HIGH SCHOOL IMPLEMENTATION GUIDE

A DAY IN THE LIFE OF A POGIL CLASSROOM

Welcome to our Implementation Guide!

https://www.youtube.com/watch?v=ivOb5kIBncY
This resource was developed through the High School POGIL Initiative (HSPI), a 3-year project designed to bring student-centered, guided inquiry instruction to secondary school classrooms. The HSPI has created a set of activity collections, for biology and chemistry, at both the first year and AP levels. They are available through our publisher Flinn Scientific.

High School Chemistry


High School Biology

ISBN 978-1-933709-87-6


For descriptions and to order copies please go to:
https://www.flinnsci.com/search-results/?type=All&query=pogil

As any classroom teacher can attest, quality curriculum materials are only a piece of the educational puzzle. Effective implementation of an instructional strategy is key to having a successful classroom experience with students. Contained within the pages of this web-based Implementation Guide, you will find suggestions, tips, videos clips, material files and more, created and shared by high school POGIL practitioners. These teachers are working in a variety of settings - from large and urban to small and rural, from public schools to private academies - but all share the common goal of improved science education. Each has experienced success using POGIL activities with their students and wants to pass along what they have learned. We want to acknowledge the HSPI Partners and Editorial Team and the participants in the Northern Colorado POGIL-Hach Collaboration.
Stage 1  
Shifting to a Student-Centered Classroom

Whether you are looking to test the waters with some preliminary adjustments to your classroom routines or are ready to dive in the deep end of the POGIL pool, here are some points to consider BEFORE implementing your first activity.

Making the change to a Process Oriented Guided Inquiry Learning (POGIL) classroom is a big transition for most teachers and their students, a change that goes far beyond introducing new materials to the classroom. Adopting POGIL represents a real philosophical shift in your perceptions of the roles of teacher and student in a learning environment. We encourage you to attend a workshop and to explore the POGIL website to deepen your understanding of the POGIL pedagogy. For more information about our upcoming workshops please go to: http://www.pogil.org
POGIL is an acronym for Process Oriented Guided Inquiry Learning. POGIL originated in college chemistry departments in 1994; there are now well over 1,000 implementers in a wide range of disciplines in high schools and colleges around the country.

POGIL uses guided inquiry — a learning cycle of exploration, concept invention and application is the basis for many of the carefully designed materials that students use to guide them to construct new knowledge. POGIL is a student-centered strategy; students work in small groups with individual roles to ensure that all students are fully engaged in the learning process.

POGIL activities focus on core concepts and encourage a deep understanding of the course material while developing higher-order thinking skills. POGIL develops process skills such as critical thinking, problem solving, and communication through cooperation and reflection, helping students become lifelong learners and preparing them to be more competitive in a global market.

POGIL is a classroom and laboratory technique that seeks to simultaneously teach content and key process skills such as the ability to think analytically and work effectively as part of a collaborative team.

A POGIL classroom or lab consists of any number of students working in small groups on specially designed guided inquiry materials. These materials supply students with data or information followed by leading questions designed to guide them toward formulation of their own valid conclusions — essentially a recapitulation of the scientific method. The instructor serves as facilitator, observing and periodically addressing individual and classroom-wide needs.
POGIL is based on research indicating that a) teaching by telling does not work for most students, b) students who are part of an interactive community are more likely to be successful, and c) knowledge is personal; students enjoy themselves more and develop greater ownership over the material when they are given an opportunity to construct their own understanding.

We have found that a discovery-based team environment energizes students and provides instructors with instant and constant feedback about what their students understand and misunderstand. Students quickly pick up the message that logical thinking and teamwork are prized above simply getting “the correct answer.” This emphasizes that learning is not a solitary task of memorizing information, but an interactive process of refining one’s understanding and developing one’s skills.

**POGIL Process Skills**

One of the principles that characterizes POGIL as a teaching strategy and philosophy is the explicit emphasis on the development of process skills as an important component of the student learning process. The process skills that we refer to here include both cognitive and affective processes that students use to acquire, interpret, and apply knowledge. At its outset, The POGIL Project identified seven process skills as those that would be the focus of development in a POGIL classroom.

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**OPERATIONALIZED POGIL PROCESS SKILLS DEFINITIONS**

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<th>Process Skill</th>
<th>Operational Definition</th>
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| ORAL & WRITTEN COMMUNICATION  | *Oral Communication*: Exchanging information and understanding through speaking, listening and non-verbal behaviors.  
*Written Communication*: Conveying information and understanding to an intended audience through written materials (paper, electronic, etc.) |
| TEAMWORK                      | Interacting with others and building on each other’s individual strengths and skills, working toward a common goal                                      |
| PROBLEM SOLVING               | Identifying, planning, and executing a strategy that goes beyond routine action to find a solution to a situation or question.                           |
| CRITICAL THINKING             | Analyzing, evaluating, or synthesizing relevant information to form an argument or reach a conclusion supported with evidence.                           |
| MANAGEMENT                    | Planning, organizing, directing and coordinating one’s own and others’ efforts to accomplish a goal.                                                                 |
| INFORMATION PROCESSING        | Evaluating, interpreting, manipulating, or transforming information.                                                                                     |
| ASSESSMENT (Self Assessment and Metacognition) | *Self and Peer Assessment*: Gathering information and reflecting on an experience to improve subsequent learning and performance.  
*Metacognition*: Thinking/reflecting about one’s thinking and how one learns, and being aware of one’s knowledge. |
What makes POGIL different?

Why Teachers use POGIL

There are a number of student-centered instructional techniques that can be effective for achieving valid learning goals in the classroom. POGIL differs from other approaches in its use and design of distinct classroom materials. Three characteristics of POGIL materials are as follows:

• POGIL materials are designed for use with self-managed teams that interact with the instructor as a facilitator of learning rather than as a source of information.
• POGIL materials guide students through an exploration to construct understanding.
• POGIL materials use discipline content to facilitate the development of higher-level thinking skills and the ability to learn and apply knowledge in new contexts.

