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EDU 273
Artifact #8

Research cooperative learning as an instructional strategy for encouraging student development of critical thinking and problem solving. Create a cooperative learning [project] appropriate for the subject and grade level you intend to teach.

Your project should address and illustrate:

1. *A clearly identified and articulated outcome for the project that cannot be completed unless all team members work together.*
2. *How small heterogeneous teams will be created.*
3. *Tasks each team member is individually accountable for.*
4. *At least one teambuilding task.*
5. *At least one complete lesson plan for the project.*
6. *A project rubric detailing both individual and group assessment standards.*
7. *Any handouts or supplementary material needed to complete the project.*

The project I have in mind is called "Energy Futures." It is first about energy sources (coal, oil, wind, solar, etc.) and second about futures, as in alternate ways the future might look. As in the Jigsaw Classroom (http://www.jigsaw.org/), there are heterogeneous work groups and then separate expert groups. Unlike the Jigsaw Classroom, this classroom does not have heterogeneous work groups performing the same task. Each works on one of the alternate futures. The expert group members are not all alike, either. They concentrate on different facets of an energy source. This arrangement amounts to a two-layer Jigsaw Classroom. Both kinds of groups are also heterogeneous in that they include a mix of gender, ethnicity, ability, etc. Composition of each kind of group is determined by where students' names are entered into each of the two tables:

Expert groups		Role			
		Historian	Engineer	Proponent	Opponent
Energy	Oil				
	Coal				
	Nuclear				
	Wind				
	Solar				
	Hydro				
	Conservation				

Work groups		Expertise						
		Oil	Coal	Nuclear	Wind	Solar	Hydro	Geothermal
Futures	Future 1							
	Future 2							
	Future 3							
	Future 4							

The number of roles, energy sources, and futures can be adjusted based on class size and interest. It is also completely possible that all futures are the same. Many Jigsaw Classroom projects have each work group assigned the same scenario (e.g., predict what energy sources we will be using in fifty years) or each expert group member assigned to the same task (e.g., all paleontologists). Either of these changes turns the double-layer project into a simple, single-layer project. It is probably advisable to keep the first Jigsaw Classroom project simple and attempt this project only after substantial practice.

Members of the expert groups study the development of the energy source over time, find out how it works, praise it, and criticize it. Their information comes from online sources, mainly links used in the many WebQuests on the topic of energy. Since expert group members all assume different roles and file individual reports, they are individually accountable. Since they file a group report and give a presentation, they are accountable as a group as well. The group will not succeed without contributions of every member. If while reading an expert comes across information useful to someone playing a different role, that information can be shared. This assistance is evaluated.

Work groups are comprised of experts in each energy source. Each group is presented with a problem to solve that involves critical thinking. The group members should brainstorm together and come up with a collective answer, but will also need to detail how their individual energy sources are involved. This is a required individual contribution. The collective answer, submitted on paper and in a presentation, will not be satisfactory without effective cooperation involving all members. Specific problems to solve are included with lesson plans for work groups and are similar to these sample problems:

> It is 2020 and researchers suddenly realize that estimates for the size of the world oil reserve is half that of what was expected (someone mixed up pounds and kilograms). Your team heads the United States Department of Energy. What changes need to be made in order to cope?
>
> After many years of civil war, a country finally has a stable government and begins working on its energy infrastructure, which needs to be built from the ground up. Your team is hired as advisors. How can you ensure the country's energy future?
>
> More nations with more people are using more energy. Neither power companies nor the environment can keep up with demand. Your United Nations panel needs to address the issue before conflict breaks out. What do you encourage member countries to do?

This general description of the project has very briefly addressed items 1-4. These items are now revisited individually and then items 5-7 are presented.

1. As the assignment statement suggests, the highest level goal of this project is to create critically thinking problem solvers who can work in groups. This begins with an understanding of a single aspect of an energy source, next the energy source as a whole, subsequently the spectrum of energy sources, and finally how energy influences our future. It proceeds from expert group to work groups.

This understanding is demonstrated first in fact finding reports filed by the historians, engineers, proponents, and opponents of each source. They simply list the facts and sources that

members collect from visiting a list of suggested websites. The expert groups then combine facts into a report on their energy source. Each student is responsible for at least one paragraph describing his or her findings in prose. The report is presented to the class with visual aids or demonstrations, questions, and answers. The working groups file similar individual reports on how the particular energy sources relate to the problem. These reports are combined into the final report and presented. The outcome, if not understanding, is a collection of individual reports, group reports, and presentations.

