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ABSTRACT

This publication contains class activities and provocative inquiry questions for intermediate-grade teachers to use to involve students in map making and map interpretation. The author believes that the only things that are needed to develop an inquiry-oriented unit on mapping are a good map, a small group of students, and a perceptive teacher who can ask relevant and stimulating questions. In the first activity students study topographic and aerial maps of their home town, road atlases, and physical landform or physiographic maps. They discuss questions, such as "What does the map tell about the river running through town?" and "For what purposes is an aerial photograph better than a topographic map?" In a simulation activity students assume the role of a leader of a wagon train who plans a trail from New York to the west coast. Other activities and questions involve students in decision making, analyzing the differences between maps, drawing maps of their own town and of the United States, collecting resource maps from the local community, and constructing three-dimensional models of cities and parks. The publication also contains a philosophical rationale for the inquiry approach and an annotated listing of mapping resources. (Author/RM)

AN INQUIRY-ORIENTED CURRICULUM IN MAP MAKING AND MAP INTERPRETATION FOR THE INTERMEDIATE GRADES

by W. Whitney Janeway

A Philosophical Rationale for the Inquiry Approach

Definition

Individuals in many academic disciplines engage in active research. Investigations may differ in content, and to some extent in methodology, but basically researchers in physics and psychology, anthropology and biology, or mathematics and history all carry out these inquiries. In fact, it would not be incorrect to say that science, social or natural, is inquiry. And inquiry is investigation, figuring something out, or laying groundwork for making a decision. It is helpful to realize that the fields mentioned above and many others share the investigative approach in seeking knowledge. In the natural sciences, especially, many are comforted by the familiar "Scientific Method." Supposedly, scientists rigorously carry out the following five steps in gaining knowledge. They (1) identify and state a problem, (2) formulate hypotheses, (3) search for evidence to test the hypotheses, (4) assess the validity of the hypotheses, (5) revise the hypotheses if necessary, and (6) apply the conclusions to similar problems (Kuslan and Stone, 1968). Even if we agree that science is inquiry, a standard sterile list of steps a scientist carries out, which lead to discovery of the unknown, does not provide us with insight into the true nature of the thought of the scientist.

Some find a list of processes that inquirers utilize to be helpful in defining inquiry. Such processes, according to Science-A Process Approach (an American Association for the Advancement of

Science curriculum), might be observing, measuring, estimating, predicting, comparing, classifying, experimenting, communicating, inferring, analyzing, and drawing out inductions. Because each of these processes can be behaviorally defined and each contributes to investigation, process science programs are now enjoying some popularity. Difficulty arises in that no single process, or even a collection of processes, insures that a major behavior, inquiry, is going on. Adding up parts or sub-behaviors does not necessarily constitute a whole or a major, complex behavior. These sub-behaviors must occur in the context of a problem. They need to be motivated by a moderate to strong interest within the child. And they need to occur with some degree of sophistication. Even more complex behaviors as discovery, problem solving, deduction, induction, creative thinking, and critical thinking are only components of inquiry, although they often are given as synonyms.

For me, the only acceptable definition of inquiry requires the description of its salient features which are attitudinal in nature. These attitudes are embodied in the actions described below and their detection might be a prime criterion for the occurrence of inquiry. When in pursuit of knowledge, the inquirer:

1. detects and to some extent defines a problem. An inquirer indeed is prone to see his environment as a myriad of problems to be investigated.

2. tries to move toward greater understanding of the problem, its factors, and its solution.

3. exhibits an interest and involvement in his work.

4. makes use of the variety of resources (literature, objects, and people) that are available to him.

5. examines all conceivable possibilities as hypotheses, or at least all that are practical. Or as P. W. Bridgman (in The prospect for intelligence, The Yale Review, 1945, 34, 450) has explained it, "doing one's damnedest with one's mind, no holds barred."

6. follows leads, not fearing dead ends or wrong decisions. In fact he expects them.

7. withholds judgment until all the evidence is in.

8. seeks closure on the matter only when the problem is reduced to a very simple, obvious matter, when the problem is quite thoroughly worked out, or when a decision based on his conclusion must be made.

