











### **Cooperative Learning Objectives**

Participants will be able to list and describe essential features of the instructor's role in implementing cooperative learning

Participants will be able to elaborate on multiple ways Positive Interdependence and Individual Accountability can be structured

Participants will identify features to implement in their own courses

### **PROJECT-BASED LEARNING VIGNETTE**

Jon J Kellar - Materials and Metallurgical Engineering

Course: Met 220L Mineral Processing and Resource Recovery

Required laboratory course for Metallurgical Engineering students

Enrollment typically 20-25 students, taught every spring semester

Prior to 2015 taught in a traditional manner, weekly lab exercises and student memo/lab report

There were 15 lab exercises, often leaving unused time within the 3 hour laboratory time block (opportunity for efficiency)

### **PROJECT-BASED LEARNING VIGNETTE**

- Concept---make labs more efficient and merge like labs to create a five-week final project
- The project would require that students 'put into practice' the prior lab training (magnetic, gravity separation etc.)
- Projects typically are of local interest---first project was the 'Gold Rush' project (see image)



National Smelting Company had smelter on edge of campus—adjacent present day O'Harra Stadium

### **PROJECT-BASED LEARNING VIGNETTE**

- Gold Rush Project involves student teams collecting samples from 'Smelter Hill' and determining how much gold they could concentrate
- Five out of six teams were able to assay for gold content with the winning team producing a sample assaying at 63 oz/ton
- Subsequent projects have involved concentration of nickel powder from spent 3D printing powder, concentration of garnet from spent water jet cutting materials and a 'student selection' project

### **PROJECT-BASED LEARNING VIGNETTE**

- Assessment results (student course surveys and SGID) indicate that the students enjoy the final project, and also appreciate the competitive aspects and team-building associated with the project
- Instructor assessment---much more rewarding teaching experience than previous format, allows industrial interaction that feeds into departmental senior design projects, student hires, research and fundraising

>Questions/Comments? Jon.kellar@sdsmt.edu









A team is a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable:

SMALL NUMBER

- COMPLEMENTARY SKILLS
- COMMON PURPOSE & PERFORMANCE GOALS
- COMMON APPROACH
- MUTUAL ACCOUNTABILITY

--Katzenbach & Smith (1993) The Wisdom of Teams **Cooperative Learning** is instruction that involves people working in teams to accomplish a common goal, under conditions that involve both *positive interdependence* (all members must cooperate to complete the task) and *individual and group accountability* (each member is accountable for the complete final outcome).

### **Key Concepts**

- Positive Interdependence
- Individual and Group Accountability
- □ Face-to-Face Promotive Interaction
- Teamwork Skills
- Group Processing

http://personal.cege.umn.edu/~smith/docs/Smith-CL%20Handout%2008.pd



## Six Basic Principles of Team Discipline

Keep membership small

Ensure that members have complimentary skills

Develop a common purpose

Set common goals

Establish a commonly agreed upon working approach

Integrate mutual and individual accountability

Katzenbach & Smith (2001) The Discipline of Teams

## Hackman – Leading Teams



Real Team

**Compelling Direction** 

**Enabling Structure** 

Supportive Organizational Context

Available Expert Coaching

Team Diagnostic Survey (TDS) https://research.wjh.harvard.edu/TDS/

### Real Team

J. RICHARD HACKMA

clear boundaries

team members are **interdependent** for some **common purpose**, producing a potentially assessable outcome for which members bear **collective responsibility** 

at least moderate stability of membership

## **Compelling Direction**

Good team direction is:

- challenging (which energizes members)
- clear (which orients them to their main purposes)
- consequential (which engages the full range of their talents)

### **Enabling Structure**

Key structural features in fostering competent teamwork

- Task design: The team task should be well aligned with the team's purpose and have a high standing on "motivating potential."
- Team composition: The team size should be as small as possible given the work to be accomplished, should include members with ample task and interpersonal skills, and should consist of a good diversity of membership
- Core norms of conduct: Team should have established early in its life clear and explicit specification of the basic norms of conduct for member behavior.













