Voyage to Mars Teacher's Guide

You and your team have been invited to try out for a position on a television game show called *Extreme Travel Adventure Challenge*. In order to qualify for participation, you and your team must prepare and present the best possible travel plan for one of this nation's most challenging locations. The goal of the application process is to describe how to most quickly and safely traverse the distance between two isolated locations using only the materials your team can carry.

~ Extreme Travel Adventure Challenge ~

PROBLEM-BASED LEARNING: Problem-Based Learning (PBL) is a form of curriculum that deals with both the content and processes of what is to be learned. It is an instructional approach that helps students to become active problem solvers using a real-world problem. The PBL approach can do amazing things for students. Properly implemented, a PBL activity can build multidisciplinary knowledge, integrate knowledge from a variety of disciplines, assist in values clarification, help students see the utility of many disciplines, help students apply what they know about subject matter to real-life situations.

The PBL approach places students in active roles as problem solvers. The approach confronts students with a complex problem that does not necessarily have a single best answer. The problem-solving process will be messy and complex, just like in the real world. A solution of the problem will require students to inquire into the stated problem, gather information, and reflect upon the findings. The solution will always be tentative and changing as more information is obtained and internalized. Students working in small groups will frequently find that they are required to state and defend their conclusions on the basis of evidence and argumentation. This provides students will both a challenge and motivation.

Good PBL problems will always require students to learn both broadly and in depth before they will be able to provide meaningful, practical solutions to the real-world problem provided. A good PBL statement will appeal to the human desire for a resolution, and thereby sets up the need for context of learning. The problem will necessarily be based on desired outcomes, learner characteristics, compelling situations, and suitable resources. Several examples of PBLs follow:

- How can we best defend the Earth from an asteroid of comet impact?
- Is it wise to locate a theme park in an environmentally sensitive area?
- Should a nuclear waste dump be built in someone's back yard?
- What is the value of conducting the search for extraterrestrial intelligence?
- How should we modify society to best conserve limited energy resources?
- Should nuclear energy replace fossil fuels, or should we use an alternative?

In preparing a PBL activity, the teacher anticipates learners' needs, and makes resources available through such things as laboratory materials, books, and Webquests.

PBL BENEFITS – Solving problems such as those given above, students learn to become critical thinkers and active problem solvers. By being placed in active roles as critical problem solvers, they come away from a PBL experience understanding personal and societal values, and become much more capable of solving complex, real-world problems. In learning to find solutions for such problems they develop and hone important job-related skills such as the following:

- **Problem Solving** – students develop authentic problem-solving abilities associated with real-world phenomena. In so doing, they investigate information, examine issues,

formulate and propose solutions supported by reason and evidence. This includes clarifying individual and societal values.

- **Communicating** – students learn to gather, read, interpret, and share information, ideas, and conclusions. Both written and oral exposition skills are practiced and improved.
- **Using Technology** – students come to know how to use important equipment such as sensors, computers, and networks to gather information, process data, draw conclusions, and communicate results.
- **Working on Teams** – students learn the rules of appropriate social and to contribute as productive members of a group.
- **Making Connections** – students identify important connections between ideas when addressing various issues that involve a number of learning areas; they develop and integrate multi-disciplinary knowledge at a greater depth than would normally be encountered during conventional teaching. The process helps students to understand the value and limitations of science. It helps students see the utility of science and come to realize its role in solving authentic problems.

PBL METHODOLOGY – The PBL methodology calls for the design of an authentic, real-world problem with highly compelling to the students. The problem statement is typically ill structured and based on desired outcomes, and learner characteristics. It is imperative that the problem be one in which there is no "right" solution, and which students cannot immediately forecast the outcome. The PBL problem must require the use of inquiry, information, and reflection. It involves students making value judgments. It demands that students make and defend their conclusions on the basis of evidence and argumentation. The problem is one that provides both a challenge and motivation; it must appeal to the human desire for resolution, and sets up a need and context for learning.

In the PBL classroom, students change from passive receptacles of information to active investigators. The PBL process stresses learning over teaching. The problems that students encounter are messy, real-world problems with no clear answers. As a result, PBL problems tend to be both engaging and motivational. Students learn what it means to be a scientist by working in context. The PBL process demands the use of higher-level critical thinking and problem-solving skills. In the end, PBL helps students learn how to think and not what to think.

COOPERATIVE LEARNING A cooperative learning environment is essential to the success of any PBL. The cooperative learning environment must have the following components if the work isn't going to degrade into non-cooperative group work.

- shared learning goals – desired future state in which the students demonstrate, as a group and individually, a mastery of the subject studied
- goal structure – specifies the ways in which students will interact with each other and the teacher during the instructional session

The teacher must set up and use strategies that ensure cooperative group work. This can best be done by ensuring that the "PIGS FACE" components of Johnson, Johnson, & Holobek "Circles of Learning" (1998) is fully incorporated into any PBL. See this excellent short reference work for details.