How POGIL Helps Students

https://vimeo.com/108973858
https://vimeo.com/109415622
When do I use a POGIL activity?

Once you have a grasp on the WHY’s, you can move on to the WHEN’s of using POGIL with these tips shared by our practitioners.

Do consider using a POGIL activity WHEN:
- Introducing a unit.
- Introducing a difficult concept.
- Replacing a lecture.
- Reviewing or checking for understanding.
- A deep conceptual understanding is necessary, i.e.- more than just delivery of facts.
- Lecture is not efficient or effective.
- Students have known misconceptions or to uncover student misconceptions.
- Covering dense, chunkable content.

Do NOT use a POGIL activity WHEN:
- Assigning something to be completed as an independent worksheet.
- A substitute is in the room, unless the students are well trained in POGIL methodology and the substitute knows how to properly facilitate an activity.

Curriculum Considerations

When using the HSPI collection of materials, either first year or AP, you can rest assured that the topics included cover the typical units found in any traditional science curriculum. They are aligned with the most frequently cited national standards NSTA (https://www.ngss.nsta.org) and the new K-12 Framework (https://www.nap.edu/catalog/13165/a-framework-for-k-12-science-education-practices-crosscutting-concepts)

These activities do not, however, serve as a stand-alone course; they are designed to be incorporated into your existing curriculum. You will need to spend some time reviewing your school’s curriculum requirements to determine which activities are the best match for your needs. Each HSPI activity lists clear learning objectives, background knowledge pre-requisites and extension questions, all of which will help guide your selection and placement in your course timeline.

My new role as Facilitator

The list that follows covers some important points shared by our practitioners to help you make the shift into the new role of Facilitator of student learning.
- Using POGIL changes how the classroom is controlled and directed.
- Using POGIL takes the spotlight off the teacher.
- The teacher in a POGIL classroom is not the expert - the data/model is the source of information.
- Because the teacher in a POGIL classroom is not the primary source of information, he/she does not answer questions directly, but refers students back to the data/model.
- Gain the expertise to not tell students the answer but be able to guide them to the evidence required to invent concepts and draw conclusions.
- The teacher’s workflow may shift in a POGIL classroom, with more preparation and planning required prior to class and less obvious tasks taking place during class.
- Facilitation is ACTIVE!
- Become a data collector. Watch and listen to your students as they work.
• Roam the classroom with a clipboard, so you can record misconceptions or points to expand in mini-lectures or for specific groups.
• Have answers in your hand as you facilitate an activity.
• Prepare to listen more as the teacher.
• Teachers report a change in their internal dialogue, from thinking about what they are going to say to instead focusing on what students are saying.
• Student centered learning invites more conversation from the students and less from the teacher - mouth closed, eyes and ears wide open!
• Develop techniques to have students ask questions of each other.
• Model questioning techniques for students.
• The teacher should only talk to the person in each group whose assigned role includes that function, to honor the assigned roles.
• Ask students questions but do not interrupt group work.
• Develop eavesdropping skills or use the ones you already have to listen to group discussions.
• Think of yourself as a project manager that delegates to groups.
• Set goals for yourself each day.
• Be transparent about your goals for yourself as the teacher and your goals for your students.

• Summarize your facilitator role after an activity. Keep a log of SII evaluations. (Appendix-SII Evaluation form)
• Develop and use tools to evaluate and provide feedback for both content goals and student process skills being developed. (see page 5)
• Frame and relate POGIL to Bybee’s 5E model for students. (http://enhancinged.wgbh.org/research/eeeee.html)
• Do an “Engage” activity before doing the POGIL: question, demo, quiz, survey, to allow misconceptions to surface, KWL-like warm up, or use AAAS assessment website (http://assessment.aaas.org/) for misconception list and test questions
• Have students map Explore/Explain/Elaborate in POGIL activity to see learning cycle - Exploration/Concept Invention/Application.
• Extend - revisit and compare starting point with current state of understanding, have students write/report out reflections after activity, provide an explanation to a new situation that is recognizable as similar to original and/or revise original explanation.
• Don’t offer general praise (like “Great!”) because it encourages students to seek affirmation from the teacher.
• Exude confidence and comfort with this technique. Students will sense your hesitation and discomfort with POGIL and they will be uncomfortable, too.
• Fake it ‘till you make it! Don’t get discouraged - it takes time to master new skills for new methods. Be patient with yourself and your students.
Communication

Because a POGIL classroom operates in a very different way than traditional lecture-based classrooms, clearly communicating the changes in expectations is critical. Here are some points to consider when developing your communication plan.

With Administration and the Community:

• Work early to get support from your administration.
• Administrators need to understand you are using research-based cooperative learning strategies. Share the research on the POGIL website. *(see Appendix, #2 Effectiveness of POGIL)*
• Invite administrators to observe your classroom.
• Get support from the local community. Science or business related industries in your area may be interested in the 21st Century Skills *(http//www.p21.org/index.php)*

With Fellow Teachers:

• Offer to hold informational meetings to describe the purpose of the activities.
• Share with colleagues to allow for peer support. Having 2 practitioners in a building, regardless of content area, can be a valuable tool for professional development and growth.
• Use Critical Friends *(http://www.nsrflharmony.org/)* or Professional Learning Community tools. *(http://www.allthingsplc.info/tools-resources/page,1/filtered,0/categories,/type)*

With Parents:

• Model the process on “Parent Days” and “Back to School” nights.
• Use the “Talking Points” list to highlight the benefits of this instructional practice. *(http//www.pogil.org/uploads/media_items/hspi-talking-points.original.pdf) (see Appendix #3 Talking Points)*
• Highlight the 21st Century Skills valued by business and industry that the learning activities are designed to build. *(https://www.professionalpractice.org/about-us/skills_for_success_2/)*