9. makes decisions that are consistent with the evidence he has collected. He thus attempts to be objective, unbiased, and insightful, in the hope of reaching the best conclusion in the long run.

10. continues his search (or reopens it) upon disclosure of new and conflicting information.

It is hoped that this definition does not too loosely describe the process of inquiry. A tighter, more behaviorally-defined description is difficult to find agreement upon and is probably not very helpful to the development of the student of inquiry. With inquiry thus defined, a philosophical rationale can now be developed for the inquiry approach.

Rationale

Several values inherent in the inquiry approach and missing in the alternatives should be stated clearly as they constitute the strength of the approach. Two specific cautions follow as well.

Value 1. Problems, their detection, delineation, and solution, are so characteristic of academic fields and everyday life, that they can only be described as highly relevant to any curricula. Ability to investigate problems or general interests is a vital concern, therefore, to any educational undertaking.

Value 2. The exercise of inquiry increases the intellectual potency of the learner.

Value 3. The tendency of inquiry-oriented work is to draw upon intrinsic motivation rather than to depend predominantly on the extrinsic. This begins the upward moving spiral of children liking their schoolwork because it follows their interests. Thus they do more schoolwork as they broaden and deepen these interests.

Value 4. Retrieval of items from memory is expedited due to the greater organization of knowledge gained by the active process of learning it.

Value 5. Becoming a good inquirer is transferable to new areas of interest. (Items two through five are paraphrased points Jerome Bruner makes in The act of discovery, Harvard Educational Review, 1961, 31, 21-32. They are made in the context of being experimentally based yet not of proven validity in the school.)

Value 6. Inquiry is a good vehicle to deemphasize compartmentalization of learning. Most living and learning activities quite naturally dip into one area after another as we carry out a task or solve a problem. Diversified aspects of a problem and an interdisciplinary approach to it should be welcomed because it is a natural approach to learning. Children characteristically exhibit this approach until they are trained to do otherwise.

Value 7. Rebellion against oppression is an unheard-of problem in inquiry-oriented teaching. This is not to say that the teacher need not be well aware of the chaos that lack of direction or frustration from the lack of easy answers can bring.

Value 8. Inquiry, while requiring the teacher to take a chance in facing the unknown, is quite often a great source of satisfaction to both students and teacher. A successfully developing inquiry program exhibits students who are more and more competently charting their own directions, finding and using resources, and showing confidence in their ability to come to reasonable conclusions.

Caution 1. Generating praise for the technique of inquiry is not to be taken as a statement that the content approach or the activity approach should be abandoned. I stress inquiry only because of its merit and because it is so often the missing element in a curriculum which may otherwise be well rounded. Inquiry is a skill which involves many intricacies. It perhaps needs to be stated that the skill of inquiring can grow in each individual just as do many other skills that educators attend to with more regularity.

Caution 2. Mapping is not some golden subject area to be revered. In many respects it is merely a tool to help us understand other subjects. An inquiry-oriented curriculum could be designed in any of a thousand subject areas relevant to elementary students. It is hoped that this following treatment of map making and map interpretation with an inquiry approach will be of great help to teachers in their map teaching. More importantly, it should help them with their skills and attitudes toward teaching in general.

A Practical Guide to the Use of Inquiry

Teachers who basically agree with the philosophical approach outlined in the previous section may find the following brief list of teaching suggestions particularly helpful. With these suggestions as a basis, teachers will have to evolve their own teaching style consistent with their unique talents, personality, and teaching situation.

1. Be a inquirer yourself. On many problems, puzzles, and subject areas, you can learn with the children. By doing so, you present a model of a learner to your students and reduce the potential for boredom from repetition.

2. If any topic or problem generates a special interest, follow that interest to whatever depths the inquiry will take you. None of the suggested activities that follow are sacred, so if any do not stimulate interest, discard them.

3. Encourage children to begin to take on responsibility for the direction of their investigations as well as for what subjects or problems they study. Student direction can, in fact, be an indicator of how well the inquiry process is progressing in your classroom.

4. While becoming involved in the learning process and promoting student independence and self-direction, be aware of the possible conflict in these two roles. No rules can be made about whether or not you should interject a comment or point a direction in a discussion. Using the major criterion of maximum student growth, teachers can use only their common sense and their deepest insights in determining their day-to-day actions.