2. Teams can be created in various ways, of course. If the class is new, then it may be best to distribute names randomly into the tables above and then adjust for any accidental clustering. Students have more incentive to see their team succeed if they have a say in its composition, however. For this project there are two basic approaches: top-down and bottom-up. In the former, students pick (or are assigned to) a problem they are interested in and join that work group. Within each work group people volunteer to cover an energy source they are interested in. Groups with like energy sources form and within these expert groups roles are distributed in a similar way. In the bottom-up approach, roles are chosen first. Next, role players form a group with three complementary role players and choose an expert group. The working group is formed similarly.

Since I would like to change the problems on the spur of the moment based on current events and because I don't see strong preferences for roles, I recommend starting in the middle by letting students pick an energy source they are interested in. They form an expert group and can divvy up the roles themselves. The expert groups may be comprised of non-heterogeneous groups of friends. Therefore, the teacher will construct the working groups by assignment.

3. In expert groups, each individual is accountable for a fact finding report, a paragraph of the expert group report, and participation in the expert presentation. In working groups, each expert writes a paragraph of the working group report and participates in the presentation. Group reports have introductions, conclusions, and transitions to which everyone should contribute.

4. Group work can be very unpleasant if the group does not gel into a team. Rather than just hope for the best, one can teach teamwork and cooperative skills following a step by step process (http://www.intime.uni.edu/coop_learning/ch5/teaching.htm) and turning it into a stand-alone lesson. Given a group of unknown students and a fairly serious topic, I suggest two fun team building games, one for expert groups and one for work groups. The helium stick exercise seems particularly appropriate for the larger work groups and public school students (http://www.wilderdom.com/games/descriptions/HeliumStick.html). For the smaller expert groups whose members are working to put together a whole, I suggest playing zoom (http://www.wilderdom.com/games/descriptions/Zoom.html). Rather than using the generic and expensive zoom kit, the teacher should cut pictures related to the energy sources into strips and use them.

In the helium stick game, team members form two lines and face each other. They hold out their hands horizontally with pointed index fingers so that the helium stick, a thin light rod, can be placed across their fingers with all fingers touching it. The task is to lower the stick to the ground while all fingers remain touching the stick. If any finger leaves the stick, the team has to start over. It's called a helium stick because rather than sinking to the floor, it generally rises. A much more thorough description is available on the web page. The game emphasizes that everyone needs to be taken into account and coordinated.

In the zoom game, picture pieces are distributed to team members. Nobody is allowed to see other people's pictures, but the team must decide how the pieces fit together, spatially, temporally, logically, etc. Each team member has to speak up to at least describe his or her piece and they all cooperate to figure out how to make a coherent whole from the pieces.

5. At least one complete lesson plan for the project.

The project is broken down into activities to work on over several days, not necessarily consecutive.

Day 1. Selection of energies, zoom game, selection of roles
Day 2. Web research and completion of fact finding sheets
Day 3. Conversion of facts to paragraphs and export group reports
Day 4. Preparation of expert group presentations
Day 5. Expert group presentations

Day 6. Assignment to work groups, helium stick game
Day 7. Presentation of future problem and brainstorming session
Day 8. Writing of individual paragraphs
Day 9. Preparation of work group presentations
Day 10. Work group presentations

Solar Energy Fact Finding Lesson

Vital Information	
Author	Keith Alcock
Subject(s)	Science and information literacy with language arts and social studies
Topic or Unit of Study	Energy
Grade/Level	5-9 depending on problem solving task, possibly gifted and talented
Objective	To understand an energy source, solar energy
Summary	Students explore and learn about solar energy and record their findings on fact finding sheet based on their chosen role
Implementation	
Learning Context	This lesson is part of the larger “Energy Futures” cooperative learning project and this lesson is performed by expert groups
Procedure	Students are allowed to follow the links below to research their energy source. Consider downloading the web pages to a local computer so that students can’t get off track in their exploration. Facts that apply to different roles can be shared within the expert group. See the rubric for anticipated number of websites that should be visited and facts collected. Groups may want to divide up the list and then share finds pertinent to other roles with the rest of the group. Solar Energy Technologies Program Energy Story Solar Energy Photovoltaics – Timeline of the History of Photovoltaics Solar Today North Carolina Solar Center Energy Matters: Theory Behind Solar Power Green Buildings Info – Solar Water Heating Clean Energy – Information on Solar Electricity NREL: Solar Research Home Page SEIA – Solar Energy Industries Association Interstate Renewable Energy Council