With Students:

• Students need to understand what you are doing to create buy-in.
• Explain and “sell” the idea of POGIL to students and make the philosophy transparent.
• Share with students the research on learning and why you have chosen to use the activities.
• Spend time early in the year on the importance of student roles and the value of sharing constructive feedback.
• Create a rubric for POGIL on Task (POT) and Daily on Task (DOT) points.
• Some teachers don’t use the term POGIL and instead just call the activities a “Learning Activity”, as it is just another part of their class and another learning tool.
• Send a postcard home to students before school starts to welcome them to your course and start a positive relationship. Be aware that parents will read this before the students!
Classroom Setup

• Make a plan for how to arrange tables/desks for both group and individual work in the classroom. Draw room sketches for both configurations.
• Try to set up your classroom so that there is no direction or “stage” in the classroom during group work situations.
• Arrange room for groups so that instructor can move around easily.
• If at all possible, students should face each other when doing POGIL work, to be able to look at each other and also have a surface to write on.
• Develop a procedure for rearranging the desks/tables and have students practice moving things into place.

Materials Needed / Implementation

Implementing POGIL in your classroom is relatively low cost. After the initial fees for training and the cost of materials, the activities are mainly pencil/paper based and require no special equipment or materials. However, many teachers find advanced planning for some organizational tools to be helpful. (http:www.pogil.org/events)

Equipment for the classroom:

• Chime or gong for audio cues.
• Timer or download an electronic version (http://www.online-stopwatch.com/)
• Classroom sets of materials like colored pencils, rulers, highlighters, and calculators.
• Copy and laminate classroom sets of role cards. (see Appendix, #4 Role Cards)
• Create sets of materials (periodic table, calculator, set of manipulatives, etc) for each group.
• HSPI activity books from Flinn Scientific (https://www.flinnsci.com/search-results/?type=All&query=POGIL).
• Plan for photocopying costs for student versions of activities.

Materials for Students:

• Develop a system for students to keep and organize their completed POGIL activities to study as a reference for the rest of the year.
• Provide students a summary sheet to help them summarize, keep and reflect on the knowledge gained through the POGIL activities.
• Develop a system to inform students what to use for notes.

Additional Costs:

• Trainings - workshops and meeting fees.
Grading

Determining POGIL's place in your classroom grading system is an important consideration when planning for implementation. POGIL practitioners have found success using a variety of grading policies, pieces of which are outlined below. Within all of these ideas, one guiding principle is evident - whatever grading policy you create, you want it to complement and encourage your students’ process skill growth and the emerging group dynamic. Be it individual or group grades, participation points or content focused, be mindful of your instructional goal(s) in choosing to use a POGIL activity versus some other instructional technique. In other words, always keep the group process in mind!

- POGIL activities are designed as learning tools, not assessment instruments.
- Use activities primarily as notes, not necessarily for grades.
- Feedback on learning is most effective when that feedback is not linked to a grade.
- Reflect on what you are choosing to grade and why you grade particular items. Does the grade reflect student learning (content) or student participation?
- If grading an activity, the emphasis should be on the process skills rather than the mastery of the content knowledge.
- Use rubrics so you can compare scores across classes and years and so that students understand your expectations.
- Consider creating a rubric for “POGIL on Task (POT)” points.
- Award participation points for on task behavior. Create a clipboard rubric to carry with you around the room.
- Have students collect and store activities in a binder/notebook and then selectively grade a small sample of the activities for quality of completion.
- Sometimes collect all of a group’s work just to check if a particular question is exactly the same then score 10/10 if ALL the same or 0/10 if not the same. Note - the answer may or may not actually be correct. This encourages reaching a consensus and proper recording of the consensus answer.
- Collect one copy of the activity per group (choose randomly) to check for completion.
- Give a quiz the day after doing a POGIL activity.
- Consider having “Open POGIL” quizzes (i.e. - using the completed POGIL to answer the quiz questions, like an ‘Open Book” quiz). This encourages all group members to record the answers.
- Start class with a daily mini-quiz, focusing on the key concepts from class the day before.
- Use a concept check with tools such as clickers, as described by the CWSEI,  (http://www.cwsei.ubc.ca/resources/clickers.htm) or NCTE’s exit slips. (http://www.read writethink.org/professional-development/strategy-guides/exit-slips-30760.html)
- If the POGIL activity covers a particularly difficult concept, or if you notice that all members in a group didn’t write answers, collect the activity and check for accuracy. Pay particular attention to the key questions or points you might have discussed during the course of the day in class, helping students to learn to zero in on those important concepts.
- Provide opportunities for students to earn both individual points and group points during POGIL activities.
- Alternate between awarding group and individual points.
- Be sure to match the assessment questions you develop to the target objectives of the activity.
- Grade only the key questions.
• Consider giving extra points for the supplemental / extension questions.
• Put one of the questions from the POGIL activity on the test/summative assessment for the unit.
• Don’t forget to assess process skills. Remember if you don’t let them know process skills are important, the students won’t value process skills.
• Evaluate process skills subjectively and translate to 10% of grade in “Personal Skills” category.
• Establish a partnership with other colleagues to compare test questions used during an assessment and then reflect on student performance on those assessment items. Use this data as a springboard to brainstorm on how the instructional sequence or learning activities can be modified to improve student learning.

Student Roles

The use of student roles is a hallmark of the POGIL pedagogy and successful implementation of this learning strategy is dependent upon their use. Some practitioners believe roles are the real key to having a positive experience with POGIL. Particularly in the high school setting, because of the broad range of cognitive and social skill levels that exist within any given group of teenage students, it is essential to clearly define and provide instruction about the appropriate, pro-social behaviors associated with working in cooperative groups. This section of the guide provides tips and resources developed by our practitioners to help you incorporate student roles successfully into your classroom. Examples of student roles include: time keeper/timer, cheerleader/encourager, facilitator, spokesperson, quality control, process analyst, manager, recorder, reader, materials manager, document controller, technician. Most teachers form groups of 3 or 4 students, so not every role is used during an activity.
Description of Roles

In POGIL courses, most of the class work is done in groups of about four. The membership of the groups may change. The roles within a group will change to allow everyone an opportunity to try out a role. Here are some roles that are commonly used:

**Description of Roles**

**Manager/Facilitator**
Manages the group. Ensures that members are fulfilling their roles, that the assigned tasks are being accomplished on time, and that all members of the group participate in activities and understand the concepts. Your instructor will respond to questions from the manager only (who must raise his or her hand to be recognized.)

