

OPENING UNIT

INTRODUCTION TO GROUP WORK

BOB AND CAROL

Introductory Problem for Graph Theory

PURPOSE:

1. To introduce students to the group problem-solving nature of the course. Have students work in groups of 3-to-4.
2. To introduce students to different ways to represent data to solve problems (tables, and ultimately graphs).
3. To introduce students to the complexity of problem solving and the value of communication. Leads to the development of group norms.

Note: At the end of the semester, there is another team problem solving task. The purpose of that task is to assess how well students work together on an unfamiliar task.

FORMAT:

The teacher will assemble students in groups of 3-to-4 and then describe the following problem for them to work on together. Afterward, groups will share solutions and their thought processes with the rest of the class.

SUGGESTED TIME:

25 minutes for activity, 10 minutes for sharing-out

THE PROBLEM: BOB AND CAROL'S DINNER PARTY

Bob and Carol invite four couples over for dinner. During the party Bob realizes that he hasn't been a very good host and he has not introduced anyone to each other. He does a quick survey to find out who has met whom. After questioning the other nine people (including his wife) at the party, he finds that one person shook hands with 8 other people, the second person shook hands with 7 other people, the third with 6 other people, and so on down to the ninth person who shook hands with 0 other people.

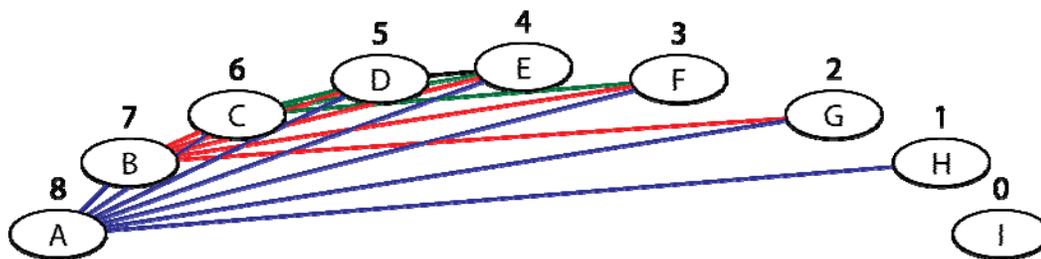
Bob knows that a person can't shake hands with himself and he can't shake hands with his spouse. Keeping in mind these two conditions, how many people did Bob shake hands with?

THE SOLUTION

Students will struggle with this problem and many will try different problem solving strategies. One that is tried often is to act out the problem. This usually doesn't work well since students get confused on how many hands they shook and who they shook with. Tables are somewhat successful, but the graph below is the best. If students have trouble getting started, have them try to organize like the graph below first. Then give them the hint to start with the person who shook hands with 8 people first. That is usually all that is necessary.

To sort out all the information, start by naming the people *A* through *I*. Person *A* shook hands 8 times, *B* shook hands 7 times, *C* shook hands 6 times and so on down to person *I* who shook hands 0 times. We don't know how many times Bob shook hands, but he is not one of the people *A* through *I*, although Carol is one of those people.

Organize the people in a simple graph such as below.



If we look at person *A*, who shook hands with 8 people, and draw lines (which represent handshakes) to those people, then only one person is left out. That is person *I*.

Since A doesn't shake hands with himself or his spouse then person A and person I came as a couple. Those lines are in black.

Following this pattern, if we look at person B who shook hands with 7 people, we should then draw in 7 lines out from B to represent his handshakes. Note that one handshake is already done for B and that is the handshake with A . So we should add 6 more lines and they go to $C, D, E, F, G,$ and Bob. Person B can't shake hands with person I since I didn't shake hands with anyone, and person B didn't shake hands with H since H only shook hands once and that was with A . The additional 6 handshakes for B are in red.

B didn't shake hands with H or I and therefore one of them must be her spouse. Since I is the spouse of A , H is B 's spouse.

