

## Reference Packet

For the next two weeks, this reference packet, and additional resources can be downloaded at:

[http://www.webpages.uidaho.edu/mindworks/active\\_learning.htm](http://www.webpages.uidaho.edu/mindworks/active_learning.htm)

Active Learning Symposium

10:30 – 11:20 – Whitewater Room

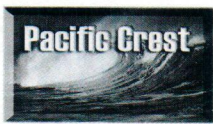
Starting Small - Converting a Single Lecture to an Active Format

Presenters: Dan Cordon and Sean Quallen - University of Idaho

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## 2.4.14 Designing Process-Oriented Guided-Inquiry Activities

by David Hanson (Chemistry, Stony Brook University)

Faculty Development Series

Research in the cognitive sciences, contemporary learning theory, and classroom research contribute to a design for classroom activities or lessons that is based on how people learn. This design recognizes that people learn by constructing their own understanding in a process that involves accessing prior knowledge and experiences; following a learning cycle that consists of exploration, concept formation, and application; discussing and interacting with others; reflecting on progress in learning; and assessing performance (Bransford, Brown, & Cocking, 2000). In this design, each activity consists of five stages: *orientation*, *exploration*, *concept formation*, *application*, and *closure*. These activities are most effective when teams of students work on them together with much discussion both within and between teams. The sequence of exploration, concept formation, and application lies at the heart of this design. This sequence, called the “Learning Cycle,” was originally proposed by Karplus as part of SCIS, the Science Curriculum Improvement Study (Atkin & Karplus, 1962; Karplus & Thier, 1967). A discussion of the Learning Cycle is provided by Lawson (1995), and studies have documented that most students learn best when this sequence is followed. Specifically, students exhibit improved attitudes, higher achievement, better understanding and retention of concepts, and the development of learning process skills (Raghubir, 1979; Lott, 1983; Abraham & Renner, 1986; Abraham, 1988; Lawson, Abraham, & Renner, 1989).

### Orientation

The orientation stage prepares students for learning. It provides motivation for the activity and creates interest, generates curiosity, and makes connections to prior knowledge. Learning objectives and criteria for success are identified. As a result, learning is enhanced because the learner feels that the topic is important and worthwhile, the learner has some understanding of what is being learned, and the learner can build understanding from explicit prior knowledge. The identification of learning objectives and success criteria focuses the learner’s efforts on essential issues and sets the expected level of mastery. Background, vocabulary terms, prerequisites, and references to resources provide the learner with the necessary information to begin learning something new.

### Exploration

Each activity gives students a plan or a set of tasks to follow that embody what is to be learned and that leads to meeting the learning objectives. In the exploration stage, students have the opportunity to make observations; design experiments; collect, examine, and analyze data or information; investigate relationships; and propose, question, and test hypotheses.

### Conceptual Formation

As a result of the exploration, concepts are invented, introduced, or formed. Rather than presenting information in texts or lectures, educators engage students in guided inquiry or discovery to develop their conceptual understanding. This process is structured by supplying questions that compel students to think critically and analytically as they engage in the exploration. These questions, which are called guided-inquiry, critical-

thinking, or key questions, guide the learner in the exploration. They can help define the task, direct the learner to information, lead the learner to appropriate connections and conclusions, and help the learner construct understanding of the concept being learned.

### Application

Once the concept is identified, it is reinforced and extended. Application involves using the new knowledge in exercises, problems, and even research situations. *Exercises* give the learner the opportunity to build confidence in simple situations and familiar contexts. *Problems* require the learner to transfer the new knowledge to unfamiliar contexts, synthesize it with other knowledge, and use it in new and different ways to solve real-world problems. *Research questions* identify opportunities for the learner to extend learning by raising new issues, questions, or hypotheses.

### Closure

Each activity ends with the students validating their results, reflecting on what they have learned, and assessing their performance. Validation can be obtained by reporting results to peers and to the instructor to get feedback regarding the content and the quality. When students are asked to reflect on what they have learned, their knowledge is consolidated, and they see that they have been rewarded for their hard work. Self-assessment is the key to improving performance. When students recognize what they have done well, what they need to improve, and what strategies they need to develop in order to achieve these improvements, they are both encouraged and motivated to work toward their goal. Self-assessment is the key to success in courses, college, and careers because it produces continual improvement.



