however, they may also take place beforehand.] Shallow-water line drills provide the opportunity:
   - For you to practice the skills learned during the land drills before having to apply them in an actual cavern.

f. Demonstration dive. [Give date, time and location; identify how this dive will be sequenced relative to the land drills and shallow-water line work.] The demonstration dive provides the opportunity:
   - For the instructor to make certain that you are properly weighted for cavern diving and to recommend or make adjustments in weight.
   - For the instructor to further assess your buoyancy control skills and overall abilities, and to make recommendations for further improvement.
   - For you to see and practice the specialized propulsion techniques associated with cavern diving.

g. Practice cavern dives. [Give dates, times and locations.] Practice cavern dives provide the opportunity:
   - For you to practice and apply the skills learned during classroom sessions, land drills, shallow-water line drills and the demo dive in a realistic environment.
   - For the instructor to evaluate how well you can apply what you have learned to date and to make suggestions for further improvement.
   - For everyone to enjoy exploring underwater caverns.

4. Certification
    a. Upon successful completion of the course, you will be awarded PADI Cavern Diver Specialty certification.
    b. This certification means that you will be able to plan, organize, conduct and log dives in which you safely explore caverns that fall within the stated limitations of cavern diver training and that offer conditions as good as the caverns in which you were trained. The limitations of cavern diver training and certification are:
        - No dives outside of daylight hours.
        - No dives outside of *direct sight* of the cavern entrance.
        - No dives beyond a linear distance of 40 metres/130 feet from the surface (depth to the entrance plus penetration distance).
        - No dives requiring planned stage decompression.
        - No dives that require divers to pass through *restrictions* (places too narrow to allow divers to pass through side-by-side or piggyback).
        - Dives below a depth of 21 metres/70 feet are not recommended.
    c. You may apply for the rating of Master Scuba Diver if you are a PADI Advanced Open Water Diver (or have a qualifying certification from another training organization) and a PADI Rescue Diver (or have a qualifying certification from another training organization) with certification in four other PADI Specialty ratings.
5. Class requirements
    a. Cost of course [Explain all costs involved.]
    b. Equipment needs. [List all the equipment students must provide and explain that the use of specific equipment will be discussed later in the course.]
    c. Materials needed for the course
    d. Attendance requirements
6. Administration
    a. Complete paperwork: enrollment, Standard Safe Diving Practices Statement of Understanding, PADI Medical Statement, Liability Release, and Assumption of Risk Agreement. [These should be filled out and signed, even if you have students who have completed them before as part of another course taken from you. The PADI Student Record file contains all of these forms and simplifies paperwork.]

B. Conservation

> ***Learning Objectives.***
> ***By the end of this session, you will be able to:***
> - ***Explain the need for conservation of the cave/cavern environment and give examples of how cavern divers can help preserve and protect it.***

1. You are in a cave by choice; the cave has no such choice.
   a. Remove no cave rocks. The ecological balance of a cave is very fragile. Removing rock formations or gathering other souvenirs may cause damage which could require thousands of years to repair.
   b. No graffiti
   c. Do not disturb plants, animals or natural features of the cavern.
   d. It may also be a violation of local law to disturb or remove anything from a cave.
   e. Caves provide geological windows into the past. For the modern explorer, this is a very rare opportunity to see what this world was like from thousands to hundreds of thousands of years ago. A careless placement of equipment or your body can cause irrevocable damage to this very fragile environment. Enter caves only with the utmost respect for this fragile environment and the potential damage you could cause.
2. No trash! Trash is as unsightly underwater as it is on the surface. Trash underwater may contribute to the decline of the cave life by forming a growth place for bacteria foreign to the cave.
   a. Never leave your trash in or near a cave. Always dispose of trash properly.
   b. Always attempt to remove trash left by others and dispose of it properly.
3. Plants and animals often rely on the cave and/or cave spring for a habitat. Respect this life and be careful to minimize your intrusion in this environment.

C. Landowner relations

> ***Learning Objectives.***
> ***By the end of this session, you will be able to:***
> - ***Explain the need for good landowner relations and give examples of how these relations can be maintained.***

1. There is no unowned land
   a. You enter and dive at owner's pleasure.
   b. Consult owner (no trespassing)

   c. Respect owner's limitations. (For example, the owner may have an established *No Lights* policy, which prohibits non-certified cavern divers from using underwater lights when entering a cavern. This policy discourages the nontrained diver from venturing into danger.)

2. Time consideration
   a. When the area is closed, or the agreed departure time arrives, leave.
   b. Plan dives to coincide with owner's desires.
   c. Noise consideration (loud radios, voices, etc.). Do not tamper with the natural serenity.
   d. Gate privileges (at some locations it may be necessary to cross gates to enter dive sites):
      - Keep gate closed to prevent livestock from roaming.
      - Do not force open.
   e. Develop good landowner relations:
      - Best way to keep access
      - Without encouragement it dies and so do our privileges.

D. General terminology and geology

> ***Learning Objectives.***
>
> ***By the end of this session, you will be able to:***
>
> - ***Explain how and why the common definition of caverns and caves is different from that used by diver.***
> - ***Define the term geology and explain why a fundamental understanding of the geology underlying the creation of caverns and caves enhances the experience of diving in them.***

1. Terminology use
   a. Geologists' use of terms:
      - *Cave* is defined as a naturally occurring room or passage in bedrock, large enough to be entered by a human being.
      - *Cavern* is defined as two or more such interconnected underground rooms or passages.
   b. Divers' use of terms (different needs dictate different use):
      - *Cavern* is defined as the initial room of an underwater cave, which is illuminated at least in part by natural daylight. There are other qualifying terms and definitions which we will be referring to later on in this course. From this point on in the course, our use of the word *Cavern* will refer only to the diver's definition of a cavern.

- *Cave* is defined in the same context as the geologist except that the diver tends to refer to all underwater passages, which doesn't exactly fit the definition of a *cavern, as a cave.*

2. Geology
   a. Definition: The scientific study of the origin, history and structure of the earth.
   b. Scope:
      - Geology is a specialized discipline beyond the scope of this course. [You may wish to provide the student with sources of information to learn more about the study of geology. Reference works on the topic can provide insight into what students can observe while cavern diving.]

E. Types of caves and their formations

> ***Learning Objectives.***
> ***By the end of this session, you will be able to:***
> - ***List and define the four different types of caves, give examples of where they are most likely to be found and identify any special features divers may need to take into account when diving them.***
> - ***Describe the process by which solution caves are formed.***

1. Sea (littoral) caves. Caves formed by wave (hydraulic) action.
   a. Typically not extensive; perhaps one large chamber.
   b. Sea caves occur along coast lines. In North America, they are usually found along the Great Lakes, California coast, New England and the Sea of Cortez.
   c. Special considerations:
      - Usual marine growth
      - Tides and currents can make the dive more difficult. Currents can batter you against rocks or marine growth. Tides can change flow directions very quickly in a cave and make it more difficult for you to escape the cavern.
2. Coral caves. Coral caves form when coral polyps grow together to form coverings over coral canyons, resulting in passageways through which you can swim.
   a. Coral caves are usually not very extensive. They are typically one long passage with many surface openings.
   b. Coral caves occur in any area favorable for coral growth.
   c. Special considerations:
      - Usual marine growth can result in many protrusions into passageway. These can snag you and prevent you from backing out or turning around.

- Tides and currents, as described earlier, can make the dive more difficult.

3. Lava tubes. Caves formed by volcanic action.
   a. Lava tubes are formed when the surface of a lava flow hardens while the molten, inner core continues to flow. If the flow of lava is cut off suddenly, this inner core may empty out, leaving a hollow tube.
   b. Most common in Hawaii and along Northwest Pacific coast.
   c. Special considerations:
      - Usual marine growth can cause many protrusions into passageways. These can catch you and prevent you from backing out or turning around.
      - Tides and currents, as described earlier, can make the dive more difficult.
      - Typical passage color is near black (result of the type of rock in which the cave was formed). Available light can be quickly absorbed.
4. Solution caves. Caves formed by the dissolution of limestone (calcium carbonate) or dolomite (calcium-magnesium carbonate) by water containing carbonic acid. These are the most commonly dived caves.
   a. Formation:
      - Rain falling through the atmosphere and percolating through the ground picks up CO_2 to form a mild solution of carbonic acid.
      - This mild acid:
        1) Collects and flows in and along pockets (voids), faults (cracks), joints (joining of two different rock formations) and bedding planes (layers of rock formations).
        2) Over time, the acid dissolves the rock in which it comes into contact to enlarge the emerging cave.
        3) This is a very slow process, sometimes taking thousands of years.
      - Rising and lowering of water tables increases or decreases the speed of the dissolving process.
      - Changes in the direction and rate of groundwater flow can also increase or decrease this process.
      - Breakdowns (cave-ins) are not common within the cave system as water provides much of the support for the cave walls and ceiling. However, it is always a possibility, and this is exactly the way in which many cavern entrances form.
      - As a result of the dissolution process, there is the potential for a long and complex maze of tunnels to form within the system.

- Water source:
  1) The typical water source for most caves is local rain conditions.
  2) Water quality within the cave is directly related to surrounding groundwater conditions.

b. Most common type of rock in which solution caves occur: Limestone and Dolomite (specific types of rocks).

c. Karst terrain. Distinctive landscape in which caves are likely to occur. Characteristics include sinkholes, sinking streams (streams which seem to disappear into the ground), and large springs.

d. Location.
  - Most all areas with rocky terrain and sufficient rain have solution caves.
  - Most diveable caverns in North America occur in or near North-central Florida; the Ozark Mountains of Missouri; the Yucatan Peninsula of Mexico; Texas; and the entire Caribbean archipelago.

F. Entrance descriptions

Learning Objectives.

By the end of this session, you will be able to:

- ***List and define the four different types of cave/cavern entrances.***
- ***Give examples of the characteristics that generally identify them.***
- ***Explain which types are and are not suitable for cavern diving and why.***

Cavern and cave divers tend to describe cavern and cave entrances by their hydrologic characteristics under normal conditions. As with other terms, these too have been modified from standard speleological use to fit our special needs.

1. Spring. This term is used to describe the entrance to a cave(rn) system in which water usually flows *out.* Springs are considered safest for cavern diving because you will need *less* air, time and energy to exit than you did to enter.

   a. Typical characteristics:
      - Surface boil. This is what occurs when water is discharged with such force that a *boil* is visible at the surface.
      - Pool. A collection of water near the cave entrance. (Also referred to as the spring *basin.*)
      - Run. a stream of water flowing from the pool toward another nearby body of water (river, ocean, etc.).

b. Other spring conditions:
   - Springs do not always obey the rules described above.
   - Springs may discharge directly into a river, lake, etc.
   - Springs runs may be just a few inches or centimetres in length — or may be several miles or kilometres long.
c. Reversing flow. During locally heavy rains, springs may reverse directions. Such reversals in direction bring with them all the concerns associated with diving *siphons* (see below). Some springs may have sections within the cavern in which water may flow in a different direction than that indicated by the overall appearance of the spring.

2. Siphon. This term is used to describe the entrance to a cave(rn) system in which water usually flows *in*. Siphons are generally considered unsafe for cavern diving because you will need *more* air, time and energy to exit than you did to enter.
   a. Typical characteristics. May share many of the same characteristics as springs, yet flow into the ground. A telltale exception may be a whirlpool-like appearance at the surface, as opposed to the slick or boil common to springs.
   b. Reversing flow. Just as some springs may, during periods of heavy rain, reverse to become siphons, some siphons, during droughts, may reverse to become springs.
   c. Other terms used to describe a siphon:
      - Swallow hole
      - Ponor
3. Spring-siphon. This term is used to define a single basin containing both a spring and a siphon (some basins contain multiple springs and siphons).
   a. Sinkholes (also referred to as *dolines*) are the most common form of spring-siphon. They form when the ground collapses over an underground river. The upstream side of the underground river will now be forced to flow up and over the resulting *breakdown* pile to get to the downstream side. The forms a *spring* at the upstream exit and a *siphon* at the downstream entrance. There may be no visible water flow at the surface.
   b. Depressions in the earth in areas of karst terrain may indicate the formation of a future sinkhole.
4. Cenotes, blue holes, and karst windows. These are all specialized versions of sinkholes. Most are associated with local descriptions of sinkholes, although each may share some characteristics of any or all of the general types of cave entrances described above.
5. Sumps and underground lakes

a. Sumps. These are water-filled sections of a cave within an otherwise air-filled passage.
b. Underground lakes. These are:
   - Very large sumps, or sections of very wide passage-ways that may partially fill with water. These sections resemble a lake and thereby earn their name.
   - Also referred to as *Sump Lakes.*
c. Caution: Due in part to a lack of natural daylight and potential disorientation, these types of dives must be accorded all of the respect due to technically advanced cave dives. Exploration in these areas is beyond the scope of this level of training.

