Foundations of Chemistry

Applying POGIL Principles

Fourth Edition

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- Support from the National Science Foundation made it possible to develop, test, and revise activities for general and physical chemistry; share them with others; help others move from lecturing to more student-centered teaching strategies; and work toward enhancing process-oriented guided-inquiry activities with computer and web technology. The following grants supported this and related projects: DUE-9752570, DUE-9950612, DUE-0127650, DUE-0127291, DUE-0231120, and DUE-0341485.

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To the Instructor and Student

Process-oriented guided-inquiry learning (POGIL) is both a philosophy of teaching and learning and a strategy for teaching and learning. It is a philosophy because it encompasses specific ideas about the nature of the learning process and the expected outcomes. It is a strategy because it provides a specific structure for teaching that is consistent with the way people learn, and it leads to the desired outcomes.

The goal of POGIL is to engage students in the learning process, and to help them master the material through conceptual understanding, rather than by memorizing and pattern matching, while developing essential learning skills. Important skill areas for success in chemistry courses, college, and careers are information processing, critical and analytical thinking, problem solving, oral and written communication, teamwork, and metacognition (reflection on learning, self-assessment, self-management, and self-regulation).

To support this goal, POGIL activities utilize a learning cycle design of exploration and concept formation followed by application.

Each activity begins with an *Orientation* that sets the stage for learning. The importance of the activity is described in a *Why?* statement. *Learning Objectives* and *Success Criteria* are identified along with prerequisite activities. The learning objectives describe what the student is expected to learn. The success criteria specify the measurable outcomes of the activity, i.e., what the learner should be able to do at the end. It is quick and easy to make up examination questions simply by looking at the success criteria for each activity.

Students then explore a *Model* in response to *Key Questions*. The model is any representation of what is to be learned. Key questions unlock the information present in the model and reveal its significance. They guide the learner to discover the relevant concepts and to develop an understanding of them. *Information* is provided at the beginning and throughout an activity, but only when a *need-to-know* has been created.

The new knowledge is then applied in simple *Exercises* that build confidence, and then to higher-level applications, called *Problems*, that require synthesis of ideas, transfer to new contexts, and problem-solving skills.

While individual students can complete an activity, the activities are most effective when used by students working in learning teams with the instructor acting as a coach, guide, or facilitator.

Many resources are available to help instructors teach in this new student-centered environment. They can be found at the Pacific Crest and POGIL web sites (www.pcrest.com, www.pogil.org). Both Pacific Crest and the NSF-supported POGIL Project sponsor workshops for faculty to introduce them to process-oriented guided-inquiry learning, assist them in developing facilitation skills, and guide them to materials for use in their courses.

To the Student

Changes in society, technology, and the world economy are occurring at increasingly faster rates. As a college graduate, you will need to be a quick learner, critical thinker, and problem solver to succeed. You will need to be computer literate and skillful in communication, teamwork, management, and assessment. This book is intended for use in courses where faculty are responding to these demands through changes in teaching style and curricula that will actively engage you in learning and help you develop these essential skills.

This book is not like textbooks that you have used before. It does not provide you with information to read, memorize, and repeat during exams. Rather, it provides some representation, or model, of what is to be learned. Key questions guide your exploration of the model, unlock the information present, and reveal its significance. The key questions help you discover the relevant concepts and develop an understanding of them.

Exercises then give you practice at applying these concepts in straightforward situations. They build your confidence in using your new knowledge to solve problems and answer questions. A few problems are included and your instructor will assign others. Problems are not as straightforward as the exercises; they often require the use of two or more concepts and the application of your knowledge in new contexts.

The goal is to help you learn how to process information, analyze situations by asking yourself key questions, construct your understanding of chemistry, and develop the problem solving skills that you need to be successful in this course, in college, and in your career.

You will learn the most and have the most fun if you work on these activities with other students. Discussions among members of your learning team will produce different perspectives regarding the concepts and their use in solving problems. They will identify and correct misconceptions and strengthen and deepen your understanding of chemistry. Use your textbook to resolve disagreements, to find answers to questions that arise, and to see examples of problem solutions. It is through your understanding of the concepts and how to use them that you will be able to answer examination questions and solve real-world problems successfully. When you are working in a learning team, you should have two learning objectives: to understand the material and to ensure that every other member of the team understands the material. Explaining ideas and helping others learn are among the best ways for you to deepen your own understanding and knowledge and to gain the insight needed to do well on examinations and apply your knowledge and skills successfully in the real world.

We have found that this approach works for most students. They do better on exams, understand more about chemistry, recognize that they have become stronger learners, and have had more fun along the way.