### An Activity Design Methodology

1. **Identify the focus of the activity.** An activity will usually involve one of the following: learning a concept, developing proficiency with a process or use of a tool, or increasing understanding within a context of a discipline. The focus should be sufficiently sharp so that each activity can be completed in 20 to 40 minutes.
2. **Select and develop the principal activity type.** Since students have a variety of preferred learning styles and since learning takes place in many different forms and disciplines, it is useful to have many tools, techniques, and processes to support learning. A productive learning environment will incorporate a diversity of activity types. A list of possibilities is provided in *2.4.13 Overview of Learning Activities*. Also, any single activity can be composed of a combination of activity types. The activity should be at the appropriate level for the students and should support the learning objectives and success criteria.
3. **Choose an appropriate title.** Use a short sentence or phrase rather than a word or two. The title should be clear and inspiring, and should convey a sense of the content.
4. **Create the “Why” for the activity.** Begin each activity with a section titled “Why.” This section should put the activity in context for the learner by addressing three questions: What will the student learn? Why is it relevant to the subject? Why is it relevant to the learner? The first sentence clarifies the title and further defines the content of the activity. The second sentence defines the general importance of the activity and describes how it fits into the course. The third sentence provides justification for the activity from the perspective of the individual learner.
5. **Identify the learning objectives.** A learning objective identifies what is to be learned or understood as a result of completing the activity. An activity should have two or three objectives: activities with only a single objective may not be very interesting to the learner while those with many objectives may be too formidable. Objectives should be orthogonal, i.e., not overlapping, and should relate to the “Why” statement. Compound objectives need to be separated. The objectives should be written in a clear, concise style that is easy for students to understand, so both students and faculty know when they are achieved. The most important objectives should be listed first and the least important last. Finally, objectives should include learning process skills, not just mastery of content.
6. **Define the success or performance criteria.** Success criteria are the measurable outcomes of the activity; they describe what the learner should be able to do after completing the activity. Good success criteria are understandable, measurable, realistic, and relevant to the learning objectives. Generally, an activity should have one or two success criteria. Without any criteria, students can easily lose accountability for their outcomes and the tendency is to coast through the activity with minimal effort. More than two criteria can confound students and cause them to lose their focus. If students know what is expected and how they will be assessed, their accountability and performance level increase dramatically.
7. **Identify prerequisites.** Students and others who may use your activity need to know what prior knowledge and skills are needed to complete the activity and whether any reading assignments need to be completed in advance.
8. **Identify necessary information and resources.** The information and resources should help students answer the key questions and complete the activity. Information can be provided within the activity itself, by outside resources that are referenced for students, or by sources that they need to find or research for themselves.
9. **Create a glossary of relevant terms.** List the new important terms and vocabulary required to complete the activity. Definitions may accompany the terms, or you may require students to find and write definitions in the glossary in their own words.
10. **Write a plan for the activity.** The plan is a numbered list of tasks or steps that detail what is to be done in the activity. A process-oriented course is likely to be a new experience for the students, so at the beginning of the course, the plan should be explicit, thorough, and complete. As the course progresses, it should become less structured, providing broad guidance and challenging the students to devise the specifics. After the students have gained experience, the plan may be implicit, or the students can be asked explicitly to develop their own plan in order to achieve the stated objectives and meet the success criteria.
11. **Create key questions.** Critical-thinking questions are the heart of a guided-inquiry learning environment in which students are actively working to learn new content and develop process skills. This form of learning is most effective when it involves the use of three types of questions: *directed*, *convergent*, and *divergent*. Each activity should require students to



answer five to ten key questions: two or three directed questions, two to six convergent questions, and one divergent question.

*Directed questions* require that students process and recall information. The answer can be found by examining the model, information, resources, or by drawing on personal experience and prior knowledge. Such questions have a definite answer and build the foundation for more challenging questions.

*Convergent questions* require that students make connections and reach conclusions that are not obvious upon first examination. Convergent questions have answers that are not directly available in the model, information, or resources; they require students to analyze and synthesize; and they may have more than one correct answer. The level of difficulty should progress with the questions, and the questions should drive students to develop and understand the concepts presented in the activity.