5. Use your influence as teacher to promote meaningful inquiry activity. Your enthusiasm for a subject or the solution of a problem

may be highly contagious and thereby significantly strengthen your program.

6. Provide for the use of accessory resources. This can be done through having as rich a classroom environment as possible in terms of a general assortment of books, magazines, charts, maps, cloth, cardboard, wood, hardware, etc. Also you may wish to make comments that lead an investigation into an area in which the classroom or school has known resources. Caution should be used here so as not to subvert the entire inquiry process in trying to promote student experimentation with prepared resources.

7. Encourage a variety of group sizes in implementing your inquiry-oriented curriculum. There is no natural or best way to solve problems. Some investigations call for involvement of a whole class, while others require a small group approach. Often a pair works well because it allows the possibility of disparate points of view, yet both members are likely to be instrumental in working out the problems.

8. Allow, of course, short term problem-solving opportunities, perhaps even at a special time each day, but do not neglect an in-depth investigation when the occasion presents itself. One good question and its solution often lead to other questions.

9. Constantly evaluate the thinking behavior you observe in your classroom and constantly try to increase your understanding of the subtleties of inquiry process. In doing this you will move toward being a facilitator of inquiry as an integral part of your teaching.

An Annotated List of Suggested Mapping Activities

The following list of suggestions will surely fail if it is taken as some sort of mandate or material that must be covered. It is intended only as a help to the teachers who must apply their imagination in full measure. It is in no way a comprehensive list.

It is my belief that the procedure of including numerous questions similar to ones teachers might normally ask in the course of teaching is a way of helping them implement inquiry-directed lessons. It is through the stimulation of an unordered or perplexing element of the environment and/or the presentation of provocative questions that the student begins to inquire, to investigate, and to solve problems. In fact, I would put forth the position that just having one good map, a small group of students, and a perceptive teacher is probably enough to develop an entire unit on mapping that is inquiry oriented. One or two good questions can develop a sustained interest and encourage the group to formulate its own direction.

Activities Dealing with Commercially Constructed Maps

1a. Compose questions on topographic maps of your home town for the students to discuss.

"How far is it from your school to the post office?"

"How many features (buildings, streets, water towers, etc.) can you think of that are so new they are not included on the map?"

"Name five facts that the map tells you about the river running through town. Name two things you can infer from facts the map shows."

"Why do you suppose the town grew to be the shape it is on the map? What evidence does the map provide that you are correct?"

1b. Provide the students with an aerial photograph of their home area and ask questions.

"What looks the most different to you from this perspective (directly above)? Are there things you cannot recognize?"

"Find the route you take from your house to your school."

"How can you tell how many inches equal one mile in this photograph?"

"Can you tell what time of day this photograph was taken? What day of the week? What time of year? What year? From how high? What evidence do you use? How sure can you be?"

"For what purposes is an aerial photograph better than a topographic map? Vice versa?"

1c. Provide the students with a road atlas and ask questions.

"Look through the atlas. How many different kinds of maps are included?"

"In planning a road trip from Atlanta to Denver, what considerations would you have to make in deciding a route? What would be the fastest way? The shortest way? The most scenic way?"

"Study the state maps of two states you have never been to. Based on the maps, what are the differences between them? Which would you prefer to live in? Why? Would you ever choose a place to live based partly or mostly on studying that place on a map?"

"How many lakes are there in Minnesota? Is your answer exact or an estimate? Name the biggest one. Find the smallest one. What do you suppose would be a good definition of a lake?"

1d. Provide the students with a physical map, landform map, or a physiographic map and ask questions.

"Does the fact that there are no words on some of these maps keep you from understanding them? What have you learned by studying this map? Can this map help you learn things that other maps you have seen cannot?"

"Suppose you lived long ago. How do you suppose government officials decided to divide the United States' land into the separate states? What ideas might you have had for making states? See if you can find out somewhere how the decisions were really made."

"Based on this map, which state probably has the most scenic variety? Why do you think so?"

"When large parts of North America were being sold, would a map like this have been useful? What kinds of maps were available then?"

