AQUATIC FACILITY OPERATOR'S PREP SCHOOL

PPOA

PROFESSIONAL POOL OPERATORS OF AMERICA

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distributed by the author and the

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NOTE to PPOA Site Visitors:

Taking a prefessional pool course soon? This little Prep School was originally designed to prepare a student for the National Recreation and Park Association's Aquatic Facility Operator course. The AFO program is a thorough, up-to-date two-day technical-and-operations class. However, applicants for other professional courses which would equally qualify for membership in the Professional Pool Operators of America may find this primer a valuable assistance in preparing her or him for that course as well. Most notably, the NSPF's Certified Pool Operator course(r) is popular in the U.S. and is universally accepted as professional training for pool operators. The YMCA and oather national organizations have non-commercial, full-certification courses as well. Whichever course you may be applying for, this Prep School is designed to be of help.

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A PREP SCHOOL FOR THE AQUATIC FACILITY OPERATOR

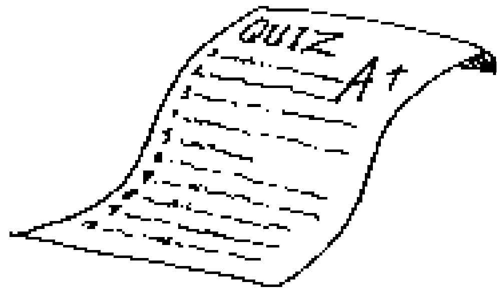
or

I CAN'T UNDERSTAND CHEMISTRY SO WHAT AM I GETTING MYSELF INTO...?

You've decided (or is it someone's decided for you?) to take the AFO or CPO course. Hey, they say that it's pretty interesting, even a lot of fun. That is if you're not *snowed*. (Snowed: Slang for overwhelmed or blown away by unfamiliar stuff...) So the beginning of this little advanced-warning booklet is designed to let you decide what your *snow factor* is – that is whether or not you *need* a primer to get you ready for the 16 hours of classroom work, some book-learnin', two lunches, five breaks and a test that you're somewhat committed to endure in the near future. The rest is an introductory, simplified study guide of sorts so, if you need it, you can reduce your SF (snow factor) and walk in the door with a bit more confidence. After all, we all weren't born chemists.

First let's decide where you are on the SF scale now. What's been your experience around pools? Have you managed and maintained a public pool for a few years? Maybe a shorter time? You've been a life guard for a summer or two, right? Just recently got the job, huh? Haven't even seen the pool yet! (Don't fret; that's often the case in certification classes...) Well, that sequence of possibilities may have described a pool-guy student with an SF of zero through about 10! And you don't want to walk into class being a 10, believe me.

The course is not difficult, we promise. But it covers a lot of stuff you do need to be familiar with. You've got the AFO manual, right? Well, take a look inside. The table of contents is pretty much what's going to be covered, and in just about that order too. See, it's not all chemistry - not even close. Pool-water chemistry is, however, one of the areas of most concern. So read on; we can help.



QUIZ

Take this little self test (true, false, or who knows):

1. pH is a type of shampoo.

2. A typical park pool holds millions and millions of gallons of water.

3. Hard water slows competitive swimmers.

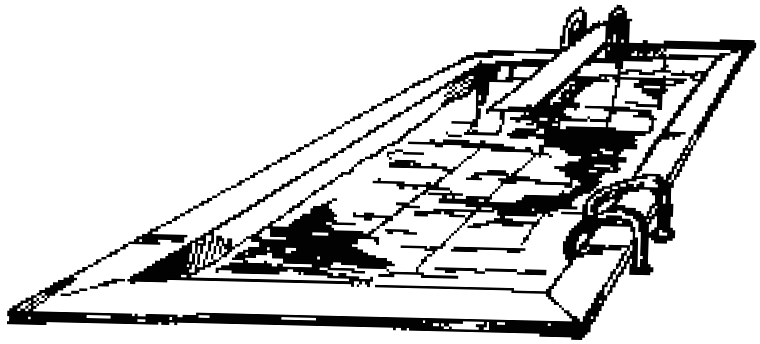
4. Calcium hypochlorite, calcium chloride, calcium carbonate are all about the same thing.