P – Positive Interdependence. Students must understand that they have two responsibilities in cooperative groups: (1) they must learn the material required to solve the problem, and (2) they must ensure that all members of their group learn the material. Each student should see

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his or her work as benefiting the group effort; each student's effort must be seen as essential; each student makes unique contributions. Interdependence occurs when students cannot succeed unless their group members also succeed. Structuring interdependence requires a common goal, joint rewards, equitably distributed resources, and complimentary roles

I – Individual Accountability. Teacher must assess how much effort each member is contributing to the group's work. Teacher must communicate concerns to groups and individual students as necessary. Teacher should help groups avoid redundant efforts by individual team members. Teacher must ensure that every member is responsible for the final outcome. This is most commonly done through good assessment procedures that have clear performance expectations and public criteria. Assessments should be provided out the outset and generally should take the form of rubrics.

G – Group Processing. At end of learning process, or even periodically throughout the process, students should be helped to reflect on what member actions are (were) helpful and unhelpful. Students then make decisions about which actions to continue, change, or delete. Such processing allows groups to: focus on maintaining good working relationships, learn cooperative skills, provide feedback on member participation, think at a metacognitive level as well as cognitive level, and celebrate success of the group.

S – Social Skills. Students must get to know and trust one another. This will allow students to communicate accurately and unambiguously, accept and support each other, and resolve conflicts constructively. It should be pointed out again for the teacher that many students do not come to the classroom with appropriate social skills for working in cooperative groups. This is how cooperative group work degrades to the point where it becomes the work of only a few or even one.

FACE – Face-to-face interaction. Interaction occurs as a result of the positive interdependence. To maximize opportunity for success, keep groups small (2 - 6 students), keep groups heterogeneous (a good mix of ability levels), assist students with guidelines for interaction that include aspects dealing with acceptance, support, trust, respect, exchange of information, and the role of personal motivation.

THE ROLE OF THE TEACHER IN PBL – Problem-Based Learning empowers teachers to become active facilitators of student learning and active designers of curriculum. As a PBL facilitator, the teacher role changes from implementing an externally imposed curriculum (e.g., textbook), to being an active decision maker in the curriculum planning process. Under the PBL environment, the teacher changes roles from that of disseminator of information to a facilitator of learning. The teacher will model appropriate problem-solving strategies, coach students in their work, and then fade from the scene as purveyor of information to become a facilitator of learning as the students become engaged and self-directed. The teacher will ask about student thinking, ask probing questions, challenge students to explain and justify, monitor student learning, adjust challenges as needed, and manage group dynamics. The teacher will set clear performance objectives, and explain how performance assessments will be conducted. Once the problem is set up, the teacher anticipates learner needs, makes resources available, and facilitates student definition of the problem through cycles of know/net to know/how to find out. Teachers model, coach, and fade in supporting the student learning process. As a facilitator of learning, the teacher challenges students, asks questions, stimulates student thinking, and provides learning resources for problem solving and self-directed study. Teachers help students become responsible for their

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own learning. PBL-oriented teaching ensures that important content objectives of the curriculum, standards, and benchmarks are met, including important, real-world problems. The process reaffirms the importance of certain learning objectives, and results in the elimination of others because they lack relevance or importance.

PBL CLIMATE SETTING – PBL is conducted under what is for some students a radically different atmosphere, and PBL climate setting needs to be part of every classroom teacher's management plan. In climate setting, teachers help students understand that the roles of teachers and students change. Teachers are no longer seen as purveyors of information; rather, they are seen as facilitators of student learning. Students are no longer seen as empty receptacles to be filled by teachers; rather, they are seen as active inquirers who must take responsibility for their own learning. Students must have an understanding of this shifting climate, and this difference should be pointed out on a daily basis, especially with students unfamiliar with the PBL process. This might seem overly repetitive, but it is extremely important for a successful PBL experience.

Climate setting includes two critical components – the role of the teacher and the role of the student. Students need to understand what the authentic role of the teacher is – preparing situations under which students can learn. They must understand that learning is the responsibility of the students. The PBL teacher will set up a problem, anticipate student needs and provide access to needed resources. The teacher will play the role of the mentor, and students will work cooperatively to solve the problem presented. Students must focus on the task, and follow social and intellectual rule of conduct.

Teachers should make clear to students that they might ask questions even if they know the answer; that they might ask "why?" two or three times in a row, that they will ask students to explain and justify their conclusions on the basis of evidence. Teachers must point out that questioning an idea does not mean that it is wrong. Students need to understand that their role is to speak up, ask questions, confront apparent fallacies, and ask questions when they don't understand. They must see the educational process as the construction of knowledge in which ideas are clearly stated and clearly evaluated. They need to know that no idea is "stupid", and that the only poor question is the question that is not asked. Students must assume responsibility for constructing meaning from facts that they have gathered as part of the PBL process.