*Divergent questions* send students in different directions. This type of question may have no right or wrong answer, but it requires students to ponder, explore, generalize, and expand upon their current knowledge. Divergent questions require the highest level of thinking and produce outcomes and conclusions that vary among teams and individuals. Divergent questions have no readily available solution, are open-ended, provide significant challenges, do not need to relate directly to the learning objectives, and are beyond the stated success criteria for the activity. They may even launch research ideas.

12. **Develop skill exercises.** Students apply their new knowledge in simple situations and familiar contexts to build confidence and to strengthen understanding. Typically an activity should have two to five exercises. They often repeat the key questions in an identical or similar context as that presented by the model.
13. **Design problems.** These problems present new situations that require students to transfer, synthesize, and integrate what they have learned. The purpose is to move them to the problem-solving level of knowledge. The problems often have a real-world context, contain superfluous or missing information, have multiple parts, do not contain overt clues about the concepts needed to arrive at a solution, and may not have a right answer.

In a process-oriented classroom, student teams will work at different rates and will not complete sections of the activity at the same time. The differences are made easier for faculty to manage by using different levels

of key questions and problems. An open-ended or divergent key question at the end serves as an equalizer for faster teams who reach this question ahead of others. Such questions can take up considerable time, especially with added facilitation and intervention by the instructor, allowing other teams to catch up. Not all teams will get as far on such questions, and it is important to reward or acknowledge the efforts of the faster teams for their additional work, especially if it is of high quality. Problems of varying difficulty also serve the purpose of pacing the class. The most difficult problems should be at the end. Also, note that the amount of blank space left between questions, exercises, or problems on a work sheet sends a message to the students about your expectations for their response. There should not be equal amounts of space between every question.

#### 14. **Determine how closure will be accomplished.**

Students must have some means for validating their results, and they need to be encouraged to self-assess their performance and identify ways they can improve. Their learning will also improve if they are given the opportunity to reflect on what they have learned. Self-assessment and reflection should be done in a meaningful and interesting way, consistent with the learning objectives and success criteria.

### Activity Template

The components in the Activity Design Template in Table 1 (on the following page) contribute to high-quality, process-oriented, guided-inquiry activities. While all enhance learning, not every one is needed in each activity. For example, while learning objectives and success criteria definitely should be part of the instructor's planning, it may be desirable for students to work on the exploration and concept formation without this information.

### Concluding Thoughts

While the focus of this module has been the design of *guided-discovery* learning activities, the same principles and methodology also apply to the design of other types of learning activities. The learning objectives of an activity should either contribute to or match the learning outcomes of the course. Activities are where student learning occurs in support of the learning outcomes for a course. It is important to use several different activity types during a course both for variety's sake and to support the varying learning styles of students. A learning activity should always be assessed by students to identify opportunities for refinement and improvement.



Table 1

**Activity Design Template**

<b>Title</b>	Label the activity.
<b>Why</b>	Explain and identify the reasons for learning.
<b>Learning Objectives</b>	List what is to be learned.
<b>Success Criteria</b>	Determine the desired outcomes and abilities that will be used to measure performance and achievement.
<b>Prerequisites</b>	Identify the prior skills and knowledge that are needed.
<b>Resources and Information</b>	Provide information needed for the activity. Additional information can be provided to help students consolidate their learning after they have completed the "key questions." List essential references related to the activity.
<b>Glossary</b>	Provide key terminology.
<b>Plan and/or Tasks</b>	List the plan and/or tasks for meeting the learning objectives.
<b>Key Questions</b>	Pose questions that guide the execution of the plan and/or tasks, the exploration of the model, and processing of the information and resources in order to stimulate thought, introduce or form concepts, and construct understanding.
<b>Skill Exercises</b>	Apply the new knowledge in simple situations and familiar contexts.
<b>Problems</b>	Use the knowledge in new or real-world contexts requiring transference, synthesis, and integration of concepts.
<b>Validation</b>	Share results with peers and assess.
<b>Reflection on Learning</b>	Have students think about what has been learned and assess how well the material has been mastered.
<b>Self Assessment</b>	Have students identify what has been done well, and develop strategies for improvement.