5. A pool filter is designed to stop bacteria.

6. Pool pumps are special types of shoes for use on the pool deck.

7. You really need college chemistry to run a modern pool.

If you answered any of these true or who-knows, you might need to read through the following prep-school and guided tour of the book. If you feel comfortable with the basics behind the subjects mentioned, maybe skimming the textbook would prepare you well enough. If you *know* your SF is very low and you're only worried about being bored, well, we'll see you in the classroom. I'll bet we just might introduce you to a new concept or two, or explain something you've been doing right but wondering why...



PREP SCHOOL BASICS

TERMS AND UNITS

Throughout the book and course we'll use chemical and technical terminology as infrequently as possible. That's probably not infrequently enough, because there's been concern expressed (that means complaints) over the number of technical words required. You're going to be a professional pool operator, right? So sound like one and begin using these terms - like breakpoint, cyanuric acid, chloramines, parts per million and the like. Start by pretending you know what they mean... When *you* use these terms it'll be your boss, or the new employee, who's snow-factor might become apparent! Seriously now, you'll need these terms and expressions, and I promise they'll come easy with use and repetition.

POUNDS *VOLTS*
GALLONS *TURNOVERS*

Units, all those increments of measure, are necessary when discussing water conditions and treatment. They are most often abbreviated. Let's explain just one now; the rest will show up in the text or in the course and be either self explanatory or explained on the spot. If you're confused, stop the show and ask!

PPM *GPM* *RPM*
PPD *PSI*

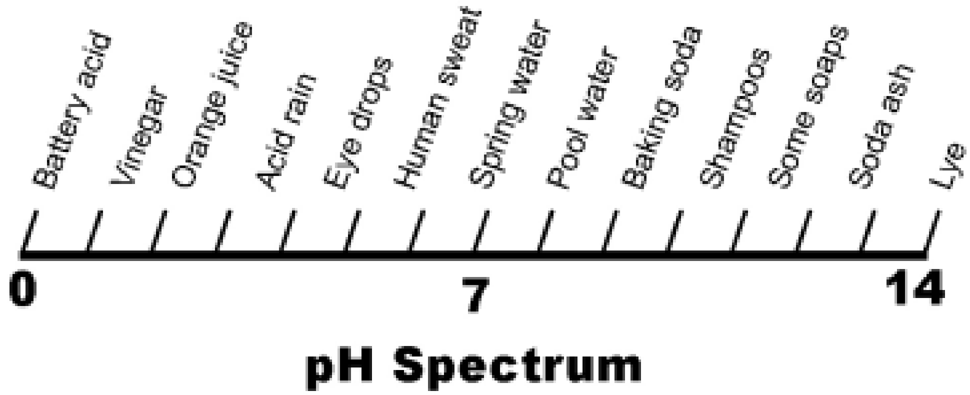
"Parts per million" is a very common term, abbreviated *ppm*. It's also confusing to newcomers. Unlike specific units of measure - like pounds, meters, or volts - a ppm is a comparison (or ratio) of the quantity of a diluted material as compared to the whole volume of liquid in which it is diluted, using the same unit of measure. Still confused? Don't panic; check these examples first...

To illustrate: One part per million of chlorine is a pound of chlorine in a million pounds (not gallons) of water. And you don't need to actually have a million pounds - that's why they use the word "part". It could be a pint in a million pints or even a drop in a million drops, or an ounce in a million ounces. The only rule is that units of measure have to be the same. And the stuff you're comparing must be full strength, or adjusted for its dilution. You can't pour a gallon of whiskey in a million gallon pool and call it a part per million alcohol. You gotta' figure the percentage of alcohol in the booze, maybe 50%. In this case, you'd only have *half* a ppm alcohol in the pool - still a waste of good hooch and a pretty silly example...