G. Silt

Learning Objectives.

By the end of this session, you will be able to:

- ***List and define the four different types of silt commonly encountered in caves and caverns.***
- ***Rate each type of silt according to how easily it is disturbed.***
- ***Identify the techniques and procedures than can be used to avoid silt.***

Defined by divers as fine, naturally occurring particles that may affect visibility. All silt is of concern to divers as it can reduce visibility. Divers rate silt according to its immediate effect on visibility; the rating goes from least serious to most serious.

1. Sand; least serious.
   a. Large particle size
   b. Drops out of water quickly
   c. Usually, but not always, tightly compacted so less likely to be disturbed by diver.
   d. Usually has a *clean* appearance
2. Mud; serious
   a. Looks like mud does on the surface
   b. Is easily disturbed
   c. May require several hours to settle
3. Mung; serious
   a. Organic growth in low-flow marine caves
   b. Is easily disturbed
   c. Tends to clear slowly
4. Clay; extremely serious
   a. Very fine particles
   b. Ability to remain suspended for very long periods of time
   c. Clings to everything; a little can go a long way

5. Silt Location:
    a. Floors — most common
    b. Walls — less common
    c. Ceiling — sometimes
6. Other factors affecting silt:
    a. Debris (leaves, etc.), which can cause more silt to remain in suspension
    b. General water quality (after periods of heavy rain, silt-laden water may flow directly into cave).
    c. Tides (incoming tides may bring silt with them; strong tidal flow can stir up silt)
7. Avoidance of silt:
    a. Choose entrances carefully. Poor entrance technique can wipe out cavern visibility.
    b. Take weather into account. (A sudden cloudburst can wipe out visibility.)
    c. Propulsion techniques and trim:
        - Most common reason visibility is lost
        - Learn and practice correct techniques
8. Other terminology associated with silt.
    a. *Silty* — The potential for disturbing silt found within the cave
    b. *Silting* — The act of disturbing silt during the dive
    c. *Siltout* — Total loss of visibility due to diver silting

H. Chemicals, gases, related terminology

Learning Objectives.

By the end of this session, you will be able to:

- ***List the various gases divers may encounter in caves and caverns; explain how these gases may affect divers and how these affects may be avoided.***
- ***Define the term*** **halocline*****; identify where divers might encounter haloclines and the effects that may result from diving in and around them.***

Chemicals and gases may be dissolved in the water flowing through a cave, or may be a result of the ongoing reactions within the cave. These chemicals and gases may be detected by the diver and can tell him much of what may be taking place within the cave. These chemicals and gases may also affect the diver during the exploration of the cavern.

1. Hydrogen sulfide
    a. Possesses a rotten egg smell
    b. May be absorbed through skin. This creates the potential for illness (sick to stomach)

c. Effect on equipment:
   - May turn some items black
   - May encourage electrolysis
d. A layer of hydrogen sulfide may create a *cloud* effect
   - There may be no surface light penetration through the cloud.
   - There may be limited visibility in the cloud.
   - Small quantities may stratify themselves in layers of clouds.
e. Hydrogen sulfide usually occurs near an interface of salt and freshwater supplies (e.g., caves and caverns near coast-lines).

2. Tannic acid
   a. Created by decomposing vegetation. Often associated with *cypress knees* (cypress tree stumps) found in the swamps that feed many of the rivers that flow adjacent to springs.
   b. The presence of tannic acid gives water the color and lack of visibility one would expect if diving in a cup of strong tea.
      - Tannic acid gives many of the rivers flowing adjacent to springs their distinct color.
      - Beautiful and dramatic effects may take place when clear spring water flows into adjacent, tannic-laden rivers.
      - However, when tannic-laden water flows into caverns and caves (a situation typical in siphons or springs that have reversed), it may have a devastating and danger-ous effect on visibility.
3. Hydrocarbons, methane and other gases
   a. The presence of these gases in caverns and caves is rare.
   b. These gases are formed as a by-product of decomposing material.
   c. These may be potentially lethal gases — and they may be odorless and tasteless.
   d. Do not breathe gas in *air* pockets.
      - Absence of O_2 or concentration of other gases in air pockets may be deadly.
4. Stale Air. High concentrations of CO_2 in air pockets is usually the result of divers' exhaust bubbles.
   a. Build-up of CO_2 may make this gas deadly.
   b. Never breathe this exhaust gas.
   c. Just one more reason to avoid wearing a snorkel!
5. Halocline. A description of the interface which can occur between different layers of saltwater (each layer containing a different concentration of salt). The result can be impaired vis-ibility as you travel between these layers.

I. Hazards of the environment

> ***Learning Objectives.***
> ***By the end of this session, you will be able to:***
> - ***List the hazards typically associated with the cave and cavern environment and describe how they may affect you.***

1. Water
   a. The basic hazard in diving in water is the fact you cannot breathe it.
   b. Hypothermia. Water conducts heat away from your body far faster than air. Cold can quickly drains your strength and reasoning.
2. Ceiling. The greatest safety factor in open water diving is the fact that, no matter what else goes wrong, you can always initiate an Emergency Swimming Ascent (ESA), go directly to the surface and have all the air you need. The presence of a ceiling in caves and caverns, however, takes away this important safety factor — unless you conscientiously stay within direct sight and 40 metres/130 feet of the surface.
3. Limited space
   a. Caves and caverns often have (or are perceived to have) restricted walls, floors and ceilings.
      - This may engender a feeling of claustrophobia.
      - Passage size and configuration may also make for difficult passage.
4. Other problems associated with limited space:
   a. Restrictions. Avoid places you and your partner cannot turn around in easily. Do not put yourself in a position where, in order to exit, you and your partner must pass through an opening that is too small for both of you to swim side-by-side or piggyback.
   b. Line Traps. Make certain that the guideline does not become pulled into a crack or space that would be too small for you and your buddy to pass through in a loss-of-visibility situation.
   c. Mazes. With limited air, you can become hopelessly lost.
5. Currents. Be aware of:
   a. The direction of flow
      - Does it tend to push you out of the cavern (good!) or pull you in (not so good…)?
      - The direction of flow may not be the same in different parts of the cavern.
   b. The fact that currents may allow silt to travel with you.
   c. Tidal currents that may reverse during the course of the dive.

6. Darkness
    a. Can cause a loss of direction
    b. Increases the amount of time needed to exit or perform other tasks.
    c. Increases task-loading
    d. Increases stress
7. Any or all of the items previously identified may be present and may combine to increase the overall level of task-loading, disorientation, exertion and stress.

J. General equipment considerations for cavern diving

Learning Objectives.

By the end of this session, you will be able to:

- ***List the general diving equipment required for cavern diving.***
- ***Explain why this equipment may need to be modified for cavern diving and how such modifications may be done.***
- ***Explain the concept of redundancy as it applies to cavern diving and give examples of redundant equipment cavern divers commonly carry.***

The equipment cavern divers use is largely the same as is used in open water; however, the way in which a cavern diver uses and deploys this equipment can be very different.

Note to Instructor

It will be helpful to have a completely rigged set of cavern diving equipment on hand during this discussion for demonstration purposes.

1. Why modify equipment for cavern diving?
    a. To control trim (body position) and thus enable you to move through the water efficiently while avoiding the disturbance of silt.
    b. To streamline your equipment to eliminate drag.
    c. To avoid *danglies* (dangling equipment that has the potential to become entangled in the guideline).
    d. To increase safety and comfort in cavern.
2. Basic equipment modifications. Masks, fins and snorkels account for most line entanglements. Here is how to avoid them:

a. Masks
    - Tape mask straps to minimize potential for entanglement.
    - Wear masks inside wet-suit hoods to better secure them and lessen chance of an accidental flooding.

b. Snorkels

- Snorkels provide no additional safety yet are a major potential line-entanglement hazard.
- The only air to be found inside the cavern would be pockets of exhaust from previous divers or natural gases such as hydrocarbons and methane — all of which may not be safe to breathe.
- If snorkels are used for the trip from the shore or boat to the cavern entrance, they should be removed and clipped to the guideline, stowed inside wet suits or BCDs prior to entering the cavern.

c. Fins

- As with masks, fin straps should be taped to avoid entanglement.
- Reverse straps prior to taping them.

3. Exposure suits

a. Whether you use a wet suit or dry suit, adequate exposure protection will enable you to remain more comfortable throughout the dive and provide protection from rocks or marine growth.

b. Hoods

- Keeps head warm (high potential heat loss).
- Holds masks (if straps worn under hood) in high-flow caverns.

c. Cavern divers generally avoid using gloves unless they are absolutely necessary to prevent heat loss or avoid abrasion. Gloves interfere with your ability to feel and control the guideline.

4. Buoyancy control

a. Buoyancy-control devices (BCDs)

- All types of BCDs may be successfully used for cavern diving.
- BCD power inflators enable you to maintain complete control over their buoyancy throughout the dive. Remaining neutral during the dive is a critical part of enjoying the cavern. This technique will be discussed in greater detail later.
- BCDs with CO_2 cartridges should have the cartridge removed and the port plugged to avoid accidental firing of the cartridge, thus pinning you to the ceiling of the cavern.

b. Weights. In open water diving, weights are worn in a certain manner to create a certain effect. This is done for safety and comfort. In cavern diving, weights should be relocated for the same reason.

- Weighting goals

1) Cavern divers need to carry only the absolute minimum weight needed to establish neutral buoyancy in the cavern environment.

   a) Carrying additional weight interferes with the ability to maintain proper body position (trim) and forces the diver to make more frequent buoyancy control adjustments than would be necessary with less weight. (This is due to the fact that excess weight must be offset by a compressible air bubble in the BCD.)

2) Weights must be positioned in a manner that makes it easy for cavern divers to maintain a perfectly level or slightly head-down/feet-up body position (trim).

- How these goals may be met:

1) Cavern divers minimize the amount of weight that must be used inside the cavern by carrying and deploying drop weights.

   a) Once inside the cavern entrance, you almost never ascend to depths significantly shallower than the entrance until it is time to exit.

   b) This means that a quantity of weight equal to the buoyancy lost through exposure suit compression on the descent to the entrance may be removed from your equipment and left at the cavern entrance, to be retrieved upon exit.

   c) You typically lose 3kg/6 lbs. of buoyancy due to suit compression by the time you reach most cavern entrances. Subsequent buoyancy loss from this point on is seldom more than 1kg/2 lbs. Thus, if you detach and leave behind a 3kg/6 lbs. drop weight at the cavern entrance, you will only need to compensate for a 1kg/2 lbs. buoyancy loss while in the cavern.

   d) Use of drop weights keeps the amount of air that must be added to BCDs inside the cavern to an absolute minimum. This is important, in that compensating air is typically added to the upper half of your body. The more air added, the more you have a tendency to assume a head-up/feet-down position — one that is not only unstreamlined, but (worse) dramatically increases the tendency to disturb silt.

   e) To deploy drop weights, you vent all air from your BCDs just inside the cavern entrance, then remove and clip your drop weights to the line. If properly weighted, you should now be neutrally buoyant.

f) Drop weights are clipped to the line to ensure that you will be able to find and recover them upon exiting — even in zero visibility.

g) The reason the use of drop weights is unsuitable for open water diving is that, in open water, you cannot be assured of returning to the bottom of a descent line (or wherever drop weights may be left) to retrieve these weights prior to ascending. Were open water divers to attempt ascending without finding and retrieving their drop weights, it would be nearly impossible to maintain a proper rate of ascent or to make safety stops.

h) You needn't worry about this; the use of a continuous guideline assures that you will exit the cavern the same way you entered and, thus, always be able to retrieve drops weights that have been clipped to the line.