**Reader**
Reads the activity out loud to the group. The reader must monitor their volume so that their group can hear them, but other groups are not disturbed. This helps to keep everyone in the group together. The Manager will tell the Reader when it is time to read the next part of the activity.

**Recorder/Presenter/Spoksperson**
Records the names and roles of the group members at the beginning of each activity. Records the important aspects of group discussions, observations, insights, etc. The recorder’s report is a log of the important concepts that the group has learned. This person is also responsible for reporting orally to the class when called for in class discussions.

**Reflector/Strategy Analyst/Quality control**
Observes and comments on group dynamics and behavior with respect to the learning process. These observations should be made to the manager on a regular basis (no more than 20 minutes between reports) in an effort to constantly improve group performance. The reflector/analyst may be called upon to report to the group (or the entire class) about how well the group is operating (or what needs improvement) and why.

**Technician/Equipment Manager**
Gathers materials and uses any equipment other than paper and pencil. Performs all technical operations for the group, including the use of a calculator or computer. Unless otherwise instructed, only the technician in each group may operate equipment such as this.

**Encourager/Cheerleader**
Acknowledges the good ideas and insights of group members (or the group as a whole) through expressions such as “That was a really good point!” at appropriate times.

**Sigfig Checker**
This role should be self-evident

Note: Not all roles are assigned on any given day, and additional roles may be assigned to group members as needed.
Students need to be trained to use roles, as many have never done this type of group work before.

Start early in the year to train students - use often enough that they don't forget how to use roles, forms, procedures, etc.

Use consistently and pervasively from the start.

Continually reinforce the use of roles.

Show videos to demonstrate roles and skills needed to successfully work in a group. See appendix for POGIL / Hach URLs.

This page contains links to a collection of more than 40 videos, created through the POGIL / HACH Northern Colorado Consortium. The videos were designed as instructional tools to help students better understand the importance of effective interpersonal skills in group work. The brief vignettes show both positive and negative examples of interactions between students, providing a starting point for class discussion on student roles and appropriate behavior in group situations.

Point out positive examples of behavior when it occurs.

Have a class discussion / lesson on roles.

Practice roles and provide rationales for using the roles.

Use of Roles in POGIL Learning Activities

Cooperative learning as an instructional strategy has a large base of research spanning more than 20 years. Numerous studies support the effectiveness of cooperative learning strategies on improving learning as compared to individualistic or competitive learning structures. One necessary component of a successful cooperative learning structure is positive interdependence of group members. This positive interdependence can be achieved in many different ways but one commonly used strategy is the assignment of roles to individual group members. The specific names or responsibilities of the roles for group members vary throughout the different research studies but the overarching principal of using the roles to explicitly create positive interdependence of the group members remains consistent.

Some other benefits:

1. Reduction of the stress-level of the students. Once students know what is expected of them they are able to feel more at ease and focus on the learning of the content material or the targeted process skills.
2. Reduction of lost instructional time due to repeating instructions to students or distributing instructional materials.
3. Keeps group focused (expectations/guidelines.)

Notes on effective strategies on implementing roles in the classroom:

1. Be sure to have some type of training on what roles “look like” - what behaviors are expected for each role
2. Provide both written and verbal instructions on each of the roles
3. Use the roles consistently - if you as the teacher don't value the roles the students will not "buy in" to using the roles and consequently not develop the necessary positive interdependence.
4. Have some system for rotating the roles within the groups so that every student has regular opportunities to be in each of the different roles throughout the year.
• Leading up to the first few activities, introduce and emphasize roles each day by role-playing.
• Introduce the POGIL classroom with a role-focused activity.
• Have groups stay constant for the first few activities of the year to ensure that each group member has the chance to try each role.
• Shift roles within groups on a regular basis.
• Create posters as reminders of the responsibilities of each role. (see Appendix - Role Poster)
• Keep roles and job descriptions simple.
• Provide role cards that include sample statements. (See Appendix - Role Cards)
• Using roles promotes student leadership in the classroom.
• Have a student classroom facilitator of the day.
• Assess student knowledge of the roles prior to activity - ask each what is your role? What are your responsibilities in that role?
• Make sure that each role is used once during a class period to provide accountability for all.
• Be careful when assigning a reader - keep in mind 504 plans! Possibly allow volunteers for that job.
• The reader is key to keep students together.
• Place roles that need to move in easily accessible areas of the classroom.
• Using roles reduces the chance for one person to dominate.
• Have a part of a role be to watch the board for clarification/notes from teacher.
• Choose one role to monitor during each activity.
• Assess and provide feedback on role performance as part of process skill development. (See Appendix - Evidence of Competency)
• Allow for student reflection of process skills. (See Appendix - Process Analyst Report Form)
• Use teaching personal effectiveness as a part of teaching roles.
• Use the roles you are confident in monitoring as a facilitator.
• Use a visual so you know which roles you have - each role sits in a particular seat location at the table, badges (See Appendix - Role Badges)
• Colored placemats, (See Appendix - Role Cards)
• Poster (See Appendix - Roles Poster)
• Use a set of magnetic role cards on the board to show groups which position at the table is which role.
• Don’t do these activities without role cards! You may be tempted, but don’t do it. The visual is important, especially early in the year.
• Manager / Facilitator tends to be the hardest role - it needs to be worked on, reinforced from teacher and peers.
• Vary the group roles as needed, depending on the activity.
• Customize roles you choose to match students’ abilities in process skills and make sense for your students and the type of activity.
• Coordinate with other teachers that use collaborative group work so that the names and jobs of students are consistent from class to class, department to department.
• Using roles effectively may be the most important factor in successfully implementing POGIL!
Appendices

POGIL SSI Form

Effectiveness of POGIL

Talking Points

Role Cards

POGIL / HACH Northern Colorado Consortium
Interpersonal Effectiveness Videos URL’s

Roles Poster

Evidence of Competency

Process Analyst Report Form

Role Badges
Assessment Form

Your feedback is a critical part of improving our workshops. We want to improve both the content and materials of the workshop (Activities, on the left, below) and the effectiveness of our facilitators (Facilitation, on the right, below). Please be specific and candid with your comments.