POOL-WATER CHEMISTRY MADE SIMPLE

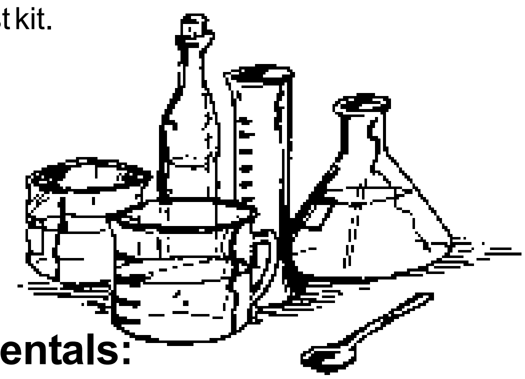
Since the so-called water-chemistry stuff is by far the biggest concern of aspiring aquatic facility operators, that's all we're going to cover in *Prep School*. You'll probably find that the approach to the subject of chemistry in the book is simple enough for you, but there's a ton of information there - so let's get some of the fundamentals out of the way right now.

We have to start with *pH*. That's pronounced "pee aich", and it's always spelled with a little "p", even if used at the beginning of a sentence. A simple definition of *pH* is *a number which represents the acid-versus-base balance of water.* The numbers run from zero to fourteen, for some crazy reason. Low numbers, from zero to almost seven, are considered ACIDic. Seven on the money is NEUTRAL. From just over seven up to fourteen represents water which is progressively more BASE-ic. (That's basic.) Take a look at the table below, showing the entire pH scale and some common materials and household products along the way - progressing from strong battery acid through weaker acids like orange juice through tap water values, on up to caustic stuff like lye (or a similar super-high pH chemical called caustic soda).



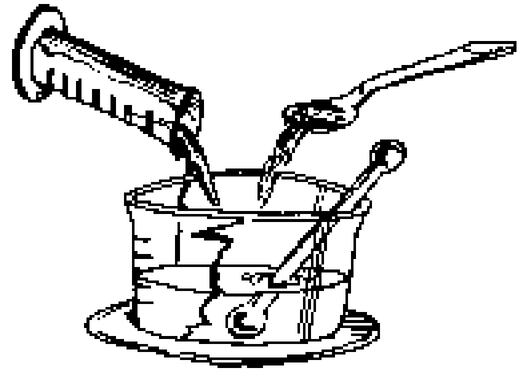
Most state health laws require the pH value in pools to lie between 7.0 and 8.0; in other words, just slightly basic. (In still other words, definitely not acid!) As a certified operator you'll bust your buns (that means work diligently) to keep your pool's water at a chosen pH value, probably pretty near pH 7.4. There's lots of reasons to hold other nearby pH values in certain pools, but let's wait for the course to find out why.

"How", on the other hand, is a reasonable question. Water's pH is increased by adding an "alkalizer" (a high pH chemical) like soda ash or caustic soda or even common baking soda. The pH is decreased by adding any acid - although, as with alkalizers, only a few types of acids are commonly used in pools. Remember, *all* sanitizers and other chemicals, soils, body secretions and so on, as well as rain and the make-up water, will have some effect on pH, either up in the basic direction or down in the acid direction. The result of all the influences on a particular pool's water is where the pH ends up - and that's the value which appears on your handy dandy pool-water test kit.



Let's look at some chemistry fundamentals:

1. The basic building block of the chemical world is an *element*. Chlorine is an "element" in its pure form. Not much in nature is found in elemental form; gold, lead, oxygen, and mercury happen to be a few of the exceptions. Chlorine is not an exception; it's never found in nature in the pure, elemental form. It's always found in one of many compounds. Salt and bleach are a couple of examples of chlorine compounds.