"As a leader of a wagon train, use this map to plan your trail from New York to the West coast. What factors need to be taken into account? Look up some of the famous westward expansion trails in the history books. Remember that you may have had more knowledge to plan with than they did. How do the actual trails compare with yours?"

1e. Provide the students with the Population Distribution: 1970 map and the Percent Change in Total Population by Counties: 1960 to 1970 map (from the Bureau of the Census, U.S. Dept. of Commerce) and ask questions.

"Which state shows the most diversity in gain and loss among its counties for the ten year period? Can you guess why?"

"What places are the United States frontiers of today, the places still attracting people? What makes these places attractive do you suppose?"

"Only one county in Alaska lost more than 10% in population. Can you determine why? If not, where might you get some information to help you?"

"State several conclusions you can draw from information presented on either map. Do any of the conclusions require the use of both maps used together?"

Comment: In suggesting the various parts of activity one, I have tried to stress provocative questions which will give depth to this type of activity. The questions are, I believe, interesting for the children to figure out and have some potential for sustaining discussion and developing further questions and inquiry. I must also recommend that children have free time to examine the maps and ask their own questions before the teacher interjects his questions. Questions, moreover, should be asked in a sequence so that the child builds up confidence through success with easier questions at the beginning.

Atlases have not even been mentioned (other than the easily accessible road atlases or maps) although with their great variety they can provide an abundance of physical, cultural, political, economic, and historic data in fresh and interesting ways when used as resources for elementary students involved in inquiry. The major caution I would mention here, in conjunction with using commercially made maps, would be for you, as a teacher, to encourage thinking rather than covering material. Emphasis should be on the process of learning and on improvement in children's abilities to conduct and sustain inquiry. Further, I would encourage the teacher to integrate the reading of maps with the drawing of maps. Uniting these two phases of map work will tend to provide mutual reinforcement; reading of standardized maps helps to develop the skills of drawing original maps while the experiences of drawing maps will produce many new insights in reading prepared maps.

2. Determine to what extent children can distinguish between factual and debatable questions. Use maps and questions like those in activity one, but follow up the discussion with an inquiry into the questions themselves.

"Is that the only possible answer to our question?"

"Is it the best answer? What makes it best?"

"Would the opinion of an American and a European be the same on that question?"

Comment: Thinking about how we think is an important part of the maturing process. Here is a good chance to point out examples of how an apparently simple question or simple situation is not really so straightforward. Children learn to deal with the real world of guesses, biases, ambiguities, and controversy.

3. Prepare questions that require decision making by students with a variety of maps as a resource.

"If you had to live within 300 miles of New York City, what state would you choose to live in? Where is that state? How did you decide?"

"Choose one of the following as your business--aircraft engine parts distributor, shoemaker, art imports, meatpacker, cotton farmer. Where would be a wise place for you to set up your business? How can maps help you to decide? What kinds of maps are helpful? Are there some businesses for which the location doesn't matter?"

Comment: The attempt is obviously to personalize a problem that may have many ramifications. Children are encouraged to use maps of all kinds as well as any other resources they can think of (e.g., past experience, the telephone, charts, almanacs, etc.).

4. Using any kind of map, have children list the man-made items symbolized or labeled on the map. They may also draw up a contrasting list of natural elements.

Comment: As well as exercising basic map reading skills, this exercise may greatly educate the children in the area of man's impact on the environment. They must classify, interpret, and analyze their environment on the basis of map symbols.

5. Have children use and create ways of describing positions and relationships on different kinds of maps.

"Find some object on the map. Don't name it; just describe it and I'll see if I can guess what and where it is from your description. How many other ways can you describe the location of your object?"

"Pick an object on the map other than the post office (or town, or junction of two routes, whatever is appropriate to the map you are using). Where in relation to the post office is it? Describe the relationship carefully so I can guess which object you had in mind. How many other ways can we describe the relationship of position of two objects?"

Comment: This activity requires children to read map symbols and solve a problem. These activities emphasize convergent thinking. The opportunity to stress divergent (creative) thinking is also present, however, if you, as teacher, take the time and make a serious effort to develop with the children a variety of ways to describe location and spatial relationships.

6. Provide two or more maps that roughly cover the same area. Have the children analyze the differences between them and the reasons for these differences.