Continuing on, we find that:

A and I are partners, $8 + 0$ handshakes

B and H are partners, $7 + 1$ handshakes

C and G are partners, $6 + 2$ handshakes

D and F are partners, $5 + 3$ handshakes

At this point only E and Bob are left and each has 4 handshakes and no more can be added at this point since they don't shake hands with each other. **So Bob shook hands with 4 other people.**

ESTABLISHING AN ENVIRONMENT THAT FOSTERS *INDIVIDUAL LEARNING IN SMALL GROUPS*

DIALOGUE

A large part of this course involves group work. Think about the groups you have been a part of in the past. Though many of you have worked in groups, not all of those experiences necessarily were good. Nor did you necessarily feel that you learned from working in these groups. Today, we are going to attempt to establish the framework for successful group work. I want you to take some time to reflect on your past groups. What members did you enjoy working with and why? What members would you have liked kicked out of your group and why?

Please take out a piece of paper and a pencil. On one side, brainstorm what positive qualities you like to see in fellow group members. On the other, list undesirable behaviors for group members.

ON BOARD

Positive Qualities	Undesirable Behaviors

Give the students 5 minutes to brainstorm. Then encourage them to share. List their ideas on the board or an overhead projector.

Divide into the groups for the first quarter. One way to create 'fair' groups is to have listed them by descending GPA order and counted off by fours (do this before

class). There will then be four members to most groups. Four to five members per group is ideal. So, divide up the remainder.

DIALOGUE

Now that you are divided into groups, elect one person to be the secretary. You are going to write your own group's codes. That is, choose from the board the desirable and undesirable attributes. You may add to them, if you wish. Write out a mission statement for your group. This will be a statement of all the positive qualities each group member will possess. It shall be phrased "each individual group member will...". Write out a contract statement for your group. This is what could potentially get you 'fired' from the group. That is, after a warning, an uncooperative member will be asked to leave the group. For the remainder of the quarter, this person will need to complete all group work as an individual. It should be phrased "each individual group member will not..."

ON BOARD

<p>Mission Statement:</p> <p>Each individual group member will:</p>	<p>Contract:</p> <p>Each individual group member will not:</p>
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Give the students about twenty minutes to complete this task. Collect results.

SECOND CLASS PERIOD ON GROUPS

Hand back mission statements and contracts with any necessary comments/corrections. Have students make a poster (one per group). They will then all sign the poster. These will be posted on the wall throughout the quarter. Explain about how violating the contract will result in divorce from the group. Divorce does not mean

being assigned to another group. Rather it means the individual must do all work for the remainder of the quarter on an individual basis.

Explain that every group assignment will have an individual component. Other group members grade each individual. In addition, each project will include a brief reflection by each individual member.

If you plan to give group exams, consider making the first part individual. Less than 80 percent on the individual portion will cause the individual's grade on the group portion to decrease in increments of 5 percent.

A STRATEGY FOR ORGANIZING GROUP PARTICIPATION

You might want to consider using the following “job descriptions” to help your students organize themselves into effective teams when working in groups of 4. Each student in the group will assume one of the four roles listed on the next page and assume the associated responsibilities. The descriptions here also give examples of the kinds of things a person in that role might end up saying regularly. You may wish to make copies of these descriptions for the students.

SEMESTER PROBLEM-SOLVING/TEAM WORK ASSESSMENT

Final Group Assessment on Team Problem-Solving, Communication

PURPOSE:

1. To assess students ability to contribute to a group task.
2. To assess students group ability to represent data in graphs and tables to solve problems.
3. To assess students communication and content skills to solve problems involving measurements in unknown units.

FORMAT:

The teacher will assemble students in groups of 4 or 5 and then describe the following problem for them to work on together. Allow students to assign team roles. Hand out possible team roles identified in the introductory unit, but let students define new roles if they want. There are six information sheets, so teams could have up to six members. If teams have less, then some team members must handle more than one information sheet. Hand out The Sales Manager's Journey. Students have 45 minutes to solve the problem and 15 minutes to write up their solution and team assessment. Afterwards each group will turn in their solution with any data, graphs, tables they used to solve the problem. In addition each member of the group will assess their contribution to the group and assess their groups' communication/problem solving skills.

PROBLEM: THE SALES MANAGER'S JOURNEY

The problem along with 6 information sheets is attached. Students should have access to butcher paper, pens, calculators and any other tools they may need to solve the problem.

SEMESTER GROUP ASSESSMENT

DIRECTIONS:

By now, your students should be able to function efficiently as a group. This activity should be used at the end of the first semester to assess how well the students are doing collaboratively.

SUGGESTIONS:

- Place students in groups randomly.
- Give directions to the problem.
- Allow one class period or approximately 50 minutes to complete the task.