## Instructor's Role in Formal Cooperative Learning

- 1. Specifying **Objectives** (Academic and Interpersonal/Teamwork)
- 2. Making **Decisions**
- 3. Explaining Task, Positive Interdependence, and Individual Accountability
- 4. Monitoring and Intervening to Teach Skills
- 5. **Evaluating** Students' Achievement and Group Effectiveness

### Formal Cooperative Learning – Types of Tasks

- 1. Jigsaw Learning new conceptual/procedural material
- 2. Peer Composition or Editing
- 3. Reading Comprehension/Interpretation
- 4. Problem Solving, Project, or Presentation
- 5. Review/Correct Homework
- 6. Constructive Academic Controversy
- 7. Group Tests

### Cooperative Problem/Project-Based Learning

**TASK:** Solve the problem(s) or Complete the project.

**INDIVIDUAL:** Develop ideas, Initial Model, Estimate, etc. Note strategy.

**COOPERATIVE:** One set of answers from the group, strive for agreement, make sure everyone is able to explain the strategies used to solve each problem.

**EXPECTED CRITERIA FOR SUCCESS:** Everyone must be able to explain the model and strategies used to solve each problem. **EVALUATION:** Best answer within available resources or constraints.

**INDIVIDUAL ACCOUNTABILITY:** One member from your group may be randomly chosen to explain (a) the answer and (b) how to solve each problem.

**EXPECTED BEHAVIORS:** Active participating, checking, encouraging, and elaborating by all members.

INTERGROUP COOPERATION:

Whenever it is helpful, check procedures, answers, and strategies with another group.

## Engineering

A scientist discovers that which exists. An engineer creates that which never was -- Theodore von Kármán (1881-1963)

**The engineering method is design under constraints** – Wm. Wulf, Past President, National Academy of Engineering

# Skills often associated with good designers – the ability to:

tolerate ambiguity that shows up in viewing design as inquiry or as an iterative loop of divergent-convergent thinking;

maintain sight of the big picture by including systems thinking and systems design;

handle uncertainty;

make decisions;

think as part of a team in a social process; and

think and communicate in the several languages of design.

Engineering Design Thinking, Teaching, and Learning -http://www.asee.org/about/publications/jee/upload/2005jee\_sample.htm

## **Design-Build Project**

Teams of 3-4 - randomly assigned

Experience entire project life cycle in about 30 minutes

Goal is for all teams to meet the specification (design requirement)

Attend to both the task and the team work

## Team Member Roles

Observer/ Process Recorder (non participant role) Facilitator/Time Keeper Task Recorder Skeptic/Prober

Action	Name 1	Name 2	Name 3	Name 4	Total
Contributes Ideas					
Describes Feelings					
Encourages Participation					
Summarizes, Integrates					
Checks for Understanding					
Relates New To Old Learning					
Gives Direction To Work					
Total					
	36	1	1	1	

#### Design objective Design and build a tower at least 25 cm high that can support a concentrated load (stack of textbooks). The tower is built from index cards and office tape. Design rules Materials are 100 index cards and one roll of office tape Cards can be folded but not torn No piece of tape can be longer than 2 inches Tower cannot be taped to the floor Tower must be in one piece, and easily transported in one hand Time to design and build: 15 minutes Height is measured from the ground to the lowest corner of the book placed on top Tower must support books for at least 10 seconds before the measurement is made Room must be cleaned up before measurements are made. Teamwork objective Collect and discuss observation data to process team dynamics

Group P Plus/De	Processing Ita Format
Plus (+) Things That Group Did Well	Delta ( $\Delta$ ) Things Group Could Improve





### **Problem-Based Learning (PBL)**

Problem-based learning is the learning that results from the process of working toward the understanding or resolution of a problem. The problem is encountered first in the learning process – Barrows and Tamlyn, 1980

#### **Core Features of PBL**

- Learning is student-centered
- Learning occurs in small student groups
- Teachers are facilitators or guides
- Problems are the organizing focus and stimulus for learning
- Problems are the vehicle for the development of clinical problemsolving skills
- New information is acquired through self-directed learning

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- Group selection?
- Group member roles?
- □ How long to leave groups together?
- Arranging the room?
- Providing materials?
- Time allocation?