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## Common Activity Types

### Excerpt from the Faculty Guidebook, 2.4.13: Overview of Learning Activities

#### 1. Guided-Discovery Learning

This type of activity requires students to construct knowledge in one of five forms: conceptual, process, tool, context, or way of being. Typically, the level of knowledge attainment for students is at the working-knowledge or problem-solving level. In guided-discovery activities the instructor identifies key resources, models, and background information, and provides a set of critical-thinking questions that guide students' thought processes in constructing knowledge at the desired level.

#### 2. Interactive Lecture

This is an alternative to an uninterrupted lecture that lasts for an extended period of time. The goal is to build in checkpoints during the lecture during which students test their understanding of what has been presented. Techniques for generating interactivity include giving a short quiz at the end of class; providing a set of critical-thinking questions that are intended to be processed during the lecture; taking breaks during which teams of two or three students think, pair, and share responses to interesting questions; assigning homework problems; and asking students to write one-minute papers in which they identify main points or muddiest points in what has been presented (Angelo & Cross, 1993).

#### 3. Student Teaching

Educators know that those who teach learn the most, and that the true test of understanding comes when a person is put in a position of teaching others. The more often students are put in the role of teacher, the more responsibility they will feel for the important learning outcomes in the course. The measure for assessing the performance of student teaching should be based on the ability of learners to perform using the knowledge associated with the activity, not on whether the faculty member likes the quality of the presentation or the level of understanding demonstrated by the student

teacher.

#### 4. Problem Solving

These activities require students to apply knowledge to new contexts, integrating complex relationships with prior knowledge. Problems should be relevant, challenging, and motivating; they should integrate knowledge gained in the class, and should require the use of a problem-solving methodology. This type of activity also lends itself well to team competition and games.

#### 5. Projects

Compared to problem solving, projects involve even greater amounts of problem identification and definition, they occur over longer periods of time, and they place more emphasis on communicating the results in a formal manner. Projects that involve team formation and development can promote the development of learning skills in the social and affective domains. An excellent way to celebrate project success is to create a poster session that is open to faculty and students outside of class.

#### 6. Self Assessment and Peer Assessment

If student learning is the goal of an activity, then assessment of student learning should be integrated in some form into almost every learning activity (Wiggins et al. 2005). A variety of assessment tools and methods are found throughout the *Faculty Guidebook* that can be incorporated in free-standing activities or supporting components of other activities.

#### 7. Student Presentations

This can be a less formal variant on student teaching. Students display some aspect of part of a performance in the class, such as homework solutions, answers to quizzes, findings from reading assignments, peer assessments, and team assessments. A higher-stakes variation of the



student presentation is a *fishbowl* situation in which a team of students works through a problem while the rest of the class watches and assesses what they see. An important part of any public performance by students is a class-wide discussion that acknowledges strengths, constructively suggests improvements, and generalizes lessons learned.

## 8. Self-Study

The nature of this activity is to allow the student to self-facilitate his or her own learning to meet the performance criteria. The facilitator's role is to provide the learner with a complete set of resources, performance criteria, and assessment tools. When using the self-study technique it is important to make sure that the scope of the activity is within the boundaries of the learner's performance capabilities, that the activity is self-contained, that there are measures for assessing performance, and that the learner has an opportunity to apply the knowledge in a relevant context.

## 9. Reading

In this type of activity students are responsible for comprehending written material, but typically they do not understand what they are supposed have learned or what they should be able to do as a result of reading the material. Quizzes and short essay questions can be used to motivate students to come to class better prepared when a reading has been assigned.

## 10. Technology

Computer-based and internet learning systems, called *interactive learning systems*, offer an asynchronous environment in which students interact with the computer and with classmates as they think through, practice, and synthesize new knowledge. This taps into an emerging part of youth culture that may engage students whose learning styles lead them to be less vocal in the classroom.

## 11. Role Playing

Students are encouraged to consider new perspectives and issues associated with a situation when

they engage in role playing. The instructor creates a scenario, assigns appropriate roles, provides information, and asks the groups to enact that scenario being faithful to their roles and using their knowledge of the subject. The module on has more information about using formal roles in learning activities as well as case studies and jigsaw sessions.

## 12. Consulting

This is a popular alternative to lecture where faculty members lend their expertise to questions and problems posed by students. While this can be a very effective starting point for a just-in-time lecture, faculty are advised to limit the time they spend consulting and redirect this effort to assessing learning. The quality of student thinking can be improved if students are challenged to process information prior to consultation and are limited in the number of questions they can ask.