Monitor groups as they proceed to complete the task. Use the following to assess each group's collaboration efforts. (Scale their score to fit your grading system)

Collaboration	Did the group work well together? <input type="checkbox"/>	Did they communicate effectively? <input type="checkbox"/>	Were all members participating? <input type="checkbox"/>	Were responsibilities assigned to members? <input type="checkbox"/>	Total /4
Task	Did the group understand their objective? <input type="checkbox"/>	Was the necessary information drawn from the information sheets? <input type="checkbox"/>	Did they work in a timely fashion to accomplish the mission? <input type="checkbox"/>	Was the task completed? <input type="checkbox"/>	Total /4
Individual Contribution	Was there a taskmaster? <input type="checkbox"/>	Was there a time keeper? <input type="checkbox"/>	Was there a record keeper? <input type="checkbox"/>	Did the others seem to be responsible for an aspect of the project? <input type="checkbox"/>	Total /4
Accuracy	Was the answer correct? <input type="checkbox"/>	Were all calculations and times included and correct? <input type="checkbox"/>	Were all paths correct? <input type="checkbox"/>	Were all conversions correct? <input type="checkbox"/>	Total /4
					Total /16

SOLUTION TO THE SALES MANAGER'S JOURNEY

ANSWER KEY

NEED TO KNOW:

10 durr/1 curr

10 curr/1 burr

10 durr/1 curr x 10 curr/1 burr = **100 durr/1burr**

5 napps/1 mapp

A to B: 1 burr/24 napps x 18 napps = .5 burr = **50 durr**

B to C: 1 burr/30 napps x 18 napps = .6 burr = **60 durr**

@ C: **40 durr** break

C to B: .9 burrs = 90 durr + 20 durr delay = **110 durr**

B to D: 5 curr x 10 durr/1 curr + 7 durr = **57 durr**

D to E: 1 burr/32 napp x 4 napp + 4 mapp x 5 napp/1 mapp =

1 burr/32 napp x 24 napp = .75 burr = **75 durr**

@ E: **45 durr** break

E to F: 1 burr/54 mapps x 27 napps = .5 burr = **50 durr**

@ F: 6 curr break = **60 durr**

F to D: **75 durr**

D to G: 9.3 curr x 10 durr/1 curr = **93 durr**

Total Durr = 93+75+60+50+45+75+57+110+40+60+50 = 715 durr

It took the Sales Manager 715 durr to visit towns A, B, C, D, E, F, and G.

THE SALES MANAGER'S JOURNEY

DIRECTIONS:

Lapps, mapps and napps represent a new international measure of distance, while burrs, curs and durrs represent the associated system of units of time. To illustrate this new system of time and distance, we have taken the case of the sales manager of the company Mighty Micro, a quickly growing electronics firm based in the south, who drove from Town *A* to Town *G* visiting Towns *B*, *C*, *D*, *E*, and *F* on the way.

YOUR GROUP'S TASK:

- You are to determine as quickly as possible, how long his trip takes from going from Town *A* to *G*. You will each be given an information sheet containing part of the data necessary to solve this problem. Your group as a whole will have all of the information necessary to solve the problem.
- You may organize your group in any way you wish in order to solve the problem as quickly as possible.
- You will find it is probably most efficient if you tell the other members of your group the relevant information that you have been given, rather than simply showing the information sheet to them.
- Your answer should be presented in durrs.

THE SALES MANAGER'S JOURNEY

INFORMATION SHEET #1:

1. The road between *D* and *F* is a continuous motorway standard dual-carriageway.
2. It took 5 currs, 7 durrs to drive from *B* to *D*.
3. There are approximately 100 durrs in each hour.
4. There are 5 napps in a map.
5. The distance between *A* and *B* is 12 napps.
6. The country between *A* and *B* is hilly, the road narrow and twisty. Progress is therefore generally slow.
7. The distance between *F* and *G* is 9 mapps.
8. It took 0.9 burrs to drive from *C* to *B*.
9. The distance between *E* to *G* is 6 mapps.
10. The route between *F* and *G* is a good cross-country road. It is straight and used very little.