## **Group Selection?**

- A. Self selection
- B. Random selection
- C. Stratified random
- D. Instructor assign
- E. Other

## **Assigning Roles**



## Chapter 8: Group Roles and Responsibilities

- Roles
  - Facilitator
  - Checker
  - Set-Up
  - Materials Manager
  - Safety Officer
  - Reporter
- Dividing the labor



TEAMWORK	Teaching Cooperative Skills
	<ol> <li>Help students see the <b>need</b> to learn the skill.</li> <li>Help them <b>know how</b> to do it (T-chart).</li> <li>Encourage them to <b>practice</b> the skill daily.</li> <li>Help them <b>reflect on</b>, process, &amp; refine use.</li> <li>Help them <b>persevere</b> until skill is automatic</li> </ol>
	Monitoring, Observing, Intervening, and Processing
	Monitor to promote academic & cooperative success
	<b>Observe</b> for appropriate teamwork skills: praise their
	use and remind students to use them if necessary
	<b>Intervene</b> if necessary to help groups solve academic or teamwork problems.
	<b>Process</b> so students continuously analyze how well they learned and cooperated in order to continue successful strategies and improve when needed

## **Team Charter**

- Team name, membership, and roles
- Team mission
- Anticipated results (goal)
- Specific tactical objectives
- Ground rules/ Guiding principles for team participation
- □ Shared expectations/aspirations



pp. 60-61, 204-205

Group Ground Rules Contract Form (Adapted from a form developed by Dr. Deborah Allen, University of Delaware)
Project groups are an effective aid to learning, but to work best they require that all groups members clearly understand their responsibilities to one another. These project group ground rules describe the general responsibilities of every member to the group. You can adopt additional ground rules if your group believes they are needed. Your signature on this contract form signifies your commitment to adhere to these rules and expectations.
<ul> <li>All group members agree to:</li> <li>1. Come to class and team meetings on time.</li> <li>2. Come to class and team meetings with assignments and other necessary preparations done.</li> </ul>
Additional ground rules: 1.
2.
If a member of the project team repeatedly fails to meet these ground rules, other members of the group are expected to take the following actions:
Step 1: (fill in this step with your group)
If not resolved: Step 2: Bring the issue to the attention of the teaching team. If not resolved: Step 3: Meet as a group with the teaching team.
The teaching team reserves the right to make the final decisions to resolve difficulties that arise within the groups. Before this becomes necessary, the team should try to find a fair and equitable solution to the problem.
Member's Signatures: Group Number:
1, 3,
2. 52 4.

### Designing and Implementing Cooperative Learning

Think like a designer

Ground practice in robust theoretical framework

Start small, start early and iterate

Celebrate the successes; problem-solve the failures



#### The Instructor's Role in Cooperative Learning

Make Pre-Instructional Decisions

Specify Academic and Teamwork Skills Objectives: Every lesson has both (a) academic and (b) interpersonal and small group (teamwork) skills objectives.

ecide on Group Size. Learning groups should be small (groups of two or three members, four at the most).

Decide on Group Composition (Assign Students to Groups): Assign students to groups randomly or select groups yourself. Usually you will wish to maximize the hererogeneity in each group.

Assign Roles: Structure student-student interaction by assigning roles such as Reader, Recorder, Encourager of Participation and Checker for Understanding.

Arrange the Room: Group members should be "knee to knee and eye to eye" but arranged so they all can see the instructor at the front of the room.

Plan Materials: Arrange materials to give a "sink or swim together" message. Give only one paper to the group or give each member part of the material to be learned.