## Matching Activity Types with Knowledge Forms

The table below matches some of the various activity types with the forms of knowledge (from a knowledge table) and indicates the appropriateness and effectiveness of the activity type; where 6 is very appropriate and 0 is not appropriate.

6 = very appropriate

0 = not appropriate

Activity Type	Concept	Process	Tool	Context	Way of Being
Guided Discovery	4	4	4		2
Lecture	2	1	1		1
Interactive Lecture	4	1	2		2
Problem Solving	1	5	3	4	1
Student Teaching	3	1	1	1	1
Laboratories		4	6	3	1
Research	3	3	2	3	2
Projects		2	3	4	1
Group Discussion	4	1		2	2
Student Presentation		1		1	
Assessment		3	1		2
Self-Study	1		2		1
Collaborative Learning	2	3	2	2	1
Using Technology		2	3		
Problem-Based Learning	1	3	2	4	2
Self-Assessment	1	1	2	1	3
Journal Writing	2	2	1		4
Reading	6	1	1	1	2
Team Building					1
Consulting Session	1	1	1	2	1
Planning		1	2	1	
Writing	2	2		2	
Portfolio		2		1	2
Storytelling		1	1	4	1
Demonstration	1	5	4		1
Role Playing		1		3	4
Service Learning	2	4	2	6	5
Poster Sessions	6	3	2	3	4
Student Consulting	6	4	3	2	2



## Developing Shared Understanding of Course Content and Expectations

Recorder \_\_\_\_\_ Spokesperson \_\_\_\_\_ Spy \_\_\_\_\_

### Orientation

In this activity, your team will review the course syllabus as a means to understand course requirements and expectations, uncover areas of confusion, and provide directional change so your outcomes can be covered in the course. Questions not answered by the syllabus should be raised early in the semester to ensure everyone has a shared vision of course outcomes and key deadlines.

### Learning Objectives

1. Identify two areas of pre-requisite topics that need polishing, and methods for getting up to speed.
2. Identify two course topics of greatest interest and greatest challenge.
3. Review classroom policies about honesty, and civility.

### Targeted Skills

Inquiring – asking key questions

Collaborating – working together for mutual benefit

Initiating Interaction – approaching and engaging others

1. What do you predict will be the three most significant topics from CHEM 111 and PHYS 211 that will be used in this course? What can you do to polish up on them?
2. Which two course goals listed in the syllabus stand out most to you? Why?
3. There are three columns on the schedule of our course website. What actions do you need to take on each of the columns?



4. What are the expectations surrounding the completion and submission of homework in this course? Who are you going to work on it with?
5. What are the major components of your grade in this course? What is the relative importance of each component?
6. What percentage do you need to earn to get the grade you want in this course?
7. How soon do you need your textbook? If you don't have it yet, what are your plans for getting one?
8. What are your top two questions about this course for which the syllabus does not provide answers?
9. What do you need to bring with you to the next class period?



# Activity Design Template for Faculty

## Design Team Members:

### 1. Identify purpose

### 2. Title

### 3. Type of Knowledge Item

Concepts (IA)

Processes (M)

Tools (T)

Contexts (CS)

Ways of Being (P)

### 4. Create the Learning Model / Instrument for the Knowledge Item

**Methodology** (*Process*), **Profile** (*Way of Being*), **Story/Case Study** (*Context*), **Template** (*Tool*), **Interactive Model** (*Concept – delay till step 10*)

### 5. Why?

What?

Big Picture

Relevance

### 6. Learning Objectives

### 7. Performance Criteria with attributes

### 8. Learning Skills

Cognitive

Social

Affective

Psychomotor



**9. Key Critical Thinking Questions**

Directed

Convergent

Divergent

**10. Plan/Tasks for Execution of Activity****11. Pre Activity****12. Sequencing Critical Thinking Questions****13. Information and Resources Needed****14. Prior Knowledge Required****15. Glossary**

Previous Terms

New Terms

**14. Skill Exercises****15. Problems to Be Addressed****16. Technology to Be Used****17. Validation/Reflection of Learning****18. Self Assessment****19. Closure**