5. Cylinders
   a. Generally, cavern divers use single cylinders.
   b. Despite differences in physical size and air-consumption rates, all cavern divers within the same buddy pair or three-person team should use cylinders of equal *volume.*
      - This helps ensure that any member of the team — no matter how small — has a good chance of having sufficient reserve air to enable him and one other team member (who is out of air) to exit the cavern.
      - Be aware that *pressure is not the same as volume.* A 8 liter/50 cubic-foot tank filled to 276 bar/3000 p.s.i. has only 5/8's the *volume* as an 11.5 liter/80 cubic-foot tank filled to the same *pressure.*
      - Single cylinders used for cavern diving should contain at least 8 liters/50 cubic feet of air.
      - It is a common standard of practice to never enter a cavern with less than 135 bar/2000 p.s.i. regardless of cylinder size.
6. Tank valves
   a. Any type of single-cylinder valve currently manufactured is acceptable for cavern diving. No valve, however, is an acceptable substitute for a submersible pressure gauge.
   b. J valves should be taped into the *reserve-activated* position to eliminate potential false readings and potential line entanglements.
      - For this same reason, J valve rods should be removed and left on the surface.
   c. Dual-orifice valves are used by cave divers and preferred by many cavern divers.

- Dual-orifice valves allow the use of two independent regulator first and second stages.
  1) Should one regulator begin to free flow, or the first stage-to-tank valve connection be damaged, the air flow to that regulator may be turned off — thus preventing a catastrophic air loss without affecting the supply of air to the remaining regulator first and second stage.
- The dual-orifice valve for single tanks is known as a *Y* valve.

7. Regulators and alternate air sources
   a. Regulators
      - Just as in open water, single-hose regulators with submersible pressure gauges and low-pressure BCD inflators are considered the minimum acceptable air-delivery system for cavern diving.
      - Due to their role in air-supply management (adherence to the *rule of thirds*), submersible pressure gauges (SPGs) are of paramount importance in cavern diving — even more so than in open water.
      - Any regulator used for cavern diving should be capable of delivering air to *two* highly-stressed divers at depth, be meticulously maintained and free from leaks (this does not refer to *bleeder* valves that are an intentional feature of some first stage designs).
   b. Alternate air sources for cavern diving
      - Acceptable alternate air sources for cavern diving include:
        1) Conventional octopus second stages.
        2) Integrated alternate air source BCD inflators.
        3) A separate first and second stage attached to Y valves.
      - The second stage that will most likely go to an out-of-air diver in an emergency:
        1) Is to be mounted in plain site, in the triangular area recommended by PADI, and in a manner that does not allow it to dangle freely or make it likely to become caught or entangled in other objects.
        2) Is to be equipped with a longer-than-standard low-pressure hose to make it easier for this second stage to reach the out-of-air diver. Use of a 1.5-2.1 metre/5-7 foot second-stage hose is highly recommended.
      - If you use separate regulator first stages in conjunction with Y valves, the extra first and second stage is to be used in lieu of equipping the primary regulator first

stage with its own alternate air source. You should have no more than a total of two first and second stages (additional second stages only serve to increase the likelihood of free-flow).

8. Knives or cutting tools
    a. The sole function of knives or cutting tools in cavern diving is cutting the guideline when no other alternatives are available (examples: hopeless reel jams or diver entanglements).
    b. Knives and cutting tools are *never* used for sawing or prying in cavern diving.
    c. Small knives or tools are preferable; larger ones only increase the likelihood of entanglement.
    d. The three most important criteria for cavern diving knives or cutting tools are:
        - Sharpness
        - Ease of access
        - Positioning to minimize like-lihood of entanglement.
            1) Cavern diving knives or cutting tools should never be mounted on your legs — this is a prime area for guideline entanglement, even if worn on the inside of the calf.
            2) Commonly preferred mounting areas include the arms and BCD shoulder straps.
9. Dive planning/monitoring and communication tools
    a. A cavern diver is to be equipped with a means of monitoring depth, time and direction.
        - Minimum equipment set-up is one depth gauge, submersible timer and compass per diver.
        - Electronic dive computers may also be used to monitor depth and time; however, you are encouraged to carry back up instrumentation in case of computer failure.
    b. Each diver is to carry a personal set of plastic dive tables (e.g., Recreational Dive Planner), as dive computers may fail or pre-established dive plans may be unavoidably altered.
    c. Each diver is also to carry a slate to facilitate dive planning and underwater communication.
10. General considerations
    a. Streamlining
        - All equipment should be mounted and attached in such a manner as to:
            1) Avoid the possibility of entanglement
            2) Increase ease of access

- Accessory rings should be added to your equipment so that lights and reels may be clipped off at or near the base of your tanks, rather than be allowed to dangle in front of (effectively, below) you or from wrist lanyards.

b. Backup equipment (redundancy).

- Strictly speaking, the term *redundant* means *unnecessary.* However, for cavern diving, this term *redundancy* has been modified to identify the essential practice of providing backups in case essential equipment fails.
  1) No diving equipment is fail-safe.
  2) Wise cavern divers carry backups for every essential equipment system.
- Examples of redundancy common among cavern divers include:
  1) Alternate air source second stages to cover a buddy diver's regulator failure.
  2) *Y* valves and separate regulator first stages to cover the failure of one of your own regulators.
  3) One or more secondary lights to cover primary light failure.
  4) Carrying personal safety reels in case the primary reel jams or you become separated from your other team members.
  5) Backup instruments to cover computer or primary instrument failure.
  6) Carrying backup dive tables and using them to plan contingencies in case of computer failure.
  7) Compasses provide a backup navigational tool for the guideline — which is, itself, a backup for the team's own knowledge of the cavern.
- The only limit to how much backup equipment is acceptable for you to carry is when you reach the point where the risk of the extra equipment causing entanglement outweighs the risk of primary equipment failure.

K. Special equipment considerations for cavern diving

Learning Objectives.

By the end of this session, you will be able to:

- ***List the specialized diving equipment required for cavern diving and describe its purpose, features, function, selection and care.***

While most of the equipment carried and used by cavern divers is slightly-modified open water diving equipment, cavern divers also carry and use two equipment items that are not normally part of daylight open water diving. These are lights and reels.

1. Lights
   a. Standard equipment for cavern diving includes a minimum of two battery-powered underwater lights.
      - Even though the sun constitutes your primary light source, additional underwater lights allow you to see the details of the cavern better.
      - Battery-powered lights facilitate communications among dive team members.
      - Additionally, battery-powered lights provide team members with the instant ability to cope with contingencies, such as loss of visibility through silting, or accidentally leaving direct sight of the exit.
      - You should carry a minimum of a primary and a secondary light.
        1) The availability of a secondary (backup) lights speeds and facilitates exits should the primary light fail.
        2) Lights have the greatest potential for failure of all the equipment you carry; this makes carrying backup lights essential.
        3) Primary lights are generally large, powerful lights with broad beams; backup lights are typically compact lights with narrow beams (the intensity of both lights' beams over a given area, however, may be comparable).
   b. Selection criteria for cavern diving lights
      - *Burn* time (the amount of time a light is capable of providing a useful level of light or until it must be turned off to avoid damage).
        1) Primary dive lights must have sufficient burn time to equal or exceed the maximum duration of the dive.
        2) The total burn time of all lights carried must equal or exceed 150 percent of the maximum duration of the dive (this is analogous to the air rule of "one third in, one third out, one third in reserve").
        3) Ideally, each light you carry should have a potential burn time of 150 percent of the maximum duration of the dive.
        4) You most often exceed your primary lights' burn times on repetitive dives. This may be avoided by:
           a) Taking time to fully recharge rechargeable batteries between dives.

b) Carrying a spare, fully-recharged battery and switching to it before a subsequent dive.

c) Replacing nonrechargeable batteries between dives.

c. Clips and handles

- Style

1) You must be capable of grasping and controlling any light you carry and your reel in a single hand.

2) Avoid lights with *pistol* grips, as it is almost impossible to manage a light with a pistol grip and a reel in one hand simultaneously.

3) While large-diameter lights with broad beams are most desirable as primary lights, make certain they are equipped (or can be adapted to) *lantern* grips (grips that run parallel to the light's body) to ensure that they can be used in conjunction with a reel.

- Mounting hardware

1) All cavern diving lights should be equipped with clips (snap-links, etc.) so that they may be clipped to your equipment when not in use.

2) Use of wrist lanyards or any other types of string-based mounting system is a hazard when cavern diving.

3) Wrist lanyards almost inevitably become entangled in the guideline.

4) Lanyards and similar attachment systems allow lights to dangle too far below you and present a further entanglement hazard.

- Battery type

1) Rechargeable batteries

2) Rechargeable batteries are often preferred for primary dive lights as they offer a high power output and an economical cost of operation over time.

3) Rechargeable batteries may be either nickel-cadmium (nicads) or lead-acid (gel cells).

a) Nicads tend to fail quickly when discharged and must be recharged in a prescribed manner to avoid developing a memory of a partial charge and, thus, diminishing performance.

b) Gel cells have a broad power output, are less prone to damage while recharging and are generally easier to care for.

4) Rechargeable batteries tend to have a shorter overall burn time and required charging between dives. For this reason, at least one back up light should be powered by nonrechargeable batteries. (Should

your sole backup light come on accidentally during a dive, and were it powered by rechargeable batteries, it could be nearly or completely discharged by the time it was needed.)

5) Nonrechargeable batteries
   a) Preferred for backup lights
   b) May be powered by alkaline or zinc-carbon batteries.
   c) Alkaline batteries last longer, provide greater power output but burn out quickly when nearly discharged. Still, they are the primary choice for cavern diving.
   d) Zinc-carbon batteries provide a more even power-output curve, but offer a shorter life and less overall power.

2. Reels. Reels are mechanical devices used to deploy and retrieve guideline. They are perhaps the single most important piece of equipment for cavern diving.

Note to Instructor

When discussing reels and guidelines, refer to the fact that lack of a continuous guideline is the number one direct cause of overhead-environment fatalities. This helps establish a powerful need to know or value.

a. Only reels specifically designed and built for overhead-environment diving should be used in cavern diving.
b. Reel features
   - Frame. The portion of the reel that holds the spool and axle, lock nut, guide, carrying handle and clip.
   - Spool (drum). The portion of the reel that holds the guideline.
   - Axle. The portion of the reel around which the drum rotates and which connects it to the frame.
   - Winding knob. May be connected by means of a crank to the axle, or directly to the spool itself. Used to turn the spool to retrieve the guideline.
   - Lock nut. Used to prevent the spool from turning. Its purpose is to totally arrest spool movement — it is not a tension adjustment or drag.
   - Guide. A portion of the frame through which the guideline passes. Its purpose is to help prevent the guideline from jumping over the edge of the spool, thus causing the reel to become jammed.
   - Carrying handle. Used to hold and control the reel while it is being used. Must be designed so that you can hold and control both a light and the reel in a single hand.

- Clip. Used to attach the reel to another piece of equipment when it is not being used.

c. Reel types
   - Closed face. A reel in which the entire spool is enclosed in an acrylic or metal housing. Such reels very unlikely to jam; however, once jammed, they are almost impossible to unjam underwater.
   - Open face. A reel in which the spool is accessible to touch. These reels are somewhat more prone to jamming; however, it may be possible to unjam them while still underwater.
   - Either type is acceptable for cavern diving. Some divers have strong feelings as to which type they prefer; however, there is no data to suggest that one type is vastly superior to the other.

d. Reel classifications
   - Primary reel. A medium to large-capacity reel.
     1) Typical minimum capacity of 120 metres/400 feet of number 21 line.
     2) Used by cave divers to form a continuous guideline between the cave entrance and permanent lines installed within a cave system.
     3) Preferred by some cavern divers as its larger size is easier to use in conjunction with lights. (If used for cavern diving, it may be better to replace the standard guideline with one that is noticeably thicker, there is little use for so much smaller-diameter line when one is limited to a maximum penetration of 40 metres/130 feet).
   - Cavern reel. A smaller version of the primary reel.
     1) Typical maximum line capacity is 45 metres/150 feet of number 21 line.
     2) Suitable for use as a primary reel for cavern diving.
     3) Also suitable for use as a personal safety reel.
   - *Jump* or *Gap* Reel. An extremely tiny reel.
     1) Typical maximum capacity is 725 metres/5 feet of number 21 line.
     2) Used primarily by cave divers to form a temporary connection between two guidelines and for other specialized purposes.
     3) With sufficient guideline, it may be suitable for use as a personal safety reel.
     4) Generally cannot carry sufficient guideline to be used as a primary reel for cavern diving.