Because PBL is very interactive in nature and depends strongly on cooperative group work, teachers must clearly state expectations for student interactions. They must not assume that students have a good understanding of what it means to work cooperatively. Teachers must assist students in gaining an understanding of the social aspects of cooperative group work. They must assist students clarify tasks and procedures, and how students can work together equitably and fairly to attain a common goal. The teacher must help students understand that the solution of the PBL problem belongs to them, not the teacher. In the end, teacher must help students understand that they are responsible for their own learning.

Students will sometimes resist inquiry-oriented instruction. It is always easier to sit passively in class than have to think. Parents and school administrators should be informed about the educational approach being used. It is better to inform parents and school administrators in advance of starting a PBL process. For pointers about this process, see "Minimizing resistance to inquiry-oriented instruction: The role of climate setting" appearing in the *Journal of Physics Teacher Education Online* (http://www.phy.ilstu.edu/jpteo/issues/dec2005.html).

SETTING RULES OF SOCIAL ENGAGEMENT – Neither PBL nor cooperative learning approaches assume that students come into the classroom with appropriate social behavior skills. That students do not possess these skills is clear when supposed cooperative group work rapidly decays into one person doing all the work while others take partial credit for the work.

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Improperly instituted, even cooperative learning will rapid decay into the more traditional group learning. In an effort to prevent this from happening, it is important that the PBL teacher teach social skills relating to whole-group and small group interactions.

Class Participation Rules

1. Every student will contribute to the discussion.
2. Every student will be non-judgmental of other student's opinions.
3. Every student will have the opportunity to express his or her ideas without their ideas being attacked.
4. Every student will ask questions when an idea or fact is presented that they do not understand.

Group Participation Rules

1. Each member of the group will contribute to the project.
2. Each member will avoid the use of put-down language.
3. Each member will get to know and learn to trust others.
4. Each member communicates accurately and unambiguously.
5. Each member accepts and supports other students.
6. Each member will resolve conflicts constructively.
7. Each member of the group will talk to or interact only with his/her group.
8. Each group member will be present and ready to work.
9. Each group member will do the research or work assigned to him/her.
10. Each group member will be present for group presentations or their grade will be lowered. If the absent group member does not wish to have their grade lowered, (s)he can come in on their own time and deliver an oral presentation by him/herself.

PBL MENTORING – The PBL teacher will mentor students through the PBL process. As mentor, the teacher must provide clear models, set expectations, establish structures, give appropriate support, and direct students to useful resources to help solve the PBL problem. The PBL approach will in all likelihood be new to students, most of whom have come to know the teacher as "sage on a stage" rather than as a "guide on the side." The students will need assistance with setting up structures to identify and complete group and individual tasks. At the same time, the teacher must avoid serving as a source of information.

The mode of interaction between teacher and students should focus on teacher questions. The mentor should help students understand whether or not they know something by asking appropriate questions.

During the mentoring process the teacher must avoid providing answers, solving the problem for the students, and providing positive reinforcement that directs students toward certain solutions. Teachers should use non-judgmental responses when students make contributions that direct a group's work in a certain directions. Mentor responses such as "that's interesting," "fascinating," or "insightful" are appropriate at these times. Nonetheless, positive reinforcement is appropriate when students are contributing in significant ways to the problem-solving process (i.e., talking about how best to achieve a particular goal).

Teachers as mentors need to understand that the PBL process takes time, and that some of the most productive time in the classroom is when there is no central focus of action. Rather, much work is accomplished by students when they have opportunity to speak, listen to others, and think. A good mentor will allow students to be the center of discussion. They will facilitate

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student efforts, rather than direct students to do things that they feel should take place. They will provide for times during which students might develop genuine insights. Allow students to learn from other students. If they allow students the opportunity to work as teachers, mentors will be surprised at how much students know, and how well they can teach their peers.

While as mentors teachers should avoid taking charge in the classroom during cooperative group work, they should feel free to contribute to modeling and helping students take charge of their own learning. The teacher as mentor should put into place a mechanism for regularly allowing students to talk about what works and what doesn't work. The teacher needs to promote and support cooperative learning so that it doesn't evolve into group learning where one student does all the work, and the others contribute little to nothing.