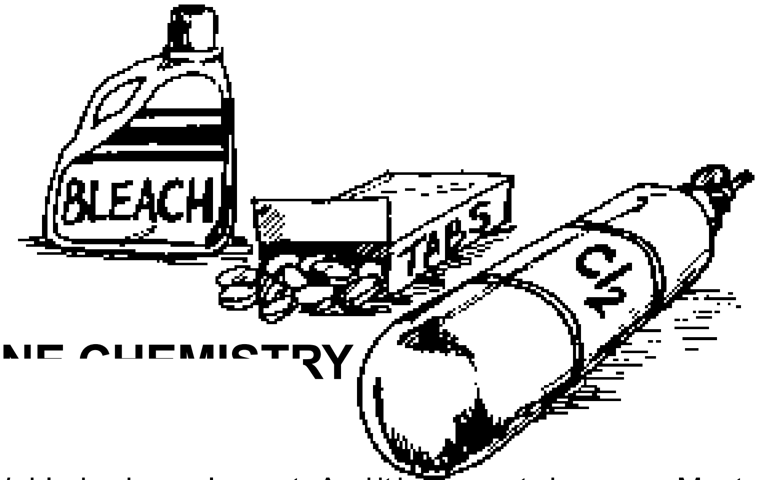
2. What are “compounds”? They are chemical combinations of elements (or other compounds) which form other materials, that is, definable chemicals that don't look anything like the stuff we started with. Sodium, a nasty element, and chlorine, another even nastier element, form something very different when combined common table salt - a *compound* we cannot live without. We can’t taste the sodium or the chlorine, thank goodness, just salt. (And what would a hard-boiled egg or fried chicken taste like without it!) All the safe-to-handle, hardware-store “chlorine” products are actually compounds *containing* chlorine, *not* the element chlorine itself.

3. What about “mixtures”? Just like blending milk and eggs, a mixture generally has the constituents still separately identifiable. (You can still taste both the milk *and* the eggs.) Don’t get compounds mixed up with *mixtures*. Air, for example, is primarily a mixture of gasses, most of them existing still as elements. Pure water, on the other hand, is a compound of two elements, hydrogen and oxygen. H_2O, as most of us know, stands for water in chemical talk - showing two atoms of hydrogen and one of oxygen. Don’t ask about atoms. AFOs and CPOs are exempt from knowing about atoms.

4. More on water: Water has much more than water in it, by the way. It is a complex *solution* of mixtures and compounds. (Solution simply means dissolved together.) We can’t taste the calcium in water, for example, but we can taste an excess of salt - and in the old swimming hole, maybe even the polywogs! Some of the materials which have been added (by nature or by AFOs) end up only mixing, some end up compounding into other chemicals altogether, and some even ionize.

5. *Ionize?* Another chemical form to learn? Well, yeah, but this is the last one, we promise. This is a phenomenon which happens often in water, and not so often elsewhere in nature. An “ion” is a *part* of a compound, temporarily broken away from its other half. It floats out there by itself, usually having an electrical charge making it pretty attractive to other ions. (If this all sounds like the singles scene at a bar or the town's meeting place, I suppose it is a fair analogy...) For example a hydrogen ion is an extra H^+, broken off of the H_2O, floating around freely in the water. It eventually will re-combine as water or end up as part of another compound altogether. There’s only a few other ions we’ll be interested in, most of them dealing with chlorine. That's for later...

CHLORINE CHEMISTRY



So *real* chlorine is an element. And it happens to be a gas. Most of you have never seen or smelled the pure stuff, and those of you who have wish you hadn't. Chlorine is so dangerous it has books written and courses given on just its safe handling. And chlorine's always hungry to become a compound, as you'll see.

The most common compound formed by chlorine in water is hydrochloric acid, HCl. (l, not 1.) That's hydrogen and chlorine in compound. This common and powerful acid is formed when water, even moisture, gives up some of its hydrogen (H) to chlorine (Cl) when the two get together.

It is, incidentally, this hydrochloric acid which makes chlorine so poisonous. It forms HCl when contacting the moisture in the lungs, doing great damage to the little parts in there. HCl also is the reason chlorine is considered so corrosive. It's the acid formed by chlorine, not chlorine itself, that corrodes. (Pure, elemental chlorine is shipped in steel bottles yet they don't corrode... There's no water in the tanks to produce the corrosive acid.)

Does any of this help us in pools? Yes, indirectly - and mostly in the understanding of general water-chemistry principles. We're not yet finished with what happens when chlorine mixes with water...