#### Explain Task And Cooperative Structure

Explain the Academic Task: Explain the task, the objectives of the lesson, the concept and principles students need to know to complete the asignment and the procedures they are to follow.

Explain the Criteria for Success: Student work should be evaluated on a criteriareferenced basis. Make clear your criteria for evaluating students' work.

Structure Positive Interdependence: Students must believe they "sink or swim together." Always establish mural goals (randent are responsible for their own learning and the learning of all other group members). Supplement, goal interdependence with celebration reward, resource, role, and identity interdependence

tructure Intergroup Cooperation: Have groups check with and help other groups. Extend the benefits of cooperation to the whole class.

and the shares and shares	ar Accountability. Each student must reer responsible for doing in
accountability are:	requent oral quizzes of group members ways to ensure
individual tests, a	id assigning a member the role of Checker for Understanding.
*Specify Expected E to see in the group classified as formi (contributing, enco elaborating), and f teach the interperso groups.	elavies: The more specific you are about the balanciers you want, it he more likely unders will do them. Social allies may be ng (staying with the group, uning quiet voices), functioning unaging others to participael, formulating (cummarizing, memoring (criticing (deau, saling for juritification). Regularly mai and small group skills you wish to see used in the learning
	Monitor and Intervene
*Arrange Face-to-Fa that students prom	ce PromotiveInteraction: Conduct the lesson in ways that ensure ote each other's success face-to-face.
Monitor Students' E circulate to see wh immediate feedbac observation data or	tehavior: This is the fun part! While students are working, you ther they understand the assignment and the material, give k and reinforcement, and praise good use of group skills. Collect leach group and student.
Intervene to Improv (clarify, reteach) if assistance if stude	e Taskwork and Teamwork: Provide taskwork assistance students do not understand the assignment. Provide teamwork nts are having difficulties in working together productively.
	Evaluate and Process
Evaluate Student Lo learning. Involve	earning: Assess and evaluate the quality and quantity of student students in the assessment process.
*Process Group Fur on group functions celebration. Have	ctioning: Ensure each student receives feedback, analyzes the data ng, sets an improvement goal, and participates in a team groups routinely list three things they did well in working together will do better tomorrow. Summarize as a whole class. Have

Cooperative Lesson Planning Form	Monitoring And Intervening
Course: Date:	1. Observation Procedure: Formal Informal
Session/Topic:	2. Observation By: Teacher Students Visitors
Objectives	3. Intervening For Task Assistance:
Academic:	
Social Skills:	4. Intervening For Teamwork Assistance:
Preinstructional Decisions	
Group Size: Method Of Assigning Students:	b. Other:
Roles:	Evaluating And Processing
Room Arrangement:	1. Assessment Of Members' Individual Learning:
Materials:	
One Copy Per Group	2. Assessment Of Group Productivity:
♦ Jigsaw	2 Secoli Course Deconscience
◊ Other:	5. Sman Group Processing
Explain Task And Cooperative Goal Structure	4 Whole Class Processing:
1. Task:	4. Which chart I recome.
	5. Charts And Graphs Used:
2. Criteria Egg Success:	
	6. Positive Feedback Jo Each Student:
3. Positive Interdependence:	
	7. Goal Setting For Improvement:
4. Individual Accountability:	
5. Intergroup Cooperation:	8. Celebration:
6. Expected Behaviors:	
	9. Other:
1	



### Identify, Formulate, and Solve Problems

Expect Some Problems, Challenges, and Barriers

- 1. Recognize problems when they appear (or before they appear)
- 2. With one or more colleagues, develop three or more solutions
- 3. Implement one, evaluate, replan, and retry













## Inside an Active Learning Classroom

STSS at the University of Minnesota

http://vimeo.com/andyub/activeclassroom



"I love this space! It makes me feel appreciated as a student, and I feel intellectually invigorated when I work and learn in it."