3. Guideline

a. Guideline characteristics
   - With few exceptions, nylon is generally considered to be the only acceptable material from which to make guideline.
   - The minimum *test* (breaking) strength for guideline is 90 kilograms/200 pounds. (Number 21 line, the smallest diameter typically used in cavern diving, exceeds this.)
   - Guideline may be either braided or twisted; braided, however, is preferred.
   - Common guideline diameters include:
     1) Number 21 (approximately 2 mm/1/16 inch). Standard on most jump, cavern and primary reels.
     2) Number 36 (approximately 2.5 mm/3/32 inch). Used on larger reels when you want a line that is easier to see, feel and control, and do not need to pack the reel with its maximum quantity of line.

b. Guidelines generally begin with a bowline knot that is large enough to pass the reel through. [Demonstrate.]
   - A noose made from a bowline knot is generally a more reliable tie-off than any snap or clip.
   - Snaps or clips are only recommended if using heavy gloves or mitts and dexterity will be reduced.
   - A small plastic ball or similar object placed at the end of the bowline loop will make the loop easier to work with and prevent the end of the guideline from accidentally passing through the reel guide.

c. Inspect guidelines frequently; replace if damaged or frayed.

L. Using guidelines

Learning Objectives.

By the end of this session, you will be able to:

- ***Define the special terminology that pertains to guideline and reel use and explain any procedures associated with that terminology.***
- ***Describe the general steps and procedures used in deploying, handling and retrieving guideline.***
- ***Explain each team member's duties and responsibilities in relation to guideline use.***

1. Special terms and related procedures

   a. Tie-off. Wrapping the guideline twice around a stationary object to prevent the line from moving. Generally done only twice — once outside the cavern entrance and again just inside.

b. Placement. Placing the guideline around an object but not wrapping it. This enables you to control the guideline but is much easier to follow and/or remove while exiting than is true when excessive tie-offs are used. [Explain that the problems with excessive tie-offs will be demonstrated very effectively during the line drills.]

c. Line trap. A crack or space into which the guideline may be pulled, as you turn a corner or pass over or under an object, that is too small for you and your buddy to pass through in a loss-of-visibility situation

d. Tension. When a line is taut, yet not under stress.
   - You must not pull on lines. Excessive tension on the guideline may cause the line to pop away from the your reach without warning. [Demonstrated during land drills.]
   - Proper tension can usually be maintained with little difficulty by just using the reel in the way it will be demonstrated throughout the course.

e. Line crossing. This term refers to divers crossing the line and what happens when lines cross one another.
   - You should cross *over* guidelines whenever possible to minimize potential entanglement.
   - One line must never cross another line, as divers who might have to follow one of those lines in a loss-of-visibility situation could easily become confused and end up following the wrong line. Should you encounter another team's guideline, keep your team's guideline well away from it.

f. Entanglement. What happens when a diver or his equipment becomes ensnared in the guideline. (This can largely be avoided through streamlining of equipment.)

g. Guideline protocol. A term referring to the standardized guideline procedures that all cave and cavern divers adhere to. Guideline protocol includes:
   - Laying line in such a manner as to avoid interfering with other divers or their guidelines.
   - Do not disturb other lines in the cavern (this also applies to other equipment which may be found inside the cavern, i.e., safety bottles, drop weights, etc.).
   - Never use another team's line without permission (possible confusion).

2. Procedures for using guidelines. [Remind students that these procedures will be demonstrated during the land drills and practiced extensively throughout the course.]

   a. Primary (initial) tie-off:
      - Made outside cavern entrance in a location that provides an unobstructed, direct ascent to the surface.

- Should you exit the cavern in zero visibility and encounter the end of their guideline (at the primary tie-off), you should be able to ascend directly to the surface from this point without running into any overhead obstructions or entanglements.

b. Secondary tie-off:
   - Made immediately inside cavern entrance.
   - Provides these benefits:
     1) Insurance against open water divers tampering with the primary tie-off.
     2) Insurance against a poorly-made, primary tie-off coming undone.
     3) Allows dive team to *sweep* the cavern from a pivot point that is inside the cavern entrance, rather than outside.
     4) Drop weights can be clipped off just before the secondary tie-off and thus be prevented from sliding further down the guideline into the cavern.

c. Other tie-offs.
   - Used only when placement cannot adequately control the line.
   - Generally considered undesirable (as will be demonstrated during the line drills).
     1) Unnecessary tie-offs cause delays during normal and emergency exits.
     2) They may also increase the risk of entanglement in high-flow caverns.

d. Placements
   - This is the most common method of controlling line position and preventing unnecessary movement.
   - When exiting the cavern, you can *reel out* without stopping to undo placements, as they come free all by themselves.

e. Reel use in conjunction with line deployment and retrieval.
   - The reel must always be turned so that the guide is on the same side of the reel as the line.
   - Facing the guide away from the line can cause entanglements if the line bundles up on one side of the spool and spills over onto the axle.

f. The team leader handles the majority of guideline deployment, handling and retrieval tasks.
   - The team leader is the first person into the cavern and the last person to exit.
   - This helps ensure that no one in the team is any farther into the cavern than the person with the reel.

g. The second team member (or buddy, in the case of two-person teams) is responsible for the following tasks:
   - Providing light for the team leader when required.
   - Re-checking line placement.
   - Removing line placements and tie-offs while exiting, whenever possible.
   - Maintaining guideline tension if the team leader is momentarily unable to do this himself. [Cite example.]
   - General assistance as required.
   - Relaying communication between the team leader and the third member, if present.
h. The third team member's responsibilities (when present) include:
   - Providing light for second team member when required.
   - Providing assistance when required.
   - Staying out of way during line retrieval unless required or requested.
   - Leading out.

3. Line following. Although the team leader bears the lion's share of responsibility when it comes to handling the guideline, other team members have responsibilities when it comes to simply following the line. They include:
   a. Staying close (within arm's reach) at all times.
   b. Avoiding physical contact with (touching, holding or pulling) the line unless absolutely necessary. The only times physical contact should be required of anyone other than the team leader include:
      - Loss of visibility
      - Team leader needs or requests assistance in handling the line.
   c. Not switching positions within team
      - The first diver in is always the last diver out.
      - The last diver in is always the first diver out.
      - The diver in the middle (if there is one) always stays in the middle.
   d. Maintaining awareness of the following:
      - Location of buddy(ies)
        1) Maintaining frequent communication with other team member(s) facilitates this process as well as helping to ensure maximum safety, enjoyment and adherence to the dive plan.
      - Location of line
      - Location of the team within the cavern

1) Frequently establishing the team's location relative to the exit can greatly enhance safety and reduce stress. In case of a loss of visibility, recalling that the entrance was clearly visible only seconds before and that it was in a certain direction, can assist the divers in following the guideline out.

4. Entanglement. Should you become entangled:
   a. Stop
   b. Signal buddy(ies)
   c. Try once to clear yourself
   d. If unsuccessful, wait for buddy to free you (a buddy can often quickly see the reason for the entanglement and correct it without making things worse.

M. Anti-silting techniques in cavern diving

Learning Objectives.

By the end of this session, you will be able to:

- ***Name the two general ways in which divers can minimize silting.***
- ***List and describe the propulsion techniques most commonly used by cavern divers, and explain why they work to minimize silt.***
- ***Define good body position for cavern diving and give examples of how it may be achieved.***

1. Propulsion
   a. Pull and glide
      - Use your hands to pull along projections from the floor or walls, then glide until the next hand-hold is located.
      - Care is needed when employing this technique as it can easily damage the cavern.
   b. Modified flutter kick
      - This is usually the easiest propulsion technique to master.
      - It is essentially comprised of only the upper half of a normal flutter kick.
      - Direct all of the thrust toward the area directly behind you, there is no down thrust to disturb silt.
      - In normal flutter kicking, the kick is from the hips while keeping the knees straight and toes pointed; in the modified flutter, keep your knees sharply bent and kick primarily from the knee joints and ankles.
   c. Push-offs (ceiling walk)
      - Use your heels to push along the ceiling.
      - Application of this technique should be limited to those locations with undecorated ceilings (no formations).

d. Frog kick
   - The same sort of kick used in the breast stroke, only with fins.
   - It may take awhile to master the technique; however, once mastered, it will seem easy and natural.
   - The frog kick is good in larger passages and as a change of pace for you to rest the muscles used in the modified flutter.

e. Other techniques
   - Many modifications of these basic techniques are possible.
   - Use what feels comfortable and effective, yet does not disturb silt or cause damage to the cavern.

f. A combination of all propulsion techniques is the most common way to move through caverns.
   - Combining techniques enables you to rest some muscles while exercising others.
   - Combining techniques also enables you to choose the individual technique that is most effective for conditions while causing the least environmental impact.

2. Body position (*trim or attitude*)

   a. The preferred anti-silting body position is either perfectly level or a slightly head-down/fins-up position, so that thrust from fins is directed away from silt.

   b. Factors that enable you to achieve this position include:
      - Buoyancy control. When buoyancy is not under control, you tend to direct thrust at the ceiling or floor in an effort to compensate.
      - Positioning of equipment. If you are tail heavy you will tend to direct thrust toward silty floors. Ways to avoid this include:
        1) Moving weights to a position higher on the body.
        2) Mounting tanks higher in your backpack or mounting system.
        3) Cinching BCD cummerbunds and shoulder straps tighter so that there is less of a tendency for loose-fitting BCDs to *ride up*, making you more buoyant toward the head. (If necessary, a crotch strap can be added to help prevent BCDs from *riding up.*)

   c. With equipment properly distributed and buoyancy under control, a diver who is in proper trim will be able to stop kicking, hover and then resume kicking without stirring up silt or sinking to the bottom.

N. Communications underwater

> ***Learning Objectives.***
>
> ***By the end of this session, you will be able to:***
>
> - ***Identify the two general methods of underwater communication in cavern diving.***
> - ***List the various types of visual signals used by cavern divers.***
> - ***Explain why cavern divers use such a multitude of communication methods -- and why sound is not one of them.***
> - ***List, describe and explain the usage and response to the light and "command" signals commonly used by cavern divers.***
> - ***Explain the significance of "command" signals.***
> - ***List, describe and explain the usage and response to other commonly used hand signals for cavern diving.***
> - ***List, describe and explain the usage and response to the five commonly used touch-contact signals.***

Effective communications at all times will make the dive safer and more enjoyable for all team members.

1. There are two general methods of underwater communication in cavern diving: sight and touch-contact.
   a. Visual signals. Signals that can be seen by other team members, and which include:
      - Light signals. To communicate general ideas easily.
      - Hand signals. To communicate more detailed information quickly.
      - Slate. To write extremely detailed messages when light or hand signals are not adequate.

   b. Touch-contact. Physical contact between divers, used to communicate when loss of visibility prevents visual communication.

   c. Why so many different methods of communicating?
      - Different cavern diving conditions may dictate the use of more than one method of communication (this is another example of the need for redundancy).
      - Having multiple communication techniques helps eliminate confusion and enables you to transmit a broader range of ideas underwater.

   d. Why not use sound (such as banging on tanks) as a communications tool?
      - The floors and walls of a cavern may absorb sound very quickly.
      - Wearing hoods may further impair hearing.
2. Command signals. These are a special set of light and hand signals that team members *must* be capable of acknowledg-

ing in a prescribed manner. If they cannot, the dive should be terminated.

a. Attention. A light signal used to gain the attention of other team members.
    - This signal is intended to be followed by other light or hand signals; no response is required other than that fellow team members pay attention to the signaler and respond to the light or hand signals that follow.
    - [Demonstrate the light signal for Attention. Explain that while various sources suggest that this signal be given in a direction different than the *Emergency* signal, the chief difference is the speed with which the light is moved back and forth/up and down.]
b. Emergency. A signal used to tell other team members that the signaler is in a dire situation; immediate response is imperative.
    - The *Emergency* signal is most often followed by the *Out of Air* signal; entrapment and entanglement are not really emergencies unless the entrapped or entangled diver is also out of air.