PBL ASSSESSMENT – A PBL lesson requires that students create a "product" or "performance" that is aligned with the original problem statement and which is the basis for assessment. Because PBL involves students at a variety of levels, it is reasonable that self-assessment, peer assessment, and teacher assessment takes place during and at the end of the process. Four types of assessments will be used in this project:

- Teacher assessment of the content of the written reports
- Teacher assessment of the style of the written reports
- Peer assessment of students' oral reports
- Peer assessment of contributions to team efforts

PBL SITES – A number of good PBL sites are available on the Web that might provide additional assistance in getting to understand the process. The following are recommended:

WebQuest:

"A WebQuest is an inquiry-oriented activity in which some or all of the information that learners interact with comes from resources on the Internet.... After completing a longer term WebQuest, a learner would have analyzed a body of knowledge deeply, transformed it in some way, and demonstrated an understanding of the material by creating something to which others can respond." Bernie Dodge, San Diego State University. The WebQuest Page at SDSU

County Board Dilemma: A Low-level Nuclear Waste Dump in Your Community? A WebQuest

County Board Dilemma: A Nuclear Power Plant in Your County? A WebQuest

Additional PBL activities on the Internet

University of Delaware PBL Site

IMSA's PBL Web site (see especially *Cosmic Collisions*)

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SCORING RUBRICS – Near the end of this section of the Teacher's Guide are detailed rubrics that can be used for scoring each team's work. They parallel the report guidelines in the Webquest. Expert essays should reflect the processes and procedures of critical thinking; oral presentations should reflect critical thinking dispositions.

Expert Essay Scoring Rubric

Oral Presentation Scoring Rubric

Peer Participation Scoring Rubric

CONNECTION BETWEEN PBL1 AND PBL2 – The writers of this teacher's guide have prepared PBL1 as an introduction to problem-based learning. If students have experience with doing performance-based learning activities, then PBL1 can be skipped. If students do not have experience with problem-based learning, then PBL1 should not be skipped. Teachers should, however, feel free to move ahead quickly with PBL1 as PBL2 can often take five weeks or more of preparation time. PBL1 is not designed to meet science content teaching standards in the way that PBL2 actually does.

MANAGING *VOGYAGE TO MARS* – This *Voyage to Mars Teacher's Guide* was first piloted during the 2006-2007 school year. Five experienced 5th - 6th grade teachers, most of whom had previously taken their students to their Challenger Learning Centers for missions, were chosen as reviewers for this project. They provided the following advice as part of a debriefing session following the conclusions of their missions:

- There is one key to managing *Voyage to Mars* – prepare, prepare, prepare. Preparation must be done 6 to 12 weeks in advance because it will take considerable time to assemble the required materials.
- First time teachers will struggle with this project, unless they are very organized.
- It will be difficult to manage the process the very first time, but subsequent missions will be much easier due to the prior planning.
- Some teachers will find it easier to manage and organize tasks by first printing out all needed Teacher Guide materials.
- Set aside folders or boxes for each mission team, as well as a box including whole group activities. Team activities will take more time to plan and implement than will whole group activities.
- While preparing for the missions is difficult and time consuming, it is well worth it.
- Organize a timeline for preparatory work, and stick with it. The work might otherwise seem overwhelming.
- The teacher should be familiar with each of the activities included in the teacher's guide, and should try them before using them with students the first time.
- The teacher should work through the *Extreme Travel Adventure* PBL.
- The importance of climate setting cannot be overestimated. Do it from the beginning, and repeat regularly. Tell the kids that this might be difficult, but that they will benefit.
- The more organized and prepared the teacher is, the better the outcome of the project.
- Feel free to include you own materials and assessment, supplementing your lessons in as many ways as you feel best.

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- Proof the WebQuests for hyperlink accessibility. Some schools have "firewalls" in place that might keep students from accessing important Internet sites. Work with your system administrator in advance of having students begin work with either of the PBLs.

PREPARING TO TEACH THIS UNIT – Follow-up interviews with five 6^{th} – 8^{th} grade pilot project participants suggest that teachers should be aware first and foremost of the fact that preparation time for teaching this unit is large and critical. Teachers probably will want to conduct up to about 10 whole-group activities and follow this with four or more small-group activities for each of the student teams. It probably would be best if teachers would prepare in advance containers holding materials for each of the activities so as to avoid confusion. Secondly, teachers should be familiar with the content and processes of the associated problem-based learning activities before beginning work with students.

This teacher's guide should be thought of as a starting point. Teachers should feel free to pick and choose from among the various activities provided, and to pick and choose as well as augment the curriculum with their own instructional and assessment materials. For instance, a teacher might feel that a post-mission press conference would be anticlimactic given the intense nature of the preparatory and mission experiences. Teachers should feel free to create their own rubrics and assessment activities or modify those found herein. Don't forget to include self-assessment and daily participation if these are important to you as well.

If time for the mission preparation is a problem, consider working with other teachers in a classroom field trip activity.

It is important to have access to computers to help students with the various projects. Build in extra time for problems with technology, as often is the case. Video projector would be very helpful in helping students move through the curriculum. Feel free to substitute *Google Earth* for the *TopoZone* web site; some teachers have suggested that this program can help students get a better understanding of the lay of the land in the *Extreme Travel Adventure Challenge*.