THE SALES MANAGER'S JOURNEY

INFORMATION SHEET #2:

1. It is 18 napps from *B* to *C*.
2. He drove from *D* to *E* at an average speed of 32 napps per burr.
3. There is a recently completed motorway route between *E* and *F*.
4. A napp is equal to approximately two kilometers.
5. When he got to *E*, he took a 45 durr break before continuing.
6. *A* to *C* is a distance of 4 mapps, 3 napps.
7. The distance from *D* to *G* is 24 napps.
8. A curr is 10 durrs.
9. At an average speed of 30 napps per burr, it took him 6 currs to drive from *B* to *C*.
10. He stopped at *C* for a break of 40 durrs.

THE SALES MANAGER'S JOURNEY

INFORMATION SHEET #3:

1. A durr is 100 bruns.
2. A mapp is a measure of distance.
3. From *B* to *D* is 18 napps.
4. After he arrived at *F*, he stopped for 6 currs.
5. His average speed on the journey between *E* and *F* was 54 napps per burr.
6. The car supplied by Might Micro to its sales manager is a Vauxhall Cavalier.
7. Driving from *A* to *B*, his average speed was 24 napps per burr.
8. The distance from *C* to *D* is 21 napps.
9. It is 3 mapps, 3 napps from *B* to *C*.
10. There is a great deal of heavy commercial traffic using the road from *C* to *D*.

THE SALES MANAGER'S JOURNEY

INFORMATION SHEET #4:

1. The distance from *D* to *E* is 4 mapps, 4 napps.
2. The sales manager drove from *B* to *C* at an average speed of 30 napps per burr.
3. He drove from *F* to *D* at 40 napps per burr.
4. He has been using this route at regular intervals during the last 18 months.
5. He stopped at *C* for 4 currs.
6. It took him 75 durrs to drive from *F* to *D*.
7. The route from *C* to *D* is usually congested with a lot of heavy lorries using it as a route to costal ports.
8. From *C* to *E* is a distance of 7 mapps, 4 napps.
9. He has been working for Mighty Micro for a little over 2 years.
10. The distance from *C* to *D* is 21 napps.

THE SALES MANAGER'S JOURNEY

INFORMATION SHEET #5:

1. A burr is 10 currs.
2. It is 27 napps from *E* to *F*.
3. It took him 9.3 currs to drive from *D* to *G*.
4. Because of work piling up back at the central office, the sales manager is anxious to complete this trip as quickly as possible.
5. A lapp is 10 mapps.
6. A burr is a unit of time measurement.
7. The weather conditions weren't good, causing him to drive slower than usual on this trip.
8. When driving from *C* to *B*, he was caught in a traffic jam caused by road work, which delayed him 20 durrs.
9. It is 30 napps from *D* to *F*.
10. It is 45 napps from *F* to *G*.

THE SALES MANAGER'S JOURNEY

INFORMATION SHEET #6:

1. From A to B is 2 mapps by the shortest route.
2. The sales manager drove from D to E at an average speed of 32 napps per burr.
3. He stopped at E for 45 durrs.
4. It is 18 napps from B to D .
5. Due to bad weather, the trip overall took him longer than normal.
6. It took him 75 durrs to drive from F to D .
7. The route he used on this occasion is the same as the one he usually takes.
8. A curr is 10 durrs.
9. 1 hour is about 100 durrs.
10. It took him 0.9 burrs to drive from C to B .

Group Roles

Team Captain

- Encourages participation
- Enforces use of norms
- Finds compromise
- Substitutes for absent roles

“Remember, no talking outside our team.”

“Let’s find a way to work this out.”

“We need to work on listening to each member of the team.”

Recorder-Reporter

- Gives updated statements on team’s progress
- Makes sure each member of the team records the data
- Organizes and introduces reports

“We need to keep moving so we can”

“I’ll introduce the report, then”

“Did everyone get that in your notes?”

Resource Monitor

- Collects supplies for the team
- Calls the teacher over for team questions
- Cares for and returns supplies
- Organizes clean-up

“I think we need more information here.”

“I’ll call the teacher over.”

“We need to clean up. Can you ... while I ...?”

“Do we all have the same question?”

Facilitator

- Gets the team off to a quick start
- Makes sure everyone understands the task
- Organize the team so they can complete the task

“Who knows how to start?”

“Does everyone get what to do?”

“I don’t get it yet ... can someone help?”

“We need to keep moving so we can”