Note to Instructor

Demonstrate the light signal for Emergency. Remind students again that while various sources suggest that this signal be given in a direction different than the Attention signal, the chief difference is the speed with which the light is moved back and forth/up and down. Also explain that if the signaler is unsuccessful and gaining fellow team members' attention, he often begins moving his light faster and faster until the fellow team member(s) finally respond; this can lead to confusion over the severity of the situation; therefore treat rapid light movement as an emergency until you see otherwise.

c. Surface. This signal terminates the dive; it supersedes all other command signals except *Emergency.*
    - Upon receiving and acknowledging this signal, the entire team heads immediately toward their original entry point and exits through it.
    - Any hand signal that resembles the *Surface* signal must mean *Surface* — not left, right, up or down.
    - [Demonstrate the hand signal for *Surface.*]
d. Okay. This signal either asks, "Are you OK?" or answers, "Yes, I am OK!"
    - If a team member cannot return a proper *OK* signal, it indicates either a problem or poor communications; in either case, the dive should be terminated
    - Although the *OK* signal may be given as an answer to a question, there is usually no confusion as to what is meant, as it is given in response to another signal.

- [Demonstrate light and hand signals for *Okay.* Explain when a light signal would be preferred over a hand signal, and why. Also, explain that a light signal should always be answered with a light signal; a hand signal with a hand signal.]

e. Hold/Stop. This signal is used to get other team members to temporarily stop and hold their position in the water until signaled to continue.
   - May be used for a variety of reasons; consulting over changes in direction or getting team members to wait while the signaler solves a minor problem are common.
   - The dive continues only when the team member signalling *Hold* signals *OK,* and other team members acknowledge signaling *OK* in response.
   - Buddy separation and lost-diver scenarios can easily result from failure to respond to *Hold* signals; this is why it is classified as a *Command* signal.
   - [Demonstrate the hand signal for *Hold.*]

Note to Instructor

How many different light and hand signals qualify as command signals is subject to debate. A broad interpretation assumes that all light signals (including attention and emergency) are command signals. A narrower (and more common) interpretation is that only the light and/or hand signals for OK, hold and surface qualify as command signals.

3. Demonstrate and explain the usage and response to the following common cavern diving hand signals:
   a. Line
      - Tie-off
      - Entanglement
      - Cut the line
      - Reel in the line/Reel out of the cavern
   b. Trouble (or, something is not quite right)
   c. Low on air
   d. Out of air
   e. Air leak (bubble signal)
   f. One of your backup lights is on, I've switched to back up lighting.
   g. Silt
   h. Slow down
   i. Direction and which direction?
      - Explain that this is a different signal than the one commonly used in open water (to avoid confusion with the *Surface* signal).

4. *Touch-Contact.* A form of communication used primarily in zero visibility.
   a. Demonstrate and explain the usage and response to the following common Touch-Contact signals:
      - Forward
      - Backward
      - Stop
      - Line entanglement
      - Emergency (out of air)

Note to Instructor

Extensive demonstration and discussion of **Touch-Contact** *signals may be reserved for the land drills that proceed most in-water work.*

O. Psychological considerations for cavern diving.

Learning Objectives.

By the end of this session, you will be able to:

- ***Identify the factors, both positive and negative, that motivate divers to enter underwater caves and caverns.***
- ***Describe the judgement, attitude, awareness, self-evalutation and self-confidence that should be exhibited by cavern divers.***

1. Motivations. The reasons divers (trained and untrained) enter underwater caves and caverns include:
   a. Discovery
      - *Star Trek* syndrome (to go where no one has gone before).
      - To explore a new aspect of scuba diving.
   b. Enjoyment
      - You may experience unexpected peace within the dark world of a cavern.
   c. Ego gratification. This can be a positive or negative influence on team safety.
      - Self-esteem
        1) I will be the best.
        2) I wish to master technically correct dive techniques.
      - Other ego-gratification motivations:
        1) *Don't do as I do, do as I say.* What you are being told is that this diver says it is, "Okay for him to break the rules but you should not." (Actually, basic rules apply to everyone regardless of their past diving experience.)
        2) *Never go cave (cavern) diving; you will die.* This is an

example of a direct challenge to one's ego. In other words, you are being challenged to prove someone else wrong. Dive this cave, prove you are brave and don't die. Simply put, "can you resist betting your life?"

3) *If he can do it so can I!* Another example of a direct challenge. What is being said here is that, "If he is fool enough to go into a cave without proper training or equipment, then I must prove that I am at least as big a fool as he is!"
4) *Sure you can, everybody else has done it, or, If he says I'm ready, then I'm ready.* Each is a slight variation of the above; it's known as the *Big Boy Syndrome.* Someone goading you on to make a dive that others want to make. If you are not happy or satisfied with making any dive, then use any excuse you want, but back out. Take dives and caverns at your own pace. No one knows you better than you!
5) *Cheated death again!* (also known as, *I never call off a dive first!*) Thrill seekers come in all shapes and sizes. These people are completely rational in all other aspects of their lives but suddenly become ego maniacs when they spot an underwater cave. They must prove, beyond any shadow of doubt, that they are stupid and need to reconfirm this by enticing others to follow them until someone else is ready to quit.

d. Conclusion. People explore caverns and caves for any number of reasons. It is not necessarily a good practice to assume that your dive partner's reason for exploring is void of excess ego. Motivation for the dive often sets the tone and pace of that dive. Accepting varied motivations can help to prepare us to evaluate the dive as it unfolds. Whatever reason chosen to explore it must not lure the diver away from basic safety practices.

2. Judgment. Should be limitation oriented.
   a. Mature judgment, along with a free and clear mind, is the most important piece of diving equipment you possess.
   b. Prioritize safety before fun; use the limits of the course to form the basis of a dive plan — then revise the plan to account for any unknown variables. Don't be lured beyond capabilities, equipment and training.
3. Attitude. Cavern diving is a continuous learning experience. It should be approached gradually and thoroughly. Your attitude in this respect is a key to continued safe practices for both you and your buddy.

4. Awareness. You must be sufficiently observant and at ease with yourself before cave or cavern diving. As this awareness of yourself develops, you are developing a similar awareness for your buddy. Only through this practice can you be confident that you know your own limitations and act on them.
5. Self-evaluation. Although not a true psychological factor, this goes hand in hand with all of the above and is significant in continued self-improvement. Know your limits, gradually work to expand those limits, but do not exceed them.
6. Self-confidence. Remember that any team member call off a dive at any time for any reason.

P. Stress factors — their sources and effects in cavern diving.

Learning Objectives.

By the end of this session, you will be able to:

- ***Identify and describe the psychological and physical sources of stress in cavern diving.***
- ***Explain how to recognize the presence of stress in yourself and others.***
- ***List the stages of reaction to stress.***
- ***Describe how to cope with stress while cavern diving.***

What is stress? Pressure from the outside which can make you tense on the inside. It is a fact of life.

1. Psychological stress sources:
   a. Time pressure
      - "Aren't you ready yet?"
      - Also, in problem situations, there may be a keen awareness of the fact that the amount of air remaining to exit the cavern and complete a task, etc. is the key determinant of the time remaining to do so.

   b. Task-loading
      - Run reel, hold light, watch line, depth, time, buddy, etc.

   c. Directional requirements
      - "Which way is out of cavern?"

   d. Ego threat
      - Peer pressure. "Everyone else dives this cavern"
      - Big Boy Syndrome. "If he says I'm ready then I must be."

   e. Self-doubt
      - "What am I doing here?"
2. Physical threats (stress) sources:
   a. Exertion and cold. Cold and fatigue will tend to impair thinking and physical performance.

b. Equipment out of adjustment. If you spend your dive fighting gear, how can you be aware of anything else?
c. Buoyancy. If you are alternating between crashing into the ceiling and burying yourself in the mud, is something wrong? You bet there is!
d. Loss of visibility. If you are unable to see, what else is important?
e. Sufficient air. If you can't breathe (real or imagined) then nothing else matters. Knowledge of an adequate air reserve may calm you sufficiently to deal competently with an emergency.

3. Recognizing stress
   a. In yourself:
      - Discomfort. May be physical or psychological (and rarely do things get better!).
      - Fatigue. Rest (stop dive).
      - Loss of concentration. Anything that disturbs the dive is stress.
      - Frustration. Continued agitation with anything before or during the dive.
   b. In others:
      - Perceptual narrowing. Concentrating only on one item (e.g., line).
      - Clumsy behavior. Dropping things or poor technique.
      - Loss of awareness.
        1) Loss of concentration.
        2) Clumsy behavior.
      - Frustration. Continued agitation with anything before or during the dive.
      - Pupil dilation. Pupils increase in diameter (also referred to as a glazed look or a *vacant stare*).
      - Constant monitoring of equipment. Switches repeatedly from submersible pressure gauge to watch to depth gauge, etc.
      - Lack of equipment monitoring. Ignores gauges and other vital sources of information.
4. Reactions to stress. This takes place in three stages:
   a. Masking of stress. Subject ignores stress; pretends that it will go away.
   b. *Fight or flight* syndrome. Subject is just barely in control.
   c. Panic. Complete loss of mind/body coordination.
5. Coping with stress:
   a. Accept that a certain level of stress will always exist during cavern dives.

- In the right quantity, stress it is good for you, as it heightens awareness of the need to follow proper procedures.

b. Practice all cavern diving skills until their proper execution is second nature.
   - Place special emphasis on the practice of emergency procedures, such as loss of visibility or interruption of air supply.
   - Don't wait to discover, through a real emergency, that your skill level is inadequate.

c. Remember that only divers with clear minds, relaxed bodies and thorough self-awareness of their own limitations can effectively cope with stress.

Q. Cavern diving procedures (Predive)

Learning Objectives.

By the end of this session, you will be able to:

- ***List and describe the steps involved in planning cavern dives.***
- ***List and describe the equipment checks and other predive activities that must take place prior to entering underwater caverns.***

1. Predive planning:

   a. Dive-buddy evaluation. Plan dive around least experienced team member, not most experienced. Avoid pushing the least experienced beyond his capabilities.

   b. Avoiding goal-oriented dives. Cavern diving should be an enjoyable activity. If you are pushing to obtain some specific goal then safety of the team may be compromised.

   c. Self-evaluation. Set your own limits; let these limits be known to fellow divers.

   d. Choosing dive sites. Gather information from:
      - Divers who have been there
      - Dive centers whose staff members are familiar with sites.
      - Regional dive guides

   e. Equipment considerations. Do the following:
      - Develop a check list using the list of minimum cavern diving equipment described in this outline.
      - Ask yourself if any special equipment/logistics be required (boats, etc.)

   f. No decompression dive planning. Be capable of establishing accurate no decompression limits for single and repetitive dives.

   g. Establishing dive (team) limits. No dive should begin without team members first agreeing upon and writing down the following limitations (SADDD):

- *Sequence.* Who leads, who brings up the rear, who (if anyone) is in the middle?
- *Air.* Personal air turn-around points for each team member; as soon as any team member hits his turn-around point, the dive is called off for everyone.
- *Depth.* Recommended maximum allowable depth for this dive not to exceed 21 metres/70 feet.
- *Duration.* Maximum allowable time limit for this dive should not exceed one-third the applicable no decompression limit.
- *Distance.* What is the maximum distance you wish to penetrate should not exceed 40 linear metres/130 linear feet from the surface nor take divers out of direct sight of the entrance.
- *Additional limitations.* Be prepared to deal with the following:
  1) Contingency planning. Team members must be prepared to cope with accidentally exceeding depth and time limits.
  2) Cavern configuration limit. Cavern may turn out to be a more complex location then originally planned for.
  3) Experience limitations. Dives may turn out to be beyond the personal limitations of some or all team members.