BASIC STEPS FOR IMPLEMENTING CURRICULUM – There is no magic formula for implementing the curriculum presented in this teacher's guide. Nonetheless, the following basic steps might prove to be helpful:

1. Attend a teacher preparation workshop based on this curriculum that is offered at your local Challenger Learning Center.
2. Observe or participate in the associated CLC mission during or following your local workshop.
3. Review in detail the student and teacher web pages associated with this mission; further practice navigating various web pages so you can be familiar with the protocol.
4. Examine PBL1 and see if it can fit more meaningfully somewhere in the curriculum earlier in the year; it need not immediately precede PBL2 in the curriculum.
5. Rank the whole-group and small-group activities by priority. Chances are you'll not be able to do all activities, and only the most important or "doable" should be chosen. Each year as your experience grows, you can revise and add to this listing. Supplement if you can't do the indicated activities for any reason.
6. If necessary, develop a matrix that aligns chosen activities with state and/or national teaching standards.
7. Review available assessment activities; update or develop rubrics as appropriate.
8. Review how you will introduce students to PBL1 and PBL2; this includes examining availability of classroom computers and/or a single computer with video projection capability.

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9. If necessary, reserve regular computer lab space and review needs with your school computer technologist.
10. Arrange with school librarian any needed textual resources.
11. Make copies of any handouts that might be needed.
12. Gather resources for whole- and small-group activities; experienced teachers find that it is very helpful to prepare small boxes with all required materials and handouts.
13. Introduce PBL1 using a computer with video projector. Include the following steps:
    a. Introduce problem
    b. Review scoring rubrics and give copies
    c. Conduct climate setting
    d. Address problem of social engagement
    e. Divide class into heterogeneous teams of 3
    f. Make spreadsheet to encapsulate team information
    g. Assign projects to teams
    h. Each team establishes member roles
    i. Start with "know/need to know" sheet
    j. Assignment – homework/computer lab/written report
    k. Stress need for citing sources of information
14. In the beginning and regularly thereafter conduct classroom climate setting.
15. Periodically restate mission goal, and review problem and rules.
16. Review written and oral report rubrics as appropriate.
17. Allow time as necessary for group report development.
18. Students submit written and present oral reports.
19. Conduct peer assessment.
20. Introduce PBL2 using computer and video projector.
21. Go over questions using "know/need to know" form.
22. Give work assignments and answer general questions.
23. Work on and turn in job applications; teacher assigns students to teams.
24. Begin work on mission patch.
25. Prepare for and conduct "Congressional Hearings."
26. Conduct other whole-group activities.
27. Conduct small-group activities.
28. Review mission procedures for visit to your local CLC.
29. "Fly" CLC mission
30. Post-mission activities and follow up.

PILOT PROJECT TEACHER COMMENTS – The following comments were recorded during the post-mission debriefing interviews:

Best group ever. These kids really got it together; they really bought into it and thought it was great. Kids stated in evaluations that they were highly motivated and really enjoyed it.

It was a great program; the kids' evaluations afterward were very positive.

This was probably my sixth mission, so I am totally committed and very well prepared. This year the PBLs were more intuitive; I was more prepared mentally for everything leading up to the mission.

Having students do the PBL, they have a better understanding of the whole process. Why and how the mission worked was quite clear.

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There is a lot available here online. You can pick and choose from among the activities and that is nice. The teacher can be selective, and this is good for students with different learning styles. You can pick and choose activities that students will be most successful with…

The students really learned; their presentations were awesome.

I loved it; it was the best thing ever. It helped to develop teamwork skills.

It's just an excellent teaching tool to open the doors of space; it generates excitement; it's great for encompassing the study of astronomy, research skills, cooperation, following directions, communication skills – some good life skills.

To see junior high students go to the CLC and come back so engrossed says a lot about the quality of the program. And then to take it home and have parents call in telling me it's all the kids are talking about. It's normally quite hard to generate that much enthusiasm among 8th grade students, and this approach certainly did it.

ACKNOWLEDGMENT – The writings of this Teacher's Guide acknowledge the ceaseless dedication and hard work, and thank the following teachers for their contributions to this project:

- Patricia Cuddington, 8th grade, St. Mary Catholic Community School, Crown Point, Indiana
- Cinda Farris, 8th grade, Holy Family School, Decatur, Illinois
- Christy Gillis, 6th Trinity Lutheran School, Bloomington, Illinois
- Suzanne Law, 7th grade, Forest Ridge Elementary School, Oak Forest, Illinois
- Judy Stellato, 8th grade, Jerling Junior High School, Orland Park, Illinois

CLOSING COMMENTS – The teachers who piloted this project have informed us that things can be confusing at first if the teacher and students have no prior experience with problem-based learning. Things go much better the second time around. Teachers remark that PBL results in very significant improvements in student comprehension and retention. Motivation is heightened with a concomitant change in student performance. As one teacher remarked, "I'll never teach without using PBLs in the future." Another remarks, "This was the best ever. These kids really got it together, really bought into it. They really thought that the process was great and want to use it again." The PBL approach used in this teacher's guide is novel for many teachers; teachers, too, can expect to be "stretched" as they learn to use new and more effective classroom techniques. Don't be surprised if the road is a bit "bumpy" the first year; things undoubtedly will improve next year as you learn to deal with this student-centered form of classroom instruction.