"Are these maps of the same place on Earth? What differences between these two maps do you notice? Let's list them. Why do you suppose two such different maps of the same place would be made? Are they for different uses? Are they for different people? Is the difference only one of cost or quality?"

"If you were a tourist in California, which of these maps would you choose? Why?"

Comment: Here is a good context for analysis where children are almost guaranteed success in detecting differences. More careful questioning may be required in eliciting the why questions, but success should be possible here, too. This activity is a good opportunity to stress the tremendous variety of information that can be conveyed by maps. You could even make a project of collecting as many different kinds of maps of the United States as the class can find.

Activities Involving the Making of Maps

1. Have the students draw a map, perhaps of their city, from an aerial photograph.

"How are you going to decide what information from the photograph to include? What do you want your map to show? Are you going to make your map the same size as the photograph or make it bigger? How can you make it bigger? How do you know what objects are on the unlabeled photograph? How will your friends know what they are on your map?"

Comment: You will not have to ask most of the questions above; they will be handled by the children themselves in the process. While this activity may be seen as a busywork exercise, I have tried to show

by the questions that the children have to think out decisions as they go along.

2. Let the children measure things.

"How long is our classroom from front to back? Take a guess. Now measure it. Now measure it with another method. Make a tool that could help you measure it faster. Did you know that geologists often use their step to measure distances when they work in the field? (see comment) Would you like to know how they do it?"

"How many ways can we figure out how to measure the height of a tree or building?"

"How could you measure short time and long time if you had no watch? There are many ways you can use to get close. Let's figure out some of them."

Comment: I have suggested some basic measuring exercises. Many such exercises lead nicely into map making. All of them can help with divergent as well as convergent thinking. The wording and sequence of questions will have to be planned carefully for different age and ability groups. When limits of thinking ability are reached it probably is better to stop than to push on by telling answers and broadly hinting.

You can easily teach children how to measure distances along the ground by having each child measure his stride. This can be done by having the children walk with normal gait along a tape measure. The distance to the point where the tenth step with the left foot is placed, having started with the right, is recorded. That distance is simply divided by 10 to find the average distance for one stride. This known measure can then be used as a standard of moderate accuracy to determine unknown distances.

3. Ask the children to make a map of their home or apartment and the yard around it.

"In what ways are your house and yard different from others? Can you show these differences on a map?"

"Could a friend seeing this map without a title know it is your house?"

"Why do you think people make maps of houses and property?"

Comment: This type of activity can be done with the very young or as one of the initial mapping activities. Also it can be done (or repeated) as a culminating activity with attention paid to scale, detail, accuracy, and symbolism. Do not expect too much discovery too early. By sharing maps with classmates and using commercially prepared maps, students will grow through self-evaluation. The everyday decisions about whether to tell how to do something or to await the slow and often frustrating discovering are painful ones for the concerned teacher. Good judgment is essential to achieve the properly balanced diet most helpful to each student's needs.

4. Have each child describe and map the route from the school to his home.

"Is your map clear? Test it out on a friend. Did he find his way to your house? Could he find the location of your house on a detailed city map?"

"What would be the clearest way to explain a proper route to a friend? See if people understand and remember better from oral instructions, written instructions, or a map?"

Comment: A great deal can be made of an exercise such as this both in experimenting with various modes of communication and in

evaluation of effectiveness of these modes. It may be good practice for students to construct maps and compose descriptions in a mapping curriculum but the essence of this lesson really lies in the analysis and evaluation of the effectiveness of the techniques used. I would favor this view, for it is only in such treatment of the original activity (mapping) that this exercise becomes active inquiry rather than practice of rather elementary mapping skills.

5. Encourage the children to extend their range of mapping skills and problem-solving techniques by suggesting unusual map-making activities.

"Can you think of a map that expresses three dimensions on a flat piece of paper? How can you make one? Think of something that exists in three dimension in your classroom (like air temperature). How can you make a map showing all three dimensions (length, width, and height or length, width, and time)?"

"Choose an object or place smaller than an 8 1/2 x 11 inch piece of paper. Can you enlarge the area in size as you map it, filling the entire piece of paper? Who can you think of that might do this kind of mapping?"