2. Dive site inspection (conducted before gear is assembled):
   a. Water conditions. What are the visibilities, flow characteristics, etc.?
   b. Entrance considerations. What difficulties might you encounter getting in or out, and how do you avoid these potential problems?
   c. Cavern location. Where is it, relative to the apparent entrance?
3. Equipment check (prior to suiting up):
   a. Equipment should be checked for completeness and function twice before suiting up, prior to leaving home and again at the dive site (it will be checked a third time near the water).
   b. After assembling equipment at the dive site, and before actually suiting up, team members should check each other's equipment for completeness and function. This may be done using the *matching* procedure described next.
4. Equipment check (immediately after entering water and before entering cavern):
   a. Method. Cavern divers use the matching method of checking equipment. Working from head to toe, team members

simultaneously check a designated piece of equipment for completeness and function. The fact that a piece of equipment is present and functions properly (examples: lights, BCDs, regulators) is demonstrated to fellow team members.

b. What to check and what to look for:
   - Masks. Loose straps taped, if necessary.
   - Air. All valves turned completely on.
   - Regulators and SPGs. Breathe from each second stage with face submerged and while looking at the submersible pressure gauge (needle should not move; minimum starting pressure is 135 bar/2000 p.s.i.).
   - Hoses. Neat and untangled.
   - BCDs. Both inflation and deflation mechanisms should function smoothly.
   - Lights. Check primary first, then back ups. Demonstrate to fellow team members that:
     1) You can get to each light . (It is okay to require a team member's assistance when snapping a back up item in place; however, you should be able to get to and remove that item without assistance.)
     2) Each light can be turned on easily and burns with a bright beam.
   - Reel. Demonstrate to fellow team members that you can easily get to your reel(s).
   - Other items to be checked in a similar manner:
     1) Instruments (depth, time, direction)
     2) Knife
     3) Slate/pencil
     4) Fins
     5) Drop weights
   - Bubble check. Have team members drop below the surface one at a time. A fellow team member should then check for air leaks. The team member being checked should be breathing through his/her regulator while this is taking place. Areas to pay particular attention to include:
     1) Regulator-to-tank connection
     2) Extra second stages
     3) BCD bladders and inflation/deflation hardware.
   - Dangle check. Each diver hovers in shallow water; look for *danglies* (equipment items that hang substantially below your body).

c. After conducting equipment/bubble/dangle checks, surface and make corrections.

d. S-Drill. *Safety* or *Share Air* drill; used to establish each team member's readiness to deal with an out-of-air emergency. Conducted as follows:
   - Two team members at a time submerge in shallow water; the agreed-upon team member signals *Out of Air.*
   - The other team member (now acting as donor) assists in deploying one of his/her second stages as agreed upon ahead of time and indicated by equipment configuration.
   - Divers share air in a stationary location while moving into touch-contact position.
   - When ready, divers proceed to swim a short distance while remaining in touch-contact position.
   - This exercise is repeated until all team members have had the opportunity to act as both donor and receiver. If difficulties are encountered, divers should surface, discuss them, then repeat the exercise until it goes smoothly. If done correctly, the S-Drill helps ensure that no unpleasant surprises crop up should an actual out-of-air emergency occur.

Note to Instructor

After students have clearly established their ability to share air in touch-contact position, it is an increasingly common practice to allow them to begin subsequent dives with a modified S-Drill. *This involves team members simply breathing from each other's extra second stage without deploying the extra-long hose or assuming touch-contact position.*

A modified S-Drill establishes that all team members have an extra second stage that is functioning properly and helps identify any second stages that have unusual characteristics. It does not, however, establish how extra-length hoses deploy and how divers would position themselves for touch-contact.

The chief benefit of allowing students to perform only modified S-Drills after the initial phases of the course is that it presents students with a more realistic reflection of the real world of cave and cavern diving. After training, students quickly discover that many real *overhead-environment divers do not begin every dive with a complete S-Drill. If students are not aware of alternatives to doing a complete S-Drill, they may forego doing any sort of S-Drill, rather than look foolish. The modified S-Drill gives them a real-life alternative.*

If you choose to allow students to perform modified S-Drills later in the course, emphasize that a complete S-Drill should be performed the first time they dive with a new buddy, or any time they have not been cavern diving for more than a few weeks. A minimum of a modified S-Drill should be performed prior to every dive, without exception.

e. Establish air turn-around points:
   - Initial considerations:
     1) Ideally, all team members will be using identical cylinders (cylinders that hold the same volume of air at any given pressure). This greatly simplifies the process of determining air turn-around points and reduces the likelihood of error.
     2) If team members are using cylinders of varying sizes, each team member must be able to convert his starting pressure into a volume measurement (i.e., litres or cubic feet). This will enable team members to calculate turn-around points based on actual starting volumes.
     3) Turn-around calculations must take into account the team member with the smallest starting air volume. Despite differences in air consumption, this person must always have sufficient air to get both himself and the heaviest-breathing team member out of the cavern.
     4) Minimum starting pressure. 135 bar/2000 p.s.i., regard-less of cylinder size. It is best to begin dive with full cylinder.
   - Methodology:
     1) Team members begin by converting starting pressures to a comparable unit of measurement (pressure, by itself, is acceptable only if using identical cylinders; otherwise, convert to volume measurements).
     2) The team member with the smallest starting volume should round his number *down* until it is easily divisible by three.
     3) *All* team members should subtract one-third of this number from their actual starting volume. The result is their own personal turn-around point.

Note to Instructor

Have students work several sample air turn-around problems until they are able to do so without error. Caution students that the most common errors in such calculations are: 1) Using a one-third figure that reflects their own starting air volume — not that of the team member with the lowest starting volume. 2) Subtracting the one-third figure from the number that the actual starting volume was rounded to — and not the actual starting volume itself.

f. Review communications (may change from diver to diver):
   - Light signals: *Attention*, *Emergency* and *OK*

- Hand signals (Command)
- Hand signals (General)
- Touch-contact signals

g. Review dive plan:
   - Make certain that each team member has written down accurate data for Sequence, Air, Depth, Duration and Distance (SADDD).
   - Confirm that *any one may call off the dive any time for any reason.*
   - Announce and write down time of descent before leaving the surface.

R. Accident Analysis

Learning Objectives.

By the end of this session, you will be able to:

- ***State the major cause of cave diving related accidents.***
- ***Apply cave diving accident analysis information in such a manner as to help avoid a cavern or cave diving mishap.***

A study of past cave-diving-related accidents has revealed some very significant information as to why people die in caves. Applying this information can aid you in deciding on some general parameters for cavern diving.

1. Training:

   a. Ninety-five percent of cave/cavern diving fatalities involve divers with no formal training in either cave or cavern diving. (Nearly 10 percent of these individuals were Open Water instructors!)
      - Recognize that no amount of past open water diving experience, or training for diving activities other than cave or cavern diving, can adequately prepare you for diving in natural overhead environments. This is why formal training for cave and cavern diving is imperative.
      - Do not take others cavern diving unless they, too, have had formal training and certification in cavern diving.

   b. Among the small number of deaths that have involved certified cave and cavern divers have been instances in which divers attempted to go beyond their current level of training.
      - Realize that this course prepares you to dive within a very specific set of limitations involving depth, time, distance from surface, visibility, etc. Going beyond these limits requires additional training and takes you beyond the realm of purely recreational scuba diving.

- Understand also that many factors may dictate staying within even more conservative limits. Such factors may include environmental conditions and personal abilities.

c. At least one fatality involving a certified cavern diver involved an individual who had not made any cavern dives between his cavern diver course and his death, some 15 months later.
   - Be aware that cavern diving involves many highly specialized skills that are not used during normal open water diving. These skills erode quickly if not used on a regular basis.
   - Seek the opportunity for refresher training any time you have not been cavern diving for more than a short period of time.

2. Guideline
   a. Failure to run a continuous guideline to open water is the leading cause of fatalities in underwater caverns and caves. Without a continuous guideline to guide them to the exit, accident victims easily become lost in maze-like passageways or experience poor visibility and run out of air before they can exit.
      - Always run a continuous guideline that connects you and your fellow team members to a point in open water where you can make a direct, uninterrupted ascent to the surface.

3. Air
   a. Failure to keep sufficient air in reserve is the second leading cause of cave and cavern diving fatalities.
      - Always keep at least *two-thirds* of each diver's starting air supply in reserve to exit the cavern.

   b. Bear in mind that a two-thirds reserve provides the absolute minimum required for two divers to exit *under ideal conditions.* It may also provide an inadequate reserve for *one diver* to exit under adverse conditions.
      - Depending on conditions, many cave and cavern divers keep an even greater quantity of air in reserve than allowed for by the two-thirds rule.

4. Depth
   a. The problems associated with going deep on compressed air in open water are magnified in overhead environments. The third leading cause of all cave and cavern diving fatalities *and the leading cause among certified cave and cavern divers* is going below a depth of 40 metres/130 feet on compressed air.
      - Under no circumstances go beyond 40 metres/130 feet while breathing compressed air — particularly in an overhead environment.

- Remember that the maximum recommended depth limit for cavern diving is 21 metres/70 feet.

5. Lights
   a. Lack of adequate light is a major contributing cause to cave and cavern diving fatalities. Lack of adequate light increases stress and may cause divers to make more serious mistakes.
      - Remember that the sun is your primary light source for cavern diving; there is no such thing as a night cavern dive.
      - Keep the cavern exit clearly in sight at all times; do not rely merely on the glow of light from the exit — it will disappear quickly in a silt out or if you accidentally turn a corner.
      - Make certain all team members use battery-powered lights of comparable intensity. To do otherwise makes communicating difficult.
      - Keep at least one battery-powered backup light in reserve to help exit the cavern. As soon as you switch to your last backup light, it is time to call off the dive.
6. To recall the rules of Accident Analysis, use this phase: "Thank Goodness All Divers Live" (Training, Guideline, Depth, Air, Lights).

S. Emergency procedures

Learning Objectives.

By the end of this session, you will be able to:

- ***Explain the appropriate emergency procedures to be followed for loss of visibility or light source, loss of air supply and lost-diver scenarios.***
- ***Explain how the rules of accident analysis can be used to prevent or solve additional emergency situations.***

Because Accident Analysis explains how accidents occurs, it also shows us how to prevent them.

1. Stay within the limitations of your training and abilities.
   a. Set personal limits and stay within them.
   b. Do not encourage others to exceed their personal limitations.
   c. Do not take untrained divers cavern diving.
   d. Seek additional training before going beyond the limits of the Cavern Diver course.
   e. Practice vital skills on a regular basis.
   f. Seek refresher training after periods of inactivity.
2. Run a continuous guideline that connects you and your fellow team members to a point in open water where you can make

a direct, uninterrupted ascent to the surface. Prepare for these guideline-related contingencies by being able to implement the following procedures:

a. Visibility loss:
   - Make physical contact with the guideline (*OK* on line).
   - Turn to face the exit.
   - Wait for buddy(ies).
   - Establish touch-contact communication.
   - Exit.

b. Primary-light failure:
   - Stop.
   - Make physical contact with the guideline ("OK" on line).
   - Activate back up light.
   - Signal buddy(ies).
   - Exit.

c. Lost diver (a fellow team member is separated from the guideline):
   - If you have not already done so, stop and make physical contact with the guideline ("OK" on line), so that you do not become separated from it as well.
   - Cover your light by holding it against your chest, then take a second or two and look for the lost diver's light. (Never simply turn a light off in a cavern; switch malfunctions are the most common cause of light failure.)
   - Sweep the cavern with your light (your buddy may see your light before you can see his).
   - Make a tie-off at the point where you first realized a team member was missing. Using this as a pivot point, search the immediate area with the guideline. This increases the effective area in which you can look for the lost diver — without pulling the guideline away from where the lost diver may already be.
   - Do not jeopardize your safety   searching for a buddy who may have already exited the cavern. (Your agreed-upon procedure should be to meet at the entrance after one minute of separation.) After searching for no more than one minute, leave the reel tied off the point at which you realized the team member was missing and exit. Should the lost diver come across the same spot later, he will find a reel in place to help him exit.
   - If you do not meet the lost diver at the exit after a reasonable period of time:
     1) Alert other cavern or cave divers, if they are present. Let better-trained or more-experienced divers conduct any subsequent searches, if possible.

2) Re-enter the cavern to continue the search only after recalculating air, depth and time limitations — and if accompanied by another qualified cavern or cave diver (having one diver already alone in a cavern or cave is bad enough; don't compound the situation by fancying yourself a solo Rescue Diver).