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WRITTEN REPORT CONTENT Scoring Rubric

Content Areas	Good (3 pts)	Fair (2 pts)	Poor (1 pt)	Unacceptable (0 pts)	SCORE
Geographical Analysis	Report contains a labeled paragraph that includes a map showing adventure location with travel route indicated; provides an accurate description of the landscape, distance to be traveled along travel route, statement of any geographical extremes to be encountered along indicated travel route; addresses all key questions identified by class.	Report contains a labeled paragraph that includes an accurate map showing adventure location with travel route indicated; provides an accurate description of the landscape; distance to be traveled along travel route, statement of any geographical extremes to be encountered; addresses some additional key questions identified by class.	Report contains a labeled paragraph that includes an accurate map showing adventure location with travel route indicated; provides an accurate description of the landscape; distance to be traveled along travel route, statement of any geographical extremes to be encountered; addresses no additional key questions identified by class.	Report does NOT contain a labeled paragraph that deals with geographical analysis OR paragraph mis-labeled OR fails to include geographical analysis OR team clearly misidentified extreme travel adventure location.	
Meteorological Analysis	Report contains a labeled paragraph that gives all important seasonal and climatological data such as provides a statement of when the best time to travel would be completed; states time of year of travel, and expected meteorological conditions, both ordinary and extreme; includes information about length of day at travel time.	Report contains a labeled paragraph that gives most of the important seasonal and climatological data such as provides a statement of when the best time to travel would be completed; states time of year of travel, and expected meteorological conditions, both ordinary and extreme; includes information about length of day at travel time.	Report contains a labeled paragraph that gives little of the important seasonal and climatological data such as provides a statement of when the best time to travel would be completed; states time of year of travel, and expected meteorological conditions, both ordinary and extreme; includes information about length of day at travel time.	Report does NOT contain a labeled paragraph that deals with meteorological analysis OR paragraph mis-labeled OR fails to include meteorological analysis OR does such a poor job of meteorological analysis as to be useless.	
Biodiversity Analysis	Report contains a labeled paragraph that gives a complete and accurate summary of life forms that might possibly be encountered along the way including plant, animal and human; identifies corresponding dangers with each species if any.	Report contains a labeled paragraph that gives a partially complete and/or somewhat inaccurate summary of life forms that might possibly be encountered along the way including plant, animal and human; identifies corresponding dangers with each species if any.	Report contains a labeled paragraph that gives an incomplete and/or inaccurate summary of life forms that might possibly be encountered along the way including plant, animal and human; identifies corresponding dangers with each species if any.	Report does NOT contain a labeled paragraph that deals with biodiversity analysis OR paragraph mis-labeled OR fails to include biodiversity analysis OR does such a poor job of biodiversity analysis as to be useless.	
Risk Assessment	Report contains a labeled paragraph that deals well with risk assessment based on findings from geographical, meteorological, biodiversity, and political analyses; the report DOES start with a summary of risks and explains well how each of the key risks will be avoided if possible and confronted if necessary.	Report contains a labeled paragraph that deals well with risk assessment based on findings from geographical, meteorological, biodiversity, and political analyses; the report does NOT start with a summery of risks but explains well how each of the key risks will be avoided if possible and confronted if necessary.	Report contains a labeled paragraph that deals well with risk assessment based on findings from geographical, meteorological, biodiversity, and political analyses; the report does NOT start with a summary of risks and explains poorly each of the key risks will be avoided if possible and confronted if necessary.	Report does NOT contain a labeled paragraph that deals with risk assessment OR paragraph mis-labeled OR fails to include risk assessment OR does such a poor job of risk assessment as to be useless.	