	Energy Matters: Solar Power Advantages and Disadvantages The Future of Energy Solar Bikes SEI: For Young Kids Solar Power TVA Kids: Solar Power Solar Energy / How Solar Power Systems Work Tri-State Generation and Transmission – Kids' Korner
Differentiated Instruction	
Sample Student Products	
Collaboration	Students will work collaboratively & individually. Students will work in groups of 4.
Time Allotment	1 class period. 1.25 Hrs. per class.
Author's Comments & Reflections	Time allotment should be verified. If internet resources are not available or satisfactory, library resources can be used. This lesson could be turned into a WebQuest by specifying more explicitly the information that should be collected.
Materials and Resources	
Instructional Materials	A blank fact finding report is included elsewhere in this document
Resources	The number of computers required is 4.
Standards & Assessment	
Standards	1SC-E5-PO1, 1SC-E5-PO2, 1SC-E5-PO3, 1SC-E6-PO1, 1SC-E6-PO2, 3SC-E3-PO1, 3SC-E3-PO2, 3SC-E3-PO3, 3SC-E4-PO1, 5SC-E3-PO1, 5SC-E3-PO2, 1T-E1-PO2, 2T-E2-PO1, 2T-E2-PO3, 5T-E1-PO1, 5T-E2-PO2, 5T-E2-PO4, 5T-E2-PO5
Assessment/Rubrics	A rubric for the fact finding sheet is included elsewhere in this document

6. A project rubric detailing both individual and group assessment standards.

Individual Assessment

	Excellent=4	Good=3	Acceptable=2	Poor=1	No credit=0	Score
Fact finding sheet						
Quantity of facts	10 or more different facts cited	6-9 different facts cited	3-6 different facts cited	1-2 different facts cited	0 facts cited	
Quality of facts	All facts are relevant to energy and role	Most facts are relevant to energy and role	Some facts are relevant to energy and role	Few facts are relevant to energy and role	No facts are relevant to energy and role	
Accuracy	Facts are objective and true	Facts are objective, but distorted	Facts are subjective	Facts are not true	Facts are purposely deceptive	
Thoroughness	Facts are collected from 5 or more different sites	Facts are collected from 4 different sites	Facts are collected from 3 different sites	Facts are collected from 1-2 different sites	Facts are collected from 0 sites	
Documentation	Sheet is complete, legible, and orderly	Sheet is complete, legible, and disorderly	Sheet is incomplete or illegible	Sheet is incomplete and illegible	Sheet is not filled in	
Timeliness	All work was ready on time	Work was nearly on time	Work was obviously late	Work needed to be completed by others	Work was not turned in	
Expert report						
Grammar and mechanics	Paragraph has 0 misspellings or grammatical errors	Paragraph has 1-2 misspellings and/or grammatical errors	Paragraph has 3-4 misspellings and/or grammatical errors	Paragraph has 5-8 spelling errors and/or grammatical errors	Paragraph has more than 8 spelling errors and/or grammatical errors	
Integration of source materials	All pertinent facts are included	Most pertinent facts are included	Some pertinent facts are included	Few pertinent facts are included	No pertinent facts are included	
Organization	Facts appear in a logical, interesting, and understandable	Facts appear in a logical and understandable or	Facts are not logically ordered, but are	Facts are not understandable	No facts are present	

	sequence	interesting sequence	understandable			
Timeliness	All work was ready on time	Work was nearly on time	Work was obviously late	Work needed to be completed by others	Work was not turned in	
Expert presentation						
Participation	Participates willingly and facilitates participation of others	Participates willingly	Participates reluctantly	No participation in presentation	Interferes with participation of others	
Communication	Contributed presentation minutes, graphics, and answered questions add to 4 of more	Contributed presentation minutes, graphics, and answered questions add to 3	Contributed presentation minutes, graphics, and answered questions add to 2	Contributed presentation minutes, graphics, and answered questions add to 1	Contributed presentation minutes, graphics, and answered questions add to 0	
Expert group						
Contribution	Contributed more than fair share of work	Contributed fair share of work	Contributed less than others	Contributed hardly at all	Contributed no work	
Discussion	Contributed many ideas to the discussions	Participated actively in the discussions	Reacted actively in discussions	Reacted passively in discussions	Did not participate in discussions	
Helpfulness	Assisted partners	Encouraged partners	Concentrated mostly on own material	Concentrated only on own material	Was unhelpful	
Giving feedback	Provided feedback in a dignified manner	Provided feedback that didn't offend	Sometimes hurt others' feelings	Often hurt feelings	Did not attempt any feedback	
Accepting feedback	Accepted feedback willingly	Accepted feedback reluctantly	Argued over feedback	Insisted on winning argument over feedback	Refused to listen to feedback	