3) Do not allow a lost-diver search to take you beyond accepted cavern diving limitations, or the personal limitations of yourself or fellow rescuers.

d. Lost diver (you are the diver missing from the line):

- Stop as soon as you realize you are lost, then take a few moments to gather your thoughts.
- Cover your light by holding it against your chest, then look for the glow of your fellow divers' lights and/or the entrance.
- Sweep the cavern with your light to see if you can locate the guideline and/or fellow team members.
- If you cannot locate the exit, fellow team members or the guideline, ascend to the ceiling, wait for localized silt to come out of suspension, then try again.
- If you still cannot locate the exit, fellow team members or the guideline, look for additional clues as to the direction of the entrance. Such clues may include:
  1) A silt trail across the floor.
  2) A bubble trail across the ceiling.
- After tying off your personal safety reel (to ensure that you can return to the point at which you first realized you were lost), use your compass to locate the most likely direction to the entrance.
- As you move toward what you believe is the exit, observe the direction the current is moving (it usually flows toward the exit).
- If unsuccessful in locating the entrance after searching a reasonable distance, use your personal safety reel to return to your starting point and try again.

3. Always keep *at least* two-thirds of each diver's starting air supply in reserve to exit the cavern. Prepare for these air-related contingencies by being able to implement the following procedures:

a. Loss of air

- Signal *Emergency*, followed by *Out of Air.*
- Share air using alternate air source.
- Make physical contact with the guideline (*OK* on line).
- Establish touch-contact communication.
- Exit.

b. General problem-solving
   - Remember that your reserve air determines the amount of time you have available to solve problems.
   - Do not compromise your reserve air by using it to unjam a reel, locate lost divers, etc. — you may need it for yourself.

4. Stay within the depth limitations for cavern diving:
   a. Do not go beyond 40 metres/130 feet while breathing compressed air.
   b. The maximum recommended depth limit for cavern diving is 21 metres/70 feet.
5. Observe the rules and guidelines for use of lights in caverns:
   a. The sun is your primary light source; keep the cavern exit clearly in sight at all times.
   b. Make certain all team members carry at least two battery-powered lights. As soon as one team member switches to his last back up light, it is time to call off the dive.
   c. [Refer to procedures for loss of primary light source and loss of visibility.]

T. Summary

1. [Review the rules of Accident Analysis using the phrase "Thank Goodness All Divers Live."]
2. [Review the limits of Cavern Diver training.]
   a. Able to see the exit clearly at all times
   b. No more than 40 metres/130 feet from surface
   c. Recommended depth 21 metres/70 feet
   d. Within the no decompression limits
   e. No restrictions

V. Equipment Modification Workshop

Note to Instructor

The equipment modification workshop is to take place prior to any in-water sessions. The following information assumes that the instructor is familiar with current standards of practice in equipment modification for cavern diving.

It may be helpful to use your own personal equipment as a model of equipment modification. Remind students that no modification should in any way interfere with the designed function of regulators, BCDs, instrumentation or other vital pieces of equipment.

A. Overview

Cavern divers use standard open water diving equipment that has undergone minor modifications to increase its suitability for cavern diving. This workshop enables students to make these modifications to their personal equipment prior to the first in-water session.

B. Modifying equipment for cavern diving enables you to achieve several goals. These goals include:

1. Eliminating or minimizing many possible sources of entanglement.
2. Modifying regulators hoses, instrument consoles, lights, reels and other equipment so that it does not dangle below your body while in a horizontal position underwater.
3. Shifting your center of gravity to make it easier to achieve a perfectly horizontal body position underwater.
4. Making equipment more accessible.
5. Streamlining yourself for easier movement through the water.

C. Modification checklist

1. Mask
   a. Snorkel removed (or removable, prior to entry to cavern)?
   b. Excess strap secured (retained/taped/tucked under hood, etc.)?
2. Fins
   a. Excess strap taped?
3. Exposure suit
   a. Adequate for environment/activity?
4. Cylinder
   a. Mounted high enough to ensure balanced center of gravity?
   b. Pressure at least 135 bar/2000 p.s.i. or equivalent?
   c. Accessory rings installed at base of cylinder if required to prevent lights and reels from dangling below diver?
5. Regulator and alternate air source
   a. Floating dust cap removed and stored separately?
   b. Alternate air source second stage secured/used in plain sight?
   c. Extra-length second-stage hose routed for easy deployment and minimal possibility of entanglement?
6. Instruments
   a. Adequate means of monitoring depth, time and direction?
   b. Console mounted in such a manner that it does not dangle?

7. BCD
   a. Secure fit?
   b. Center of buoyancy close to center of gravity?
   c. Inflation/deflation hose prevented from dangling and easily accessible?
   d. CO_2 port plugged?
8. Weight system
   a. Only minimal weight used?
   b. Drop weights considered?
   c. Weight distributed for better balance?
9. Knife
   a. Small in size and sharp?
   b. Moved to arm, BCD shoulder strap, pocket — anywhere but on the leg?
   c. Able to cut guideline quickly and easily?
10. Slate/pencil/plastic dive tables
    a. Present and easily accessible?
    b. Stored in pocket (not dangling)?
11. Lights
    a. Primary light:
       - Of comparable intensity to those of other team members?
       - Lantern grip (instead of pistol grip)?
    b. Sufficient back-up lighting?
    c. All lights secured bolt snaps (no swing gate clips or lanyards)?
12. Reel
    a. Able to be used in conjunction with lights?
    b. Secured with bolt snaps?
    c. Adequate guideline?
13. General
    a. Attachment hardware reliable?
    b. Legs/feet free of sources of potential entanglement?
    c. All equipment easily accessible?
    d. Equipment distributed for balance/streamlining?

VI. Land Drills

A. Demonstrate basic guideline and reel usage

1. Review guideline and reel terminology
2. Demonstrate the following while laying a line course typical of a normal cavern dive:

a. Primary tie-off
b. Secondary tie-off
c. Placements to:
   - Avoid line traps
   - Optimize ease of following guideline to entrance
d. Proper procedure for calling off the dive and reeling out of cavern.
e. Dive buddy providing light and assistance as needed.

B. Have students practice line-following procedures

1. Establish a line course of approximately 60 metres/200 feet in length that provides a good example of what *not* to do, including:
   a. Leaving sight of cavern entrances
   b. Passing through restrictions
   c. Making unnecessary and poorly-made tie-offs
      - Poorly-made tie-offs may include too many or too few wraps, wraps around objects that are too big.
   d. Crossing lines
      - Spacing crossed lines several inches/centimetres above or below one another adds the realism of three-dimensional space to the problem.
   e. Allowing line to pass into line traps
2. Have students walk this line course once, timing themselves.
   a. Emphasize normal line-following procedures (students should not touch line).
3. Have students walk the line course again with their eyes closed, while timing themselves.
   a. Demonstrate acceptable methods for maintaining contact with line (*OK* on line) prior to conducting this exercise.
      - If students fail to maintain proper contact, snatch the guideline from their grasp. (This generally provides the necessary reinforcement of the need to maintain positive guideline contact.)
   b. Caution students to keep one hand in front of themselves and to step carefully.
      - Close supervision of this exercise is recommended as students may hurt themselves when unable to see.
   c. [Optional] Add a false lead to the line course while students' eyes are closed.
      - This can be used to further emphasize the undesirability of unnecessary tie-offs. (Tie-offs must be negotiated in a specific manner to reduce the risk of being misled by false leads.)
   d. If your line course does not include false leads, demon-

strate the proper procedure for negotiating tie-offs while following a guideline in low visibility.

- If your line course includes false leads, you may demonstrate this *after* students have had to negotiate one.

e. Have students compare the time it took to follow the line with their eyes closed to the time it took to do so with their eyes open.

- This provides a very forceful demonstration of the fact that even two-thirds of a diver's starting air supply may not be adequate to exit a cavern when the diver cannot see.

4. Demonstrate touch-contact procedures, including:
   a. Positioning
   b. Signals:
      - Forward
      - Backward
      - Hold
      - Line entanglement
      - Emergency/out of air
   c. Line-crossing procedures
   d. Procedure for disentangling another diver
   e. Procedure for negotiating a tie-off while following a guideline in low visibility, using touch-contact communication.
5. Have students navigate the circuit in buddy teams, with their eyes closed, using touch-contact communication.
   a. Repeat this exercise at least twice, so that each student gets to be both leader and follower.
   b. You may want to have students negotiate the line course in the reverse direction on the last pass.

C. **Retrieve the line course.** This may provide you with additional opportunities to:

1. Demonstrate proper buddy communication and interaction while reeling out of a cavern.
   a. Emphasize the need to give the team leader/reel person adequate space to work.
   b. Reinforce the need to maintain tension while reeling out; demonstrate techniques for doing so.
2. Show how team members can temporarily remove slack from a guideline until the team leader/reel person has the opportunity to re-establish tension.
3. Demonstrate what happens when the reel person has to pause to remove an unnecessary tie-off while exiting a high-flow system.

a. The current may turn the reel person around while he is undoing the tie-off.
b. Before the reel person can re-orient himself to the exit and re-establish tension on the line, considerable slack may be created.

D. At the conclusion of these exercises and demonstrations, each buddy team is to practice guideline and reel usage on their own. To do this, students are to lay out a line course typical of an actual cavern dive, including:
1. Primary tie-off
2. Secondary tie-off
3. Placements
4. Buddy-interaction and communication
    a. Students should repeat this exercise so that each team member has the opportunity to act as both team leader and second team member.

VII. Water Sessions

Note

For clarity, each in-water training dive is outlined completely. The procedures specific to an individual dive appear in boldface type.

A. Training Dive One (Demonstration Dive)

Performance Requirements.

By the end of this session, you will be able to:

- ***Conduct a proper predive equipment check and S-Drill.***
- ***Demonstrate at least three effective anti-silting propulsion techniques.***
- ***Demonstrate proper weighting, buoyancy control and body position for cavern diving.***

1. Briefing
    a. Evaluate the conditions
    b. Facilities at the dive site
    c. Entry technique and location
    d. Exit technique and location
    e. Layout of the cavern
    f. Depth ranges
    g. Interesting and helpful facts about the dive site
    h. Sequence of the training dive — review Dive One tasks.
        - Equipment check (shallow water)
        - S-Drill (must be done outside cavern zone)

- Review dive plan [instructor supplies parameters for Sequence, Depth, Duration and Distance]
- Announce and record time of descent; meet at cavern entrance.
- Instructor demonstrates proper guideline and reel use.
- Students check for proper weighting, buoyancy control and body position.
- Instructor demonstrates at least three propulsion techniques; students practice each.
- Exploration of cavern [optional]
- Dive called off when:
  1) All tasks completed and instructor signals, or…
  2) Any participant reaches pre-established limits, or…
  3) Any participant gives Surface signal.
- Class exits cavern.
- Shallow-water line drills. [These may be conducted at the end of Dive One, prior to Dive One or afterward; however, the shallow-water line drills must be completed prior to Dives Three and Four.]
- Exit water.

i. Special communications or signals

j. Remind students of standard lost-diver procedures for cavern diving.

k. Review key cavern diving emergency procedures.