1. Strengths
Describe at least one strength in each category and explain why it is a strength.

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2. Areas for Improvement
Describe at least one area for improvement in each category and how to achieve that improvement.

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3. Insights into Teaching/Learning
Please describe at least one insight into teaching or learning that you gained from this experience and explain how that insight is helpful to you.

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**Effectiveness of POGIL**

The effectiveness of POGIL has been assessed at a range of institutions and for a variety of courses. (Farrell et al., 1999; Hanson and Wolfskill, 2000; Hinde and Kovac, 2001; Lewis and Lewis, 2005; McKnight, 2004; Straumanis and Simon, 2006). Several common, and important, outcomes are observed in all of these studies:

- Student attrition is lower for POGIL than traditional methods.
- Student mastery of content is generally higher for POGIL than traditional methods.
- Most students prefer POGIL over traditional methods.

Below, we provide some details from studies of general chemistry and organic chemistry.

A previously published study compared the performance of general chemistry students taught using a traditional approach during the period 1990-1994 (n = 420) to students taught during the subsequent four years by the same instructors, but using the POGIL approach (n= 485). (Farrell et al., 1999) The attrition rate (D, W, F) decreased from 21.9% (traditional) to 9.6% (POGIL). The percentage of students earning an A or B rose from 52% to 64%. These data are consistent with a study of general chemistry at a different small liberal arts college in which the 1993 ACS General Chemistry Exam was used as a basis for comparison. Over the ten year period 1993-2003, in traditionally taught classes of about 40, the exam average was 56%, the highest average in a single year was 65%. In the first year of POGIL instruction (2004), the average was 68%. (McKnight, 2004)

POGIL has also been used successfully as a component of large lecture classes. The implementation of a POGIL approach in the recitation sessions in general chemistry at a large, public university in the Northeast resulted in examinations showing significant shifts of students from lower scores to higher scores, uniformly for low through high achieving students. (Hanson and Wolfskill, 2000) Lewis and Lewis (2005) studied the effect of replacing one of three general chemistry lectures each week with a peer-led team learning session using POGIL materials. They found that the students who attended the group learning sessions achieved a higher average score on the common examinations.

In a multi-institutional study of the effectiveness of POGIL in organic chemistry (Straumanis and Simon, 2006), complementary methods were used to compare POGIL and lecture courses with class sizes ranging from 20 to 75 across a range of institutions including a large public university and a small, 1st-tier liberal arts college. The similarities of the findings, despite differences in the studies, provide additional evidence for the general effectiveness of POGIL.

One important finding was that, at each institution, the percentage of unsuccessful students (defined as D, F or W) in the traditional sections was about twice that of the POGIL sections. This result was achieved without a drop in student performance as measured by conventional multiple-choice exams, including the ACS Organic Exam. For example, a medium-size regional university with a historical average of 64th percentile on the ACS Organic Exam (n = 517, 1999-2004), and a section-average range of 39th to 82nd percentile over this same period (20 different sections, 4 different professors), employed POGIL in one section of organic chemistry in the spring of 2005. The POGIL section scored in the 81st percentile despite an attrition rate of 8%, as compared to 26% in the traditional sections of organic chemistry taught that same semester.

A common question heard at POGIL faculty development workshops is: With POGIL, can you cover all the topics found in a traditional chemistry course? The cumulative nature of organic chemistry, and the above ACS Organic Exam data suggest that coverage is achieved using POGIL. This issue was also directly studied by taking students from a lecture organic 1 section and students from a POGIL organic 1 section, and putting them all together in the same organic 2 section (taught by a 3rd professor using traditional lecture). The result was no significant difference between the lecture and POGIL-trained students, despite higher throughput from
the POGIL organic 1 course into organic 2 (POGIL: 93% vs. lecture: 73%). This result also demonstrates that POGIL students can go on to be successful in a subsequent course taught using traditional methods.

While the above results allow valuable comparisons to be made between POGIL and traditional methods, student grades and performance on exams, particularly standardized exams, are a fairly narrow assessment of the effectiveness of POGIL. For example, exams say little about students’ growth with respect to POGIL’s targeted process skills such as critical thinking, teamwork, and self-assessment. Growth in process skills is hard to measure directly. An alternative is to measure students’ perceptions of their own growth with respect to such skills. This was done using the SALG (Student Assessment of Learning Gains) instrument. SALG questions also measure students’ perceptions of the value of certain course elements (e.g. the text, review sessions, tests, lectures, working with peers outside of class). The SALG was administered at four institutions using POGIL in some or all of their organic chemistry sections. Of 30 items tested, POGIL students responded more positively than their traditional counterparts on 29 of them, with 27 items showing significant differences between the cohorts (p<0.05)

Another question that often arises is: How do students respond to POGIL? 688 anonymous surveys were collected from organic students at six different institutions. The survey achieved over 98% compliance, with 381 responses from students enrolled in POGIL sections, and 307 responses from students enrolled in traditional lecture sections. The data shown in the figure below indicate that 80% of POGIL students would recommend POGIL over other methods of instruction, whereas less than 50% of lecture students are equally well disposed to a traditional approach. Only 6% of POGIL students appear hostile to the method, versus 30% of lecture students. Chi square analysis confirms that the POGIL students are significantly more positive about the method used in their classroom (χ²= 102.48, p <0.0005).