Specifically, the mixture of chlorine and water gives us one more compound that is what we *really* want. It is *hypochlorous acid*. Sounds pretty much like hydrochloric acid. It's not. This is very mild as acids go, yet a *very* good worker as you'll see. Here's a formula - the only one we'll ever give you, promise. "Read my lips..."

$$\underset{\text{(Gas Chlorine)}}{Cl_2} + \underset{\text{(Water)}}{H_2O} = \underset{\text{(Hydrochloric Acid)}}{HCl} + \underset{\text{(Hypochlorous Acid)}}{HOCl}$$

Hypochlorous Acid (Spoken Hi-po-chlor-us asid): Oh m'gosh, another big chemical term. Well, this is ***the most important stuff you'll ever study in the water-chemistry curriculum.***

chemistry curriculum.

HOCL = CLEAR WATER & DEAD BUGS

HYPOCHLOROUS ACID is the compound of chlorine which does all the disinfecting and oxidizing that most of us will ever need in our pools. This is the good guy - the chemical we want in the pool to the exclusion of all others (if we could be so lucky). This one is worth memorizing; you'll sound like you really know your chemistry!

Trouble is, hypochlorous acid isn't very stable - it doesn't hang around long. If it did, it probably wouldn't work well, so we put up with its fragile nature, constantly adding more chlorine, playing with the pH, adding other magical chemicals and chewing our nails off trying to keep HOCl around and working. That's what The AFO's Chapter 10 is all about.

A few last words about chlorine. Most of you know that there's many other forms of chlorine at the pool supply store, and surmise by now that they're compounds, not the element itself. True. Sodium hypochlorite is liquid "chlorine bleach". Calcium hypochlorite is "dry" or "granular" chlorine. And there are more. They all produce that fleeting and wonderful HOCl, hypochlorous acid, when mixed with water, and that's what we want.

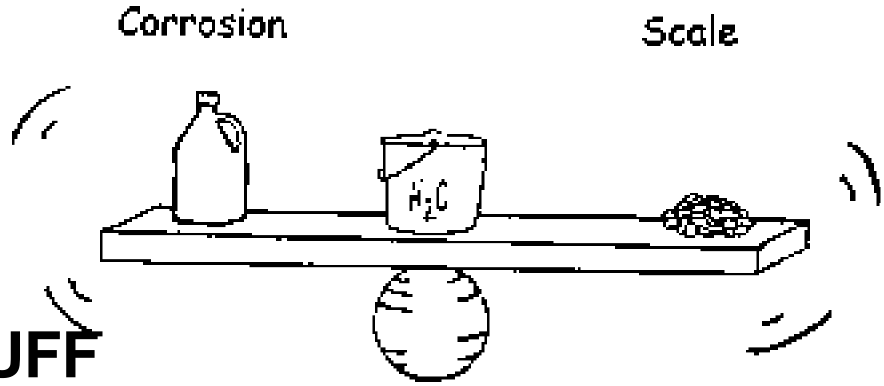
pH EFFECTS

↑ pH	Bleach Granular Scale	pH ↓	Gas Trichlor Bromine

There are *pH effects* resulting from the addition of each type of chlorine. Obviously gaseous (elemental) chlorine, which makes a powerful acid (HCl) as a by-product, will drive the pool water in the acid direction - or to lower pH numbers. The two chlorine compounds mentioned above drive the pH *upward*, not downward, indicating that the good-guy hypochlorous acid (HOCl) isn't much of an acid; other factors are much stronger in the pH-upward direction when using either bleach or calcium hypochlorite.

In the course you'll find out not only that chemicals have an effect on a pool's pH, but the pH of the water has a significant effect on how well the chlorine works! The lower the pH, the more powerful the chlorine. As pH rises near 8 or higher, on the other hand, the chlorine becomes very weak.

This pH business as it relates to chlorine is *very* important. It will be covered in Chapter 10 and thoroughly in the course; don't worry about it right now.



OTHER STUFF

What about other sanitizers? There're plenty of them. Good ones too, and poor ones with fancy promotions. (We call these "snake oil".) You'll learn about them all in Chapters 9, 13 and 17. We always seem to discuss chlorine first, as it's been the stand-by for years. As you begin to understand the principles of chlorine, the rest come easy.

We'll cover something called "water balance" too. It's a concept allowing us to adjust water so that it won't corrode and it won't scale. Chlorine is not a factor in water balance; pH, on the other hand, is the most *important* one.

