

# SCUBA and the Gas Laws

By John Fisher

## Course

General Chemistry (Chemistry 101)

## Description

This module describes the relationship between the gas laws of Boyle, Charles, Dalton, and Henry and their application to SCUBA diving. The associated chemistry lectures are supplemented with information from two separate websites, one dealing with the physics of buoyancy, and the second dealing directly with the four basic gas laws covered in every introductory chemistry course.

The site titled *SCUBA Diving Explained* and the accompanying book of the same name are outstanding. Students are given accurate information in a fun-filled context. Self-tests are provided as well as questions and answers concerning the chemistry, physics, and physiology of SCUBA diving. This lesson also involves the demonstration of a dive computer and the data it collects as an interactive lab in the college's aquatic center.

## Transferability

This module would also be applicable to introductory physical science, physiology, and environmental science or even physical education.

## Faculty Technology Skill

Faculty should have basic computer skills, Internet navigation skills, the ability to download files, and familiarity with "smart classroom."

## Student Technology Skill

Basic computer skills and Internet navigation are required.

## Faculty Equipment

Computer with Internet connection and access to smart classroom for presentation of material on *SCUBA Diving Explained* website.

## Student Equipment

Access to computer with Internet connection if module is used as an individual exercise. No equipment is needed if used in large group setting.

## Cost

The use of the websites is free. The textbook, *SCUBA Diving Explained* by Lawrence Martin, MD, is \$19.95. I plan to buy one or two copies and place them in reserve in the Learning Resource Center for student reference use with this module. The cost of a certified PADI instructor, equipment rental, and instruction will vary from \$50 to \$300, depending on the number of students and the disposition of the licensed PADI instructor that one hires.

### **Improvement on Teaching and Learning**

Presenting lessons in a real-world, fun-filled, interactive context is always preferable to a sedentary lecture. In fact, a Department of Defense study showed that the degree of learning increases by as much as 80%. The gas laws are an important part of any real life-related science course, and the students seem to approach their study with much greater enthusiasm when presented in the SCUBA context.

### **Nontechnology Comparison**

It is assuredly possible to cover the gas laws just as thoroughly without using the websites and the SCUBA module. Certainly, from the standpoint of the effort expended by the instructor, it is much easier; however, if the data I've collected on my students is valid, more students master the understanding of the gas laws when they are presented in the SCUBA application.

### **Pertinent Issues**

*Never* present the "diving lab" component of this module without the presence of a licensed and legally certified diving instructor. Participating in the diving lab must be optional, for there are some students who will be unable to participate for personal or medical reasons. The PADI forms that the students sign will alleviate liability for the instructor and the facilities. Alternative labs for the nondiving students are available upon request from the writer. Interview, or at least meet with, the PADI instructor before you allow him or her to teach with you. His or her temperament is crucial to the success of the lesson.

## **Lesson Content**

### **Discover Science by Discovering SCUBA**

#### **Target Grades**

Ages 10 and above

This project features many of the gas laws important to all sciences. Participants will actually SCUBA dive in the Rend Lake College aquatic center pool.

#### **Academic Areas**

Science and Math

#### **State Goals, Academic Standards & Benchmarks**

11.B.5a-5f

12.C.4a

#### **Objectives**

With proper guidance, students will validate the gas laws by experiencing the effects defined by said laws as they SCUBA dive in the Rend Lake pool. As an aside, Boyle's Law will be demonstrated using the SCUBA gear, compressed air, and a balloon.

#### **Technology Tools**

- SCUBA equipment
- Computer for *PowerPoint* presentation by SCUBA instructor
- PADI Video or DVD *Discovering SCUBA*, television and DVD/video player
- Dive computer

#### **Materials and Supplies**

- Balloon
- Compressed air
- Bathing suits
- Towels

#### **Evaluation**

Students will write reports on their experiences and the gas laws to which they pertain. Students will write an explanation of their observation of the balloon. Students will complete a written test, which matches the gas laws with their experiences. See the attached scoring rubric for the written lab report.

## Discover Science by Discovering SCUBA Scoring Rubric

### Rate the Criteria

3 = Excellent

2 = Satisfactory

1 = Unsatisfactory

0 = Does not attempt, or does not understand

<b>Criteria</b>	<b>Score</b>
Write-up indicates understanding of the science concepts involved.	_____
Experimental procedure and group interaction.	_____
Data chart neatness.	_____
Calculations with numbers and units shown and computations correct.	_____
Accuracy of Results 5% error = 3, 7% error = 2, 8% error = 1, >8% error = 0	_____
Boyle's Law addressed.	_____
Charles' Law addressed.	_____
Henry's Law addressed.	_____
Dalton's Law addressed.	_____
Technology used appropriately.	_____
Write-up is neatly organized and free from spelling and grammatical errors.	_____