The data shown in the figure below represent students’ responses to the following statement: “I would recommend the method of teaching used in this course to a student taking this course next year.”
References


POGIL

Talking Points

• POGIL is an acronym for Process Oriented Guided Inquiry Learning.

• POGIL originated in college chemistry departments in 1994; it is now being used in many high schools and colleges in a variety of subject areas around the country.

• POGIL has been supported by grants from the National Science Foundation and the Toyota U.S.A. Foundation. POGIL has been regularly cited as a cutting-edge innovation in science education.

• POGIL uses guided inquiry – a version of the Socratic method in which students use carefully designed materials that guide them to construct new learning.

• POGIL is a student-centered strategy; students work in small groups with individual roles to ensure that all students are fully engaged in the learning process.

• POGIL is supported by research which shows that students in POGIL classrooms have higher test scores on common and standardized exams and higher retention rates than those who are taught through lecture alone.

• POGIL activities focus on core concepts and encourage a deep understanding of the course material while developing higher-order thinking skills.

• POGIL develops process skills such as critical thinking, problem solving, and communication through collaboration and reflection, making students more competitive in a global market.

• POGIL helps students learn to analyze and draw conclusions from complex data, skills which are emphasized on high stakes tests such as AP, IB, ACT and SAT.

• POGIL addresses many state and national standards for content, process skills and inquiry-based learning.

To learn more about The POGIL Project, please visit [www.pogil.org](http://www.pogil.org).

The POGIL Project is supported by the National Science Foundation under grants DUE-0618746, 0618758, and 0618800.
The High School POGIL Initiative for chemistry and biology is supported by a grant from the Toyota U.S.A. Foundation.
Manager

Make sure team starts quickly and remains focused during the activity.
Assign tasks for collecting and distributing materials as needed.
Assign roles like reader, technician or significant figure checker.
"I think we have everything, are we ready to begin?"

Takes care of time management.
Keep an eye on the clock.
Keep team moving forward and communicate about discussion deadlines.
I think we need to focus on __________, so we complete this section on time.
"We have ____ minutes before we need to discuss this. Let's get this done."

Make sure all voices in the team are heard.
Address team members by name and ensure that everyone contributes.
Encourage team members who are quiet or need more time to contribute.
"(Name), what do you think about ....?"
"I would like to hear what you think, (name)."
Quality Indicators for the POGIL Manager Role

The group begins promptly.

The group stays on task and progresses through the activity in a timely fashion.

All members of the group are participating.

Process Skills

Oral and Written Communication
Exchanging information and understanding through speaking, listening, and non-verbal behaviors. Conveying information and understanding to group members during activity. Contributing to group discussion, rephrasing concepts in own words, and using scientifically correct language.

Teamwork
Interacting with others and building on others' individual strengths and skills. Working toward a common goal, building consensus, compromising/ cooperating and sharing ideas. Respecting everyone's opinions.

Problem Solving
Identifying, planning and executing a strategy that goes beyond routine action to find a solution to a situation or question.

Critical Thinking
Analyzing, evaluating, or synthesizing relevant information to form an argument or reach a conclusion supported with evidence.

Management
Planning, organizing, directing, and coordinating one's own and others' efforts to accomplish a goal.

Information Processing
Evaluating, interpreting, manipulating, or transforming information.

Assessment (Self-assessment and metacognition)
Gathering information and reflecting on experiences to improve subsequent learning and performance or thinking/reflecting about one's thinking and how one learns, and being aware of one's knowledge.

Problem Solving
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Recorder

Records the names and roles of the group members at the beginning of each activity.

Records the important aspects of group discussions, observations, insights, etc.

“This seems like an important conclusion. Let's stop for a minute so I can get this into our report.” “That was a great insight. Do you mind (name) if I quote you in our group's report?”

The recorder's report is a log of the important concepts that the group has learned.
Quality Indicators for the POGIL Recorder Role

Pays attention to group comments and discussion and accurately records them. Accurately logs the important concepts the group has learned.

Process Skills

Oral and Written Communication
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Presenter

Communicates team questions and clarifications with the teacher or other teams. (This is the only team member designated to do so.)

“Our team is confused about how _____ relates to ______.”

“Our team reached consensus that the answer to number _____ was ______.”

Ensures all team members have had a chance to respond before asking outside sources.

“Does anyone in our team know the answer to ______?”

“Before we ask the teacher, could someone clarify the answer to ______”

Ensures that everyone in the team agrees on what to ask if an outside source is needed.

c”Does everyone agree we need to find out ______?”

Presents conclusions of the team to the class, as requested.

“The reasoning we used to answer number ________________________ was …”

POGIL
Quality Indicators for the POGIL Presenter Role

Clearly communicates team questions with instructor/other groups.
Seeks group input before consulting instructor or other groups.
Articulates questions and responses well.

Process Skills

Oral and Written Communication
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Teamwork
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Assessment (Self-assessment and metacognition)
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Reflector

Guides consensus-building process; team must agree on responses to questions. • "Would you all agree that ____________________________ is a good answer for question number___?"
  • "Could you please rephrase what you just said?"
  • "Is your answer completely supported by your explanation?"
  • "Would that response make sense to someone from another team?"

Observes team dynamics and behavior with respect to the learning process.
  • Is everyone in the team participating?
  • Are team members listening carefully to each other?
  • Are team members being patient and respectful of each other?

Reports to the team periodically during the activity on how the team performs.
  • "Let's stop for a minute. I have a couple comments on what we are doing well and a suggestion on how we could be more productive."
  • "Let's wait for (name) to catch up before we move on."