"Choose something that you know exists but cannot be seen. Why can't you see it? Can you make a map of it? Do it. How accurate is it? Can you name several things underground that people have mapped for special reasons? What are they?"

"You know that your tongue can help you recognize different tastes. Can you make a map of your tongue that tells where on your tongue you can taste salt, sugar, lemon, and quinine water? (Teacher—these four substances represent the four basic tastes. They can be

dabbed on the tongue by means of a cotton swab.) How does your map compare with the map in a biology textbook? What method do you suppose the biologist uses?"

"How would you make an accurate map of the stars? Where would you do it? What shape would the map be? What would the scale be? How would you show the size and distance of the stars? Would you label the map? Compare your map to star maps in books."

Comment: These activities are perhaps most valuable as a follow-up of more basic mapping activities to encourage development of a broader perspective toward mapping. They can be challenging, however, and may be optional or reserved for only the few who are especially interested.

Miscellaneous Games, Puzzles,
and Short Term-Projects

1. Conduct a hunt for resource maps through the local community and through the mail.

"Who can you think of that uses maps in their work? For what purposes are the many maps used? Are we defining maps broadly enough? Has anyone looked up the meaning in a dictionary? What would be a good definition for us to use?"

"By Monday see how many different kinds of maps you can find and bring them into class. See if you can find at least one kind of map that no one else thought of."

Comment: This might be a good discussion orientation and follow-up activity with which to begin a map study unit. The students are encouraged to be imaginative in their planning, concrete in their definition, and practical in their map acquisition. Thus their introductory probe involves three important kinds of thinking activity and is participation oriented.

2. Have the children construct a large scale map of the United States covering the classroom floor. Regional or state areas can be marked off. Tape or water base paint can be used for this purpose.

"How large a scale can we use to fill the room with this map? What marks or symbols can we use to show various features in different parts of the country? What features would be good to symbolize on this map? How does seeing such a large scale map of our country change your feeling about it?"

Comment: Here is a chance to encourage group problem solving as the United States map is scaled and positioned within the classroom. The contents of the map are also to be determined by a class decision as the one map belongs to the entire class. A significant impression may be made upon the children because of familiarity with the outline map of the United States and the large size of this map. After its construction, the map may be used as a tool for reporting weather and news region by region and for illustrating such concepts as population, production, travel, and physiography. The teacher is encouraged to be sure of a fairly high interest level in such a project before embarking, however. If the children resent the infringing of the map upon their movement, the map's beneficial possibilities may quickly vanish.

3. Tack a United States map or your state map onto some cardboard. As a child throws darts at the map, he describes a trip he is taking according to dartfall. He must be prepared to describe means and routes of travel, general geography, and sights of interests all on the spur of the moment.

Comment: Like the next six, this activity is best suited to a small group of about three to ten. The activity may be used especially

to promote extemporaneous speaking mainly concerning previous knowledge. Or it may be used more as a means of setting the parameters on an in-depth planning of a trip.

4. Tack a sheet with the outline of a state or an island onto the same cardboard. According to dartfall, draw in various topographic and cultural features. Your map is thus composed somewhat by chance, but the land can be described in some detail by its creator and new owner.

Comment: The dart throw element is merely glitter added to the intended task of the creation of a map depicting various natural and human elements. The success or failure of this venture does depend upon the motivation and its resultant delving into the complex interrelationships of the mapped elements.

5. As a space filler, use a few minutes of globe spinning. With eyes closed and finger pointed at the globe's surface, the student spins the globe and becomes a native of the land pointed to when the globe stops. The native must then describe his life and country. This may be done as a spur-of-the moment speech or with comments from the group if they know facts or have ideas.

"What are your people like? What do most people do for work? What is your climate? What countries do you trade with? What is your countryside like? What are your main cities? Is your country highly populated? Do you have any port cities? What are the main exports of your country? What languages do your people speak?"

Comment: If your students use and take seriously the sample questions, this time filler may become the starting point for a major study. Atlases, economic and physical maps, almanacs, and encyclopedias may be used. Even without the element of country study, the globe-

spinning activity is a good way to teach patterns and relationships of land, water, terrain and national boundaries in a discovery mode rather than in an expository way. It cannot be maintained that the discovery in this case is planned or guided in the way systematic inquiry is often described as operating; while this fact should be noted, it need not be viewed as any less valid a discovery or learning process.