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Content Areas	Good (3 pts)	Fair (2 pts)	Poor (1 pt)	Unacceptable (0 pts)	SCORE
Team Member Roles	Report contains a labeled paragraph that explains what role each team member will play in preparation for and on the mission; such role might include any of the following: leader, path finder, doctor, cook, or expert of some sort.	Report contains a labeled paragraph that explains what team members will play in preparation for and on the mission but does not assign roles; such role might include any of the following: leader, path finder, doctor, cook, or expert of some sort.	Report contains a labeled paragraph that explains what role each team member will play in preparation for and on the mission but the number of such roles is inadequate; such role might include any of the following: leader, path finder, doctor, cook, or expert of some sort.	Report does NOT contain a labeled paragraph that deals with team member roles paragraph mis-labeled OR fails to include team member roles OR does such a poor job of identifying team member roles as to be useless.	
Planning and Preparation	Report contains a labeled paragraph that gives and thoroughly explains the physical, mental, and material preparation required for the travel adventure, and provides a list of critical materials that must be carried by the team members. The amount of time and material must be reasonable for the effort encountered.	Report contains a labeled paragraph that gives and thoroughly explains the physical, mental, and material preparation required for the travel adventure, and provides a list of critical materials that must be carried by the team members. The amount of time and material must be reasonable for the effort encountered.	Report contains a labeled paragraph that gives and thoroughly explains the physical, mental, and material preparation required for the travel adventure, and provides a list of critical materials that must be carried by the team members. The amount of time and material must be reasonable for the effort encountered.	Report does NOT contain a labeled paragraph that deals with planning and preparation OR paragraph mis-labeled OR does such a poor job of planning and preparation as to be useless.	
Final Analysis	Report contains a labeled paragraph that lists and explains thoroughly why the mission represents the quickest, safest, most cost-effective, and most extreme adventure challenge mission.	Report contains a labeled paragraph that lists and explains only very briefly why the mission represents the quickest, safest, most cost-effective, and most extreme adventure challenge mission.	Report contains a labeled paragraph that lists but does not explain why the mission represents the quickest, safest, most cost-effective, and most extreme adventure challenge mission.	Report does NOT contain a labeled paragraph that deals with final analysis OR paragraph mis-labeled OR fails to include final analysis OR does a very poor job of final analysis.	
References	Report contains a labeled list of references using a consistent standardized format as part of the information gathering process require for writing the mission report.	Report contains a labeled list of references using a mixed set of standardized formats as part of the information gathering process require for writing the mission report.	Report contains a labeled list of references using a confusing format as part of the information gathering process require for writing the mission report.	Report does NOT contain a labeled references section OR paragraph mislabeled OR includes information that does not adequately identify each resource used.	

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WRITTEN REPORT WRITING STYLE Scoring Rubric

Writing Style	Good (3 points)	Fair (2 points)	Poor (1 point)	Failing (0 points)	SCORE
Clarity	Very well written; very few grammatical errors; easy and interesting reading; clear evidence of regular revision & proofing; key ideas are fully elaborated and illustrate what is meant; examples are provided as appropriate.	Reasonably well written; several grammatical errors; easy and interesting reading; evidence of regular revision and proof reading; key points are made, but not always explained.	Poorly written; a large number of grammatical errors; major ideas there but confusing to reader; no evidence of regular review and revision; key points are made, but not often explained.	Very poorly written; many grammatical errors; essentially unreadable; paragraphs are a jumble of sentences and sentences are a jumble of words; gibberish; key points missing and/or not elaborated.	
Accuracy	No discernable errors in fact; well-grounded conclusions.	Minor errors in fact; reasonably well drawn conclusions.	Multiple minor errors in fact; poorly-drawn conclusions.	Multiple and gross errors in fact; grossly inaccurate conclusions.	
Precision	Makes concise statements rather than broad generalities; provides details; provides substantial evidence.	Mostly concise statements but a few broad generalities; moderate use of supporting evidence.	Mostly broad generalities, a few concise statements; very limited use of supporting evidence.	Makes broad statements of generalities; provides no details and no supporting evidence for claims.	
Relevance	All statements are relevant to the topic or bear on the question at hand; assists in clarifying topic or resolving issue.	Most statements are relevant; a small number of arguments provided and all are well reasoned; reader uncertain.	Statements are not always relevant; many arguments are given but they are poorly reasoned; reader unconvinced.	Statements are not relevant; few arguments are given and they are poorly reasoned, and insufficient to the task.	
Depth	Fully addresses main factors that make the topic important; deals with complexities; identifies difficulties; shows evidence of review of several resources.	Addresses most of the main factors that make this topic important; shows evidence of review of several resources.	Addresses some of the main factors that make this topic important; shows some evidence of review of two or more resources.	Address few if any of the main factors that make this topic important; clearly lacks evidence of appropriate review of resources.	
Breadth	Addresses full range of subject matter very thoroughly; includes multiple important perspectives if pertinent to topic.	Addresses full range of subject matter adequately; includes other important perspectives if pertinent to topic.	Addresses full range of subject matter irregularly; provides no or incorrect alternative perspectives.	Addresses full range of subject matter poorly; provides biased alternative perspectives.	
Logic	Arguments provided are all well reasoned, "win the day" and make sense; conclusions flow from evidence; order of written report suggests use of a topical outline	Fairly good use of logic; provides good data, but draws some improper conclusions on the basis of that data; orderly report of information and arguments.	Logic weak, perhaps flawed, but attempts to draw appropriate conclusions from the limited amount of data provided; somewhat disorganized report.	Logic flawed; draws inappropriate conclusions from data or draws conclusions without supporting data; garbled report; lacks logical flow of presentation.	
Significance	Paper deals exclusively with important, not trivial, information.	Paper deals mostly with important information; but includes some trivial.	Paper deals with some important information but much of it trivial.	Paper consists of a jumble of trivial information.	
Spelling & Punctuation	Insignificant number of punctuation errors; no spelling errors.	No spelling errors, and only a few punctuation errors.	A modest number of spelling and punctuation errors.	Numerous spelling and/or punctuation errors.	
Format & Appearance	Uses appropriate font, font size, line spacing, and border areas; good layout; good print quality.	Fails to meet one the guidelines for appropriate font, font size, line spacing, and border areas; good print quality.	Fails to meet two or three guidelines of appropriate font, font size, line spacing, and border areas; fair print quality.	Gross violation of format guidelines dealing with font, font size, line spacing, and border areas; poor print quality.	
Citations & References	Makes appropriate use of in-line citations to credit due to others; four or more references provided.	Once or twice uses other's ideas without making in-line citations; two or three references.	Often uses other's ideas without making in-line citations; maybe one or two references provided.	Cleary uses others' ideas without making in-line citations giving credit due; no references provided.	