Be ready to report to the entire class about how well the team is operating.
Quality Indicators for the POGIL Reflector Role

- Regularly checks that group members' answers are consistent (not necessarily identical).
- Encourages team members to make sure answers are thorough.
- Observes and comments on team dynamics to the group and to the class as a whole.

Process Skills

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This page contains links to a collection of more than 40 videos, created through the POGIL / HACH Northern Colorado Consortium. The videos were designed as instructional tools to help students better understand the importance of effective interpersonal skills in group work. The brief vignettes show both positive and negative examples of interactions between students, providing a starting point for class discussion on student roles and appropriate behavior in group situations.

Video #1 - Communicating Clearly (mumbling)  
https://www.youtube.com/watch?v=FfZe8phRgSE

Video #2 - Communicating Clearly (distracted - texting)  
https://www.youtube.com/watch?v=h4u9ieJV0Aw

Video #3 - Communicating Clearly (avoiding partner work)  
https://www.youtube.com/watch?v=fj6XpSsJGpI

Video #4 - Communicating Clearly (not contributing)  
https://www.youtube.com/watch?v=4qs7ERyaQZ0

Video #5 - Communicating Clearly (brusque, no eye contact)  
https://www.youtube.com/watch?v=9tmvXzcTbe0

Video #6 - Communicating Clearly (negative attitude)  
https://www.youtube.com/watch?v=1miiGzlK9hQ

Video #7 - Listening Skills (positive example of active listening)  
https://www.youtube.com/watch?v=BjkoRRaoLvU

Video #8 - Listening Skills (positive example of active listening)  
https://www.youtube.com/watch?v=JsN6kBOvdsk

Video #9 - Listening Skills (positive example of active listening)  
https://www.youtube.com/watch?v=pT19NRQ6wZc

Video #10 - Listening Skills (positive example of active listening)  
https://www.youtube.com/watch?v=yQDz455In2I

Video #11 - Listening Skills (positive example of active listening)  
https://www.youtube.com/watch?v=qYab2m6lwJo

Video #12 - Listening Skills (positive example of active listening)  
https://www.youtube.com/watch?v=vhWCRGX1drQ
Video #13 - Listening Skills (negative example, no eye contact)
https://www.youtube.com/watch?v=WcwLsmyahew

Video #14 - Listening Skills (negative example, minimal discussion)
https://www.youtube.com/watch?v=6j5syHqm1uE

Video #15 - Listening Skills (negative example, distracted)
https://www.youtube.com/watch?v=Sa45zQQrWrc

Video #16 - Courteous Interactions (positive example of helping)
https://www.youtube.com/watch?v=JMP9yP2GqUE

Video #17 - Courteous Interactions (negative example, not sharing information)
https://www.youtube.com/watch?v=GwfQo-q5ZeE

Video #18 - Courteous Interactions (positive example, correcting a peer)
https://www.youtube.com/watch?v=RuDT2hogCu8

Video #19 - Courteous Interactions (negative example)
https://www.youtube.com/watch?v=y0KSfuouEss

Video #20 - Courteous Interactions (negative example, not cooperative with group)
https://www.youtube.com/watch?v=sQR0W-7ZB1A

Video #21 - Courteous Interactions (negative example, not cooperative with group)
https://www.youtube.com/watch?v=A-EAM1jjuhY

Video #22 - Taking Responsibility (positive example, student forgot homework)
https://www.youtube.com/watch?v=Su94EQliU4M

Video #23 - Taking Responsibility (positive example, student forgot homework)
https://www.youtube.com/watch?v=xKzoLOyz7Nc

Video #24 - Taking Responsibility (positive example, student forgot homework)
https://www.youtube.com/watch?v=rVLHg2Y4_Fk

Video #25 - Taking Responsibility (negative example, blaming teacher)
https://www.youtube.com/watch?v=HYJeFralLM

Video #26 - Taking Responsibility (negative example, making excuses)
https://www.youtube.com/watch?v=KGdtQ-VaiXg

Video #27 - Taking Responsibility (negative example, rushing and copying)
https://www.youtube.com/watch?v=c_cRk7Cb2TE

Video #28 - Accepting Feedback (positive example, correcting an answer)
https://www.youtube.com/watch?v=4uQ8AsdvJ68
Video #29 – Accepting Feedback (positive example, correcting a peer)
https://www.youtube.com/watch?v=Tdcye6JBjIM

Video #30 – Accepting Feedback (positive example, different answers)
https://www.youtube.com/watch?v=AJWU6vqoHSQ

Video #31 – Accepting Feedback (negative example)
https://www.youtube.com/watch?v=2_kv-4_beCU

Video #32 – Accepting Feedback (negative example, disagreeing on answer)
https://www.youtube.com/watch?v=xLIDY7COU

Video #33 – Accepting Feedback (negative example)
https://www.youtube.com/watch?v=IOCyDq-6XBg

Video #34 – Dealing with Conflict (positive example, handling disagreement)
https://www.youtube.com/watch?v=uFl7RRdRYdU

Video #35 – Dealing with Conflict (positive example, handling disagreement)
https://www.youtube.com/watch?v=SvPPK6oqVoY

Video #36 – Dealing with Conflict (positive example, handling disagreement)
https://www.youtube.com/watch?v=xAkFh6wVZck

Video #37 – Dealing with Conflict (negative example, responding with anger)
https://www.youtube.com/watch?v=LFQPthdGnqw

Video #38 – Dealing with Conflict (negative example, arm wrestle)
https://www.youtube.com/watch?v=-Oj0fz7qCR0

Video #39 – Dealing with Conflict (negative example, no consensus)
https://www.youtube.com/watch?v=gu2a0QfHvkM

Video #40 – Dealing with Conflict (negative example, partners don't get along)
https://www.youtube.com/watch?v=jyTNPUh_gf0

Video #41 – Dealing with Conflict (negative example, fighting over paper)
https://www.youtube.com/watch?v=Hlxl4HJp8Dc

Video #42 – Dealing with Conflict (negative example, partner conflict)
https://www.youtube.com/watch?v=Uth8OpMTI2Y
TECHNICIAN
“What do we need? I’ll get it.”