6. Construct a design or a drawing from a map. Using only one-way communication, carefully describe the diagram or map to the children as they try to draw it based only on your oral cues.

Comment: This simple game can quickly become an investigation into modes of communication as you vary and extend the process described above. For instance, allow two-way communication. Allow children to do the describing. Analyze the mistakes in the drawings. See what effects time restraints have. A conceptual outcome of this exercise may well be a greater appreciation for the value of a map or drawing for communicating positional relationships. You may want to set this activity up on job cards for small groups of about five to ten, and somehow standardize the results for comparison and study purposes.

7. Perhaps as a sidelight in a discussion centering around a world map or a United States map, where the countries or states are colored differently, no two of the same color being adjacent, pose a mathematical problem.

"What is the smallest number of colors you need to color in the states with no touching of two states with the same color? How do you know your answer is correct? Can you show it? Can you prove it?"

Comment: This problem-solving exercise can fit well into your work with maps. Not everyone need work on it. It can be suggested to

the whole class or to a specially interested group. It can be a job card in a map center.

8. Cut out one and one-half inch diameter circles from an expendable atlas. The students try to identify the location of the segment from clues included in their segment. A whole reference atlas will of course need to be available.

Comment: It is suggested that this be done on job cards numbered from the easiest to the hardest. Children in twos to fours will probably comprise the optimal group size. Care should be taken in cutting circles to include clues that will tend to promote success from attention to map symbols and use of logic rather than to promote frustration or random searching. A home state map could also be used for younger children. Smaller circles would be appropriate for older children.

9. Conduct a treasure hunt. The treasure can be a mistake or inaccuracy in a map.

Comment: This might best be suggested near the beginning of your map study. It can be presented as a contest if you wish. The rationale for conducting a hunt as a long-term process is twofold. If the children take the challenge seriously, they will add a new dimension of attention to their map reading. Moreover, the finding of errors, unclarities, contradictions, misplacements and uncharted changes will help to instill a more discerning attitude in their interpretation of map data. The limitations of map making may thus be taught.

Activities Likely to Become Long-Range Projects or Thematic Investigations

1. Have children follow and later lay out orienteering courses (pathfinding by compass and stride).

"What kinds of jobs or situations might require orienteering similar to what we are doing?"

"Which part of orienteering requires more accuracy, setting up the course or following it?"

"Would orienteering be easier or more difficult on a place like the moon or a flat desert without familiar landmarks?"

Comment: Children generally appreciate the chance to work outside, but be prepared for possible uncontrolled exuberance. The use of orienteering to locate a treasure can be a powerful motivating force in channeling this exuberance. The technical details of orienteering using compass and pace or stride measurements are to be found in any scouting manual or library book on outdoor lore. (For a more complete treatment you might purchase Be Expert with Map & Compass—The "Orienteering" Handbook by B. Kjellstrom, for $3.50 from Charles Scribner's Sons, 1967.) Besides teaching basic distance, direction, and map skills, the valuable attitudes of striving for accuracy and being aware of the limitations of maps are likely to be instilled in activities such as following and laying out orienteering courses. Evaluation and purpose can also be treated during and after such activities.

2. Construct a small city, island, national park, or state in three dimensions. After enjoying it as a model to build, play with, and examine, make a map of even smaller scale in two dimensions. Also introduce the problem of contouring if the children are ready for it.

"Would you like to build a little village or island? What materials could we use to give it shape and strength? What games can we play with it? If our village is to be like a real one, what have we to put in to make it right? What have we left out?"

Comment: It is suggested that the teacher allow and encourage the exploratory play stage to run its full course with minimal teacher direction following the initial question above. Then, many of the questions that follow the initial one may be asked and answered by the children themselves. Spontaneity is of the essence here because the children may be much more amenable to measuring and mapping activities if they truly own the island or city they constructed. Many substantive and concept areas can be reached through the use of such a project, although one would not want to diminish the enthusiasm by extending the activity beyond students' natural interests. Concepts that may be approached in this way are scales and scaling, topography, cross sectioning, community planning, and environmental resources.