Super-chlorination is another vital topic in any certification course. It is the process of raising chlorine levels high enough to eliminate unwanted, irritating compounds in the water. You'll find how urine (none in *your* pool of course), sweat and decomposing organic matter will actually combine with low levels of chlorine to produce these irritants, and how more chlorine yet, through superchlorination, will destroy them and actually get rid of eyeburn and odor.

So that's about it for your Prep School... No sense teaching the course before teaching the course. There's lots of fun stuff yet to go – such subjects as filtration, energy, safety, automation, maintenance, and management... but for now this introductory primer is all you really need.

* * *

PREP-SCHOOL FINAL EXAM

Read this case study and answer the true-or-false questions:

Wally Waterdown recently got a job as pool operator at the city park. (He just signed up for the upcoming AFO course, too.) Meanwhile, Wally tested the pH and the chlorine level of his water. The pH was fine, about 7.4, but the chlorine was very low. He added quite a bit of liquid chlorine bleach to restore the desired chlorine level, then tested his water again. The chlorine was now fine. Which of the following are probably true about his pH.

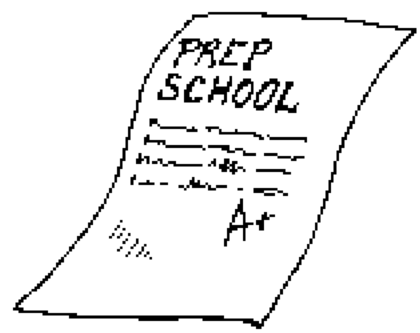
1. Wally found his pH somewhat higher than before.

2. He should add pool acid to lower the pH back to normal.

3. He'll have to do the whole darn' thing over again soon.

4. There must be a better way than hand feeding, and he'll learn about it in the Aquatic Facility Operator's training.

* * *

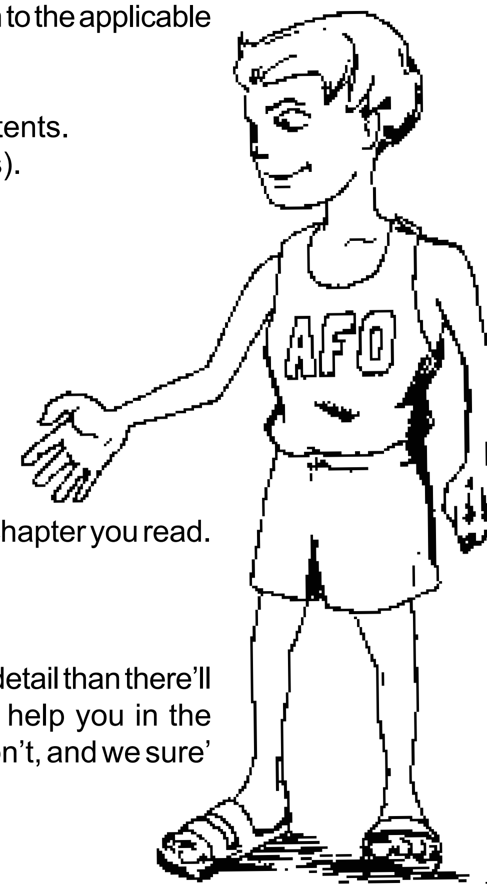


If you passed this Prep-School final exam, (finding the answers all true,) you're well on your way to becoming an AFO. (If you didn't, you're on your way anyhow, just not so well...) Understanding pH concepts is really important; if you're having trouble, read this prep-school again, read the book assignments, or get some help.

It's worth it. Ask any AFO.

YOUR ASSIGNMENT

This Prep School may be enough to get your feet wet, or you may want to be *really* prepared so you can get the most out of the course. If you got your AFO book in advance, or can get your hands on one, ead the material on this list; it will be a great start towards grasping the course and mastering pool-water chemistry. If you are taking CPO, POOL or another course, dig in to the applicable book; you'll figure out what you need to bone up on...



1. Skim the introductory material and the Table of Contents.
2. Read Chapters 1, 2 and 3 (only about 7 short pages).
3. Read Chapter 8 (3 1/2 pages).
4. Skim Chapter 9 (12 pages).
5. Read Chapter 10 (12 pages).