Participate actively.
Reach an agreement with your group members before you write anything down. Write answers that are clear and complete.
Gather any necessary materials.
Conduct the experiment or activity.
Show your group members each step of the experiment or activity.
Clean and put away the materials.

DOCUMENT CONTROL
“Let me see if everyone has finished this question before we move on.”

Participate actively.
Make sure everyone comes to an agreement on most answers before anyone writes anything down. Write answers that are clear and complete.
Double-check work before you and group members record anything.
Position your written work on your desktop so that the teacher can see your answers without interrupting your group.

MANAGER
“Come on, let’s get moving. No slacking.”

Participate actively.
Reach an agreement with your group members before you write anything down. Write answers that are clear and complete.
Keep track of time, so your group can meet the goals for the day.
Push everyone to get all their work done and to stay focused on your tasks.
Make sure everyone does his or her assigned job.

ENCOURAGER/CHEERLEADER
“You did a great job on your task today!”

Participate actively.
Reach an agreement with your group members before you write anything down. Write answers that are clear and complete.
Notice and tell other members what they are doing to help your learning group succeed.
Suggest specific actions that each member can take to improve how well the group works together to meet goals.

READER
“Okay, I’ll read the activity out loud for everyone.”

Participate actively.
Reach an agreement with your group members before you write anything down. Write answers that are clear and complete.
Read every word in the activity, so everyone follows the same order of activities.
Read slowly enough that other group members can read along and process the information well.

SPOKESPERSON
“Here’s what my group found out…”

Participate actively.
Reach an agreement with your group members before you write anything down. Write answers that are clear and complete.
Ask questions of the teacher; report out your group’s data to the class; interact with other groups to compare results.
### Personal Effectiveness Competencies

#### Interpersonal Skills
- Speaks clearly, confidently, and with appropriate eye-contact with audience

#### Integrity
- Treats others honestly, fairly, and courteously (words required)
- Accepts responsibility for one’s decisions and actions

#### Professionalism
- Accepts feedback and attempts to learn from mistakes or misunderstandings
- Demonstrates positive attitude toward work and others

#### Life-long Learning
- Seeks feedback and asks questions to strengthen own understanding
- Uses newly learned knowledge and skills to complete specific tasks

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### Group’s Area for Improvement

#### Personal Effectiveness Competencies

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- Speaks clearly, confidently, and with appropriate eye-contact with audience

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### Evidence of Competency

**Role:** Facilitator  
**Spokesperson**  
**Quality Control**

#### Personal Effectiveness Competencies

<table>
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<tr>
<th>Interpersonal Skill</th>
<th>Evidence for</th>
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<tr>
<td>Demonstrates positive attitude toward work and others.</td>
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<tr>
<td>Manages conflict respectfully while maintaining progress toward a goal.</td>
<td></td>
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<tr>
<td>Seeks feedback and asks questions to strengthen one’s understanding.</td>
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<tr>
<td>Uses newly learned knowledge and skills to complete specific tasks.</td>
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**Group’s Area for Improvement**

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</table>

**Role:** Process  
**Analyst**
Process Analyst Report Form

Activity Title ____________________    Team Members __________________
                                                __________________
                                                __________________
                                                __________________

 Evidence of Effective Process Skills     Evidence of Ineffective Process Skills

<table>
<thead>
<tr>
<th>☑ Evidence of Effective Process Skills</th>
<th>☐ Evidence of Ineffective Process Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

1. Use of Time

100%                 100%         
Socializing            On Task

2. Which three process skills (from the list) did your group do particularly well?

3. What process skill(s) need improvement? Explain.

4. What frustrated your group most today?

5. Team Effectiveness:

We were NOT Effective (0%)                             We Rocked! (100%)
<table>
<thead>
<tr>
<th>Manager</th>
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</thead>
<tbody>
<tr>
<td>- Checks for understanding of all group members</td>
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</tr>
<tr>
<td>- Encourages all group members to participate</td>
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</tr>
<tr>
<td>- Tells Reader when to read and when to stop reading</td>
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<tr>
<td>- Raises hand to get the teacher when group has a question</td>
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Manager
- Checks for understanding of all group members
- Encourages all group members to participate
- Tells Reader when to read and when to stop reading
- Raises hand to get the teacher when group has a question
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<thead>
<tr>
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<tr>
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</tr>
<tr>
<td>Recorder/Presenter</td>
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</tr>
<tr>
<td>--------------------</td>
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</tr>
<tr>
<td>Carefully records the group’s answers to questions for the “official” copy</td>
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</tr>
<tr>
<td>Presents the group’s answers in class discussions</td>
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</tr>
<tr>
<td>Travels between groups (when directed by the teacher) to check answers</td>
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</tr>
<tr>
<td>Technician</td>
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<td>Technician</td>
</tr>
<tr>
<td>------------</td>
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</tr>
<tr>
<td>Gathers equipment or materials for the group</td>
<td>Gathers equipment or materials for the group</td>
<td>Gathers equipment or materials for the group</td>
</tr>
<tr>
<td>Handles objects used as models for the group</td>
<td>Handles objects used as models for the group</td>
<td>Handles objects used as models for the group</td>
</tr>
<tr>
<td>Operates any equipment needed by the group</td>
<td>Operates any equipment needed by the group</td>
<td>Operates any equipment needed by the group</td>
</tr>
<tr>
<td>Uses calculator for all calculations required</td>
<td>Uses calculator for all calculations required</td>
<td>Uses calculator for all calculations required</td>
</tr>
<tr>
<td>Checks significant digits on all mathematical answers</td>
<td>Checks significant digits on all mathematical answers</td>
<td>Checks significant digits on all mathematical answers</td>
</tr>
</tbody>
</table>