Work report						
Grammar and mechanics	Paragraph has 0 misspellings or grammatical errors	Paragraph has 1-2 misspellings and/or grammatical errors	Paragraph has 3-4 misspellings and/or grammatical errors	Paragraph has 5-8 spelling errors and/or grammatical errors	Paragraph has more than 8 spelling errors and/or grammatical errors	
Integration of source materials	All pertinent facts are included	Most pertinent facts are included	Some pertinent facts are included	Few pertinent facts are included	No pertinent facts are included	
Organization	Facts appear in a logical, interesting, and understandable sequence	Facts appear in a logical and understandable or interesting sequence	Facts are not logically ordered, but are understandable	Facts are not understandable	No facts are present	
Timeliness	All work was ready on time	Work was nearly on time	Work was obviously late	Work needed to be completed by others	Work was not turned in	
Problem solving	Creative solution is put forth that is related to the energy source	Solution discusses advantages and disadvantages only	Solution discusses advantages or disadvantages only	Solution is unrelated to energy source	No solution is attempted	
Work presentation						
Participation	Participates willingly and facilitates participation of others	Participates willingly	Participates reluctantly	No participation in presentation	Interferes with participation of others	
Communication aids	Contributed presentation minutes, graphics, and answered questions add to 4 of more	Contributed presentation minutes, graphics, and answered questions add to 3	Contributed presentation minutes, graphics, and answered questions add to 2	Contributed presentation minutes, graphics, and answered questions add to 1	Contributed presentation minutes, graphics, and answered questions add to 0	

Work group						
Contribution	Contributed more than fair share of work	Contributed fair share of work	Contributed less than others	Contributed hardly at all	Contributed no work	
Discussion	Contributed many ideas to the discussions	Participated actively in the discussions	Reacted actively in discussions	Reacted passively in discussions	Did not participate in discussions	
Helpfulness	Assisted partners	Encouraged partners	Concentrated mostly on own material	Concentrated only on own material	Was unhelpful	
Giving feedback	Provided feedback in a dignified manner	Provided feedback that didn't offend	Sometimes hurt others' feelings	Often hurt feelings	Did not attempt any feedback	
Accepting feedback	Accepted feedback willingly	Accepted feedback reluctantly	Argued over feedback	Insisted on winning argument over feedback	Refused to listen to feedback	
Individual total						

Expert/Work Group Assessment

	Excellent=4	Good=3	Acceptable=2	Poor=1	No credit=0	Score
Expert report						
Contributions	All members contribute equally	Most members contribute equally	Some members contribute	Few members contribute	There is no contribution	
Introduction and conclusion	These paragraphs have been added and show excellent work (see work report items)	These paragraphs have been added and show good work (see work report items)	These paragraphs have been added and show acceptable work (see work report items)	These paragraphs have been added and show poor work (see work report items)	These paragraphs have not been added	
Transitions	Transitions have been added and show excellent work (see work report items)	Transitions have been added and show good work (see work report items)	Transitions have been added and show acceptable work (see work report items)	Transitions have been added and show poor work (see work report items)	Transitions have not been added	
Expert						

presentation						
Contributions	All members contribute equally	Most members contribute equally	Some members contribute	Few members contribute	There is no contribution	
Integration	Everyone's work is well represented	Most member's work is well represented	Several members don't contribute	Work is of a single person	No work is presented	
Expert total						
Work report						
Contributions	All members contribute equally	Most members contribute equally	Some members contribute	Few members contribute	There is no contribution	
Introduction and conclusion	These paragraphs have been added and show excellent work (see work report items)	These paragraphs have been added and show good work (see work report items)	These paragraphs have been added and show acceptable work (see work report items)	These paragraphs have been added and show poor work (see work report items)	These paragraphs have not been added	
Transitions	Transitions have been added and show excellent work (see work report items)	Transitions have been added and show good work (see work report items)	Transitions have been added and show acceptable work (see work report items)	Transitions have been added and show poor work (see work report items)	Transitions have not been added	
Work presentation						
Contributions	All members contribute equally	Most members contribute equally	Some members contribute	Few members contribute	There is no contribution	
Integration	Everyone's work is well represented	Most member's work is well represented	Several members don't contribute	Work is of a single person	No work is presented	
Work total						

7. Any handouts or supplementary material needed to complete the project.

Fact Finding Report

Energy: _____ Role: _____ Name: _____

Count	Facts
URL:	http://www.example.com
3	1. This energy source is renewable. 2. It first became popular during the Arab oil embargo. 3. You can use it to build your own power plant.
URL:	
URL:	
URL:	
URL:	
URL:	
Total	