If you're still hanging in there, continue:

6. Read Chapters 11 and 14.
7. Skim Chapters 12, 13, 16, 17, and 18.
8. Look through the Glossary of terms (Appendix I).
9. Try your hand at the "Case Study & Quiz" after each chapter you read. The answers are in Appendix III.
10. Get a good night's sleep prior to the course...

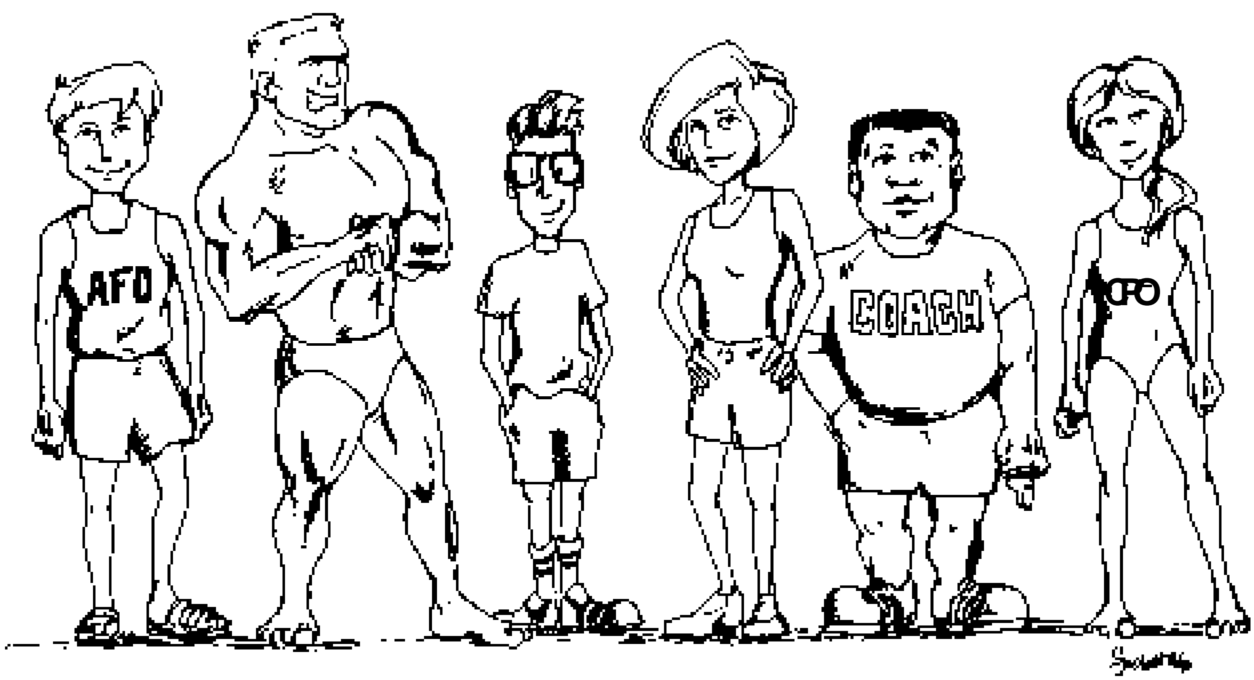
That's all the chemistry there is in the book, and in more detail than there'll be time for in the course itself. Any level of familiarity will help you in the classroom, but please don't feel you have to know it all. We don't, and we sure' wouldn't want you ahead of us...

A WORD ABOUT THE AFO EXAM:

There's been lots of concern about the final test, required for certification as an AFO. Don't sweat it. It has about 50 questions, almost all true or false, without the typical tricks usually found in such a quiz. A few (very few) of the questions will require you to do some simple calculations, so bring a calculator if you like. (You'll use it in class, too.) Formulas, constants, and technical detail are provided in the quiz itself; there's nothing to memorize. A score of 70 or higher passes. Clearly, we want you to understand the concepts of pool operation, and the test is designed simply to insure that you do. It's easy. These comments pretty much apply to the CPO exam or others, too. You'll see...

'Looking forward to seeing you at the course!

□□□□□□□□ □□□□□...



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