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ORAL PRESENTATION Scoring Rubric

Mission Number or Site Location: _____

Introduction:
0 – no clear overview statement
1 – one sentence overview statement
2 – complete but somewhat disorganized overview statement
3 – complete and well-organized overview statement
Points assigned _____

Completeness:
0 – addressed very few of the required mission elements
1 – addressed about half of the required mission elements
2 – addressed all but one or two of required mission elements
3 – addressed all mission elements
Points assigned _____

Organization:
0 – clear lack of coordination among team members
1 – disorganized and confusing presentation of information
2 – organization leaves viewers only slightly confused
3 – presentation very well organized
Points assigned _____

Participation:
0 – only one person really contributed to the presentation
1 – several contributed to presentation, but one dominated
2 – mostly everyone participated, but one failed to contribute
3 – everyone appeared to share equally in the presentation
Points assigned _____

Speaking Skills:
0 – no significant preparation evident
1 – reading written statements from cue cards; not projecting
2 – no cue cards used but talking to presentation and not audience
3 – no cue cards, good explanations, understandable, eye contact
Points assigned _____

Visual Aids:
0 – did not use or used too much
1 – little, but some misspelled words, confusing organization
2 – appropriate amount but of mixed quality
3 – all of neat appearance, creative use of media, easily understood
Points assigned _____

Technology
0 – did not use or used too much
1 – clearly did not know how to use equipment effectively
2 – clear lack of practice, lack of attention to key usage details
3 – used overhead projector, camera/TV, VCR, or computer well
Points assigned _____

Final Analysis:
0 – no concluding remarks; did not attempt to make their case
1 – very limited summary; did poor job of making their case
2 – somewhat limited summary; made a weak case for mission
3 – strongly made the case for theirs being the best mission
Points assigned _____

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PEER ASSESSMENT OF CONTRIBUTIONS TO TEAM EFFORTS

Your name: _____

Team member being scored: _____

Circle the word that best describes the contributions of the team member being scored.

Contributions to Research:

o Carried out assigned or agreed-upon duties	Always	Usually	Sometimes	Never
o Completed assigned or agreed-upon tasks on time	Always	Usually	Sometimes	Never
o Followed rules of social engagement	Always	Usually	Sometimes	Never
o Made effective use of time	Always	Usually	Sometimes	Never
o Shared equally in the work to best of ability	Always	Usually	Sometimes	Never

Contribution to Report Writing:

o Carried out assigned or agreed-upon duties	Always	Usually	Sometimes	Never
o Completed assigned or agreed-upon tasks on time	Always	Usually	Sometimes	Never
o Shared equally in the work to best of ability	Always	Usually	Sometimes	Never

Contribution to Oral Report Preparation and Presentation:

o Shared equally in delivery of oral presentation	Always	Usually	Sometimes	Never
o Provided adequate input in preparation for presentation	Always	Usually	Sometimes	Never
o Prepared adequately for presentation; appeared to know and present content area well.	Always	Usually	Sometimes	Never
o Carried out assigned or agreed-upon responsibilities	Always	Usually	Sometimes	Never
o Completed assigned or agreed-upon tasks on time	Always	Usually	Sometimes	Never

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REFERENCES:

Johnson, D., Johnson, R. & Holubec, E. (1988). *Circles of Learning: Cooperation in the Classroom.* Edina, MN: Interaction Book Company.

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