2. Buddy assignments
3. Predive procedures
   a. Prepare personal equipment
   b. Don personal equipment
   c. [Equipment/buddy checks are performed in shallow water after entering.]
   d. Proper entry
4. **Dive One tasks:**
   a. In shallow water, instructor demonstrates equipment check, S-Drill; students then practice these skills under instructor supervision.
   b. Students calculate air turn-around points.
   c. Instructor and students review, critique and agree upon dive plan; announce and record time of descent.
   d. Students descend and assemble at cavern entrance.
   e. Instructor demonstrates primary tie-off and preparation/agreement to enter cavern; students enter cavern following instructor.
   f. Instructor demonstrates secondary tie-off; students

inspect as they pass, leaving drop weights clipped to the guideline [usually just in front of the secondary tie-off].

g. **Instructor demonstrates guideline use by laying circular line course around cavern; students follow and inspect.**

h. **Instructor checks students weighting; makes adjustments as needed [assessment of students' body positions and buoyancy-control takes place here and throughout the dive].**

i. **Instructor demonstrates at least three anti-silting propulsion techniques; students practice each technique after it is demonstrated, following the circular line course around cavern.**

j. **Tour of cavern**

k. **Instructor signals Surface if not previously called by student.**

l. **Students exit cavern, retrieving drop weights along the way; instructor retrieves guideline and exits.**

5. Ascent, exit water.
   a. Upon exiting the cavern, make a three-minute safety stop at 5 metres/15 feet, as indicated.
   b. [If not conducted at another time and place, instructor may conduct shallow-water line drills immediately at the conclusion of this dive. If this is done, the instructor should conduct an immediate postdive debriefing in waist-deep water, prior to proceeding with the shallow water line drills.]
6. Postdive procedures
   a. Make an exit appropriate for the environment.
   b. Stow equipment and exchange tanks as appropriate.
   c. Calculate pressure group at the end of the dive.
7. Debriefing [may take place in shallow water immediately upon surfacing].
   a. General comments on dive:
      - Key points to remember regarding guideline and reel usage and general cavern-diving procedures.
      - General comments regarding weighting, buoyancy control and body position.
      - Key points regarding propulsion techniques.
   b. Students' assessment of their own performance.
   c. Identification of specific problems; suggestions for improvement.
8. Log dive (Instructor signs log)

B. Training Dive Two (Establishing a shallow-water line course)

Performance Requirements.

By the end of this session, you will be able to:

- ***Demonstrate appropriate emergency procedures for loss of visibility and light source.***
- ***Follow a guideline of approximately 60 metres/200 feet while underwater.***
- ***Maintain contact with a guideline while performing touch contact buddy system procedures.***
- ***Demonstrate proper use of a reel including:***
  - ***Primary tie-off***
  - ***Secondary tie-off***
  - ***Placements***

Prior to commencing this exercise, the instructor establishes a line course of approximately 60 meters/200 feet in shallow, open water. This course should mimic the one used for the land drills in many respects, but not include any features that will unnecessarily frustrate students, nor that will endanger them in any way. Appropriate features may include:

- Changes in depth
- Unnecessary and/or poorly-made ties-offs
- Line crossings
- False leads

1. Briefing
   a. Explain to students that they will now be repeating the exercises conducted during the land drills in shallow, open water, using a line course that you have laid out. [Make any special comments regarding your particular open water line course as appropriate.] These exercises will include:
      - Students swimming the circuit once with their eyes open, to learn its general layout, location of tie-offs and placements, etc.
      - Students repeating the course once by themselves, with their eyes closed [under close instructor supervision].
      - Students next negotiating the circuit with their buddy(ies), eyes closed, using touch-contact communication.
      - Students now reversing roles (leader becoming follower, etc.) and negotiating the circuit, eyes closed, using touch-contact communication *and while sharing air.*

b. At the end of each circuit, the instructor may have students surface to hear comments on their performance and suggestions for improvement.

c. Students will traverse a new circuit (may be the same circuit, run in reverse), with eyes closed, using touch-contact communications and while sharing air. The former donor will become the new receiver and vice-versa.

d. At the conclusion of these circuits, each buddy team is to practice guideline and reel usage in shallow, open water. To do this, students are to lay out a line course typical of an actual cavern dive, including:

- Primary tie-off
- Secondary tie-off
- Placements
- Buddy-interaction and communication
  1) Students should repeat this exercise so that each team member has the opportunity to act as both team leader and second team member.

2. Conduct

a. After briefing the activity, have students proceed as outlined.

b. Provide close supervision whenever students have their eyes closed, as they are not able to adequately care for themselves while unable to see.

c. Provide frequent comments, suggestions and encouragement throughout the exercises. These activities can be very frustrating to students unless adequate instructor guidance is provided.

3. Debriefings

a. Periodic debriefings of specific exercises are provided throughout the shallow-water line drills.

C. Training Dive Three (Line/reel work dive)

Performance Requirements.

By the end of the sessions, you will be able to:

- ***Construct a dive plan for a cavern dive that accounts for a minimum of team sequence, air turn-around, maximum depth, dive duration and penetration distance.***
- ***Demonstrate primary and secondary tie-offs, placements and general guideline and reel use in a cavern environment.***
- ***Provide adequate support to a diver who is acting as team leader/reel person.***
- ***Demonstrate the proper procedures for communication and buddy interaction in a cavern environment.***

1. Briefing
    - **a. Evaluate the conditions**
    - b. Facilities at the dive site
    - c. Entry technique and location
    - d. Exit technique and location
    - e. Layout of the cavern
    - f. Depth ranges
    - g. Interesting and helpful facts about the dive site
    - h. Sequence of the training dive
        - **Students formulate their own dive plan, based on instructor input.**
        - Students enter water and independently perform equipment checks, S-Drill and review dive plan.
        - Students descend and conduct a cavern dive, including:
            1) Primary tie-off
            2) Secondary tie-off
            3) Guideline and reel use
            4) Intra-team communications
            5) Surface signal
            6) Retrieval of guideline and exit
        - Students exit, make safety stop and ascend.
        - Students debrief and critique among themselves.
        - Instructor critiques
    - i. Special communications or signals
    - j. Remind students of standard lost-diver procedures for cavern diving.
    - k. Review key cavern diving problem/emergency procedures [comment on special procedures for jammed reels].
2. Buddy assignments
3. Pre-dive procedures
    - a. Prepare personal equipment.
    - b. Don personal equipment.
    - c. [Equipment/buddy checks are performed in shallow water after entering.]
    - d. Proper entry
4. Dive Three tasks [students perform all tasks independently while instructor observes closely, but unobtrusively; instructor intercedes and comments only as necessary to ensure student safety or maximize learning].
    - a. Equipment check
    - b. S-Drill
    - c. Calculate air-turn-around point.

d. Review overall dive plan; announce/record time of descent.
e. Primary tie-off; agreement to enter
f. Secondary tie-off; drop weights secured to line
g. Exploration of cavern
h. Agreement to surface
i. Retrieve guideline and drop weights; exit cavern.

5. Ascent, exit water.
   a. Three-minute safety stop at 5 metres/15 feet
   b. Normal ascent
6. Post dive procedures
   a. Make an exit appropriate for the environment.
   b. Stow equipment and exchange tanks as appropriate.
   c. Calculate pressure group at the end of the dive.
7. Debriefing [may take place in shallow water immediately upon surfacing].
   a. Students' assessment of their own performance.
   b. Identification of specific problems; suggestions for improvement.
8. Log dive (Instructor signs log)

D. Dive Four (Role reversal of line/reel work dive three)

Performance Requirements.

By the end of the sessions, you will be able to:

- ***Construct a dive plan for a cavern dive that accounts for a minimum of team sequence, air turn-around, maximum depth, dive duration and penetration distance.***
- ***Demonstrate primary and secondary tie-offs, placements and general guideline and reel use in a cavern environment.***
- ***Provide adequate support to a diver who is acting as team leader/reel person.***
- ***Demonstrate the proper procedures for communication and buddy interaction in a cavern environment.***

Have student divers reverse roles as team leader/reel person.

1. Briefing
   a. Evaluate the conditions.
   b. Facilities at the dive site
   c. Entry technique and location
   d. Exit technique and location
   e. Layout of the cavern
   f. Depth ranges
   g. Interesting and helpful facts about the dive site

h. Sequence of the training dive
    - Students formulate their own dive plan, based on instructor input.
    - Students enter water and independently perform equipment checks and review dive plan.
    - Students descend and conduct a cavern dive, including:
    1) Primary tie-off
    2) Secondary tie-off
    3) Guideline and reel use
    4) Intra-team communications
    5) Out-of-air drill while exiting the cavern zone.
    6) Retrieval of guideline and exit.
    - Students exit, make safety stop and ascend.
    - Students debrief and critique among themselves.
    - Instructor critiques

i. Special communications or signals

j. Remind students of standard lost-diver procedures for cavern diving.

k. Review key cavern diving problem/emergency procedures.

2. Buddy assignments
3. Predive procedures
    a. Prepare personal equipment.
    b. Don personal equipment.
    c. Equipment/buddy checks are performed in shallow water after entering.
    d. Proper entry.
4. **Dive Four tasks (students perform all tasks independently while instructor observes closely, but unobtrusively; instructor intercedes and comments only as necessary to ensure student safety or maximize learning).**
    a. Equipment check
    b. S-Drill
    c. Calculate air turn-around point.
    d. Review overall dive plan; announce/record time of descent.
    e. Primary tie-off; agreement to enter
    f. Secondary tie-off; drop weights secured to line
    g. Exploration of cavern
    h. Agreement to surface
    i. Retrieve guideline and drop weights; exit cavern.
5. Ascent, exit water.

   a. Three-minute safety stop and 5 metres/15 feet
   b. Normal ascent
6. Post dive procedures
   a. Make an exit appropriate for the environment.
   b. Stow equipment and exchange tanks as appropriate.
   c. Calculate pressure group at the end of the dive.
7. Debriefing (may take place in shallow water immediately upon surfacing)
   a. Student's assessment of their own performance
   b. Identification of specific problems; suggestions for improvement
8. Log dive (Instructor signs log)

PADI Specialty Training Record

Cavern Diver

I verify that this student has satisfactorily completed all academic and/or any confined water training sessions as outlined in the PADI Specialty Course Instructor Outline for **Cavern Diver.** I am a renewed, Teaching status PADI Instructor in this specialty.

Instructor Name ____________________________ PADI#___________

Instructor Signature ____________________________ Completion Date ___________

Open Water Dives

Dive One

I verify that this student has satisfactorily completed Dive One as outlined in the PADI standardized outline for **Cavern Diver** including:

- Equipment check
- Complete "S" Drill
- Review dive plan
- Record time of descent
- Review line handling and reel use
- Check weighting, buoyancy control and body position
- Practice three propulsion techniques
- Explore cavern (optional)
- Exit cavern
- Perform shallow-water line drill
- Ascent, perform safety stop for 3 minutes at 5 metres/15 feet
- Exit water

I am a renewed, Teaching status PADI Instructor in this specialty.

Instructor Name ____________________________ PADI#___________

Instructor Signature ____________________________ Completion Date ___________

Dive Two

I verify that this student has satisfactorily completed Dive Two as outlined in the PADI standardized outline for **Cavern Diver** including:

- Conduct shallow-water line course (must be completed prior to dives 3 and 4), (Optional if this skill was conducted as part of dive number one)
- Swim circuit with eyes open
- Swim circuit with eyes closed (under close instructor supervision)
- Negotiate swim circuit with buddy's eyes closed, using touch-contact communications
- Reverse roles, negotiate swim circuit with buddy's eyes closed, using touch-contact communications and while sharing air

I am a renewed, Teaching status PADI Instructor in this specialty.

Instructor Name ____________________________ PADI#___________

Instructor Signature ____________________________ Completion Date ___________

Dive Three

I verify that this student has satisfactorily completed Dive Three as outlined in the PADI standardized outline for **Cavern Diver** including:

- Equipment check
- Perform "S" Drill
- Calculate air-turn-around point
- Review overall dive plan, record time of descent
- Perform primary tie-off
- Perform secondary tie-off
- Explore cavern
- Agree to surface
- Retrieve guideline; exit cavern
- Ascent, perform safety stop for 3 minutes at 5 metres/15 feet

I am a renewed, Teaching status PADI Instructor in this specialty.

Instructor Name ____________________________ PADI#___________

Instructor Signature ____________________________ Completion Date ___________

Dive Four

I verify that this student has satisfactorily completed Dive Four as outlined in the PADI standardized outline for **Cavern Diver** including:

- Equipment check
- Perform "S" Drill
- Calculate air-turn-around point
- Review overall dive plan
- Perform primary tie-off
- Perform secondary tie-off
- Explore cavern
- Agree to surface
- Retrieve guideline; exit cavern
- Ascent, perform safety stop for 3 minutes at 5 metres/15 feet

I am a renewed, Teaching status PADI Instructor in this specialty.

Instructor Name ____________________________ PADI#___________

Instructor Signature ____________________________ Completion Date ___________

I verify that I have completed all performance requirements for this **Cavern Diver** Specialty. I am adequately prepared to dive in areas and under conditions similar to those in which I was trained. I agree to abide by PADI Standard Safe Diving Practices.

Student Name ____________________________

Student Signature ____________________________ Date ___________