3. Have students make a large map of a whole imaginary country or small continent. Allow and encourage them to use atlases and other written resources to produce a map with as much detail as the group or person is able to handle.

Comment: Let the children have a great deal of free reign in determining their imaginary country. They will know and pick up ideas about what will make a good, interesting, and complete map. Especially with previous experience in map viewing, they may well want to consider scale, terrain, cities, transport systems, natural resources, and climate. Sharing of plans should be encouraged. This kind of activity might be used at the beginning and at the end of the year to illustrate to children and to yourself how much your children have grown in mapping sophistication.

4. Show slides, movies, or pictures to provide starter ideas for a trip. Students then begin to plan a real or imaginary trip. Have

resources available to help them plan perhaps a 21 day, $300 trip with specific routes, distances, expenses, sights, and activities.

"Is $300 reasonable? Do you need more for the whole family or will you be traveling with a friend and sharing expenses?"

"Is 21 days a reasonable length of time for your interests, money, and distance to be covered?"

"What would you like to see and do? Where would you go for this? How do you get there? How far is it? Is an ordinary family car suitable?"

"Where will you stay along the way? Are there friends or relatives to see, sights or activities to stop for? Will you be camping or staying in motels or hotels? Do your traveling expenses fit your budget? Will you eat at restaurants, buy peanut butter and bread, or cook over a campfire?"

"How much distance can you cover each day? Will this depend on the area you're in? How? Will you want to spend several days in one place, but want to rush through another?"

Comment: Children will want to share their trips, especially if they have put a lot of imagination into the planning. This activity has worked well when rushed through in only two to three days and ought to yield even better results if longer time is available. Often groups will work best if they are two to four in number. Feedback and decision-making is heightened. If encouraged, children will enjoy the sharing of their trip in a variety of forms. Plays, humorous sketches, dramatic or choral readings, skits, puppet shows, or a journal of the trip may naturally appear. To make this activity most likely to succeed, it is highly recommended that you provide and encourage the use of a variety of resources. You may want to set up a map or travel corner in your room.

Brochures, books, and maps should be gathered. Encourage children to use the telephone and to question their parents or neighbors for further information and guidance.

5. Give the students imaginary ownership of about a square mile of land where they choose. Have them conduct an investigation into the many varied kinds of rights over the land that ownership brings.

"Do you own the sky above your land? Can a pilot fly over your home? How close? Can a nearby industry pollute your air? How much?

"Can the state put a highway through your land even if you don't want them to? What happens?"

"Are you allowed to keep all people off your land? If not, what exceptions are there?"

"How do you know for sure where your property ends?"

"Can you sell the water above, on, and under the surface of your land? Can you legally dam up a stream which would keep your neighbor from getting water? Can another neighbor do this to you?"

"Can you sell the oil that lies below you? Can you sell the right to oil that might be below you to someone who wants to take a chance? How do you do this? Is he allowed to come onto your property then? Is he allowed to destroy trees or buildings in order to put up a drilling rig? Is he allowed to pump out oil that may be partly under your property but partly under your neighbor's property? What other kinds of rights do you as landowner have? What other rights do you not have even with a title to the land?"

Comment: While this activity may be difficult to initiate, the potential for attacking many intriguing problems certainly exist for an inquisitive group. The kinds of problems to be solved will carry students

to a variety of community and federal resources by phone or personal interview or by mail. Children will naturally integrate such a study with map use and develop a more three-dimensional view of the land. Imagination, resource hunting, and critical thinking can all be given a thorough workout in this type of inquiry.

6. Have the children study maps, charts, and graphs in order to decide how they can be designed to persuade, confuse, or fool people.

"Find a map that is confusing or unclear. By comparing it to a clear map, can you tell what makes the second map much better?"

"Have you ever been tricked by a map into thinking something was true that really wasn't? How did the map or chart trick you? Did the designer intend to trick you?"

"Find a map that you think is trying to persuade you to go somewhere or do something. Why do you think it is trying to persuade you? Is it successful?"

Comment: This activity may achieve only limited success unless introduced very carefully. The important teacher attitude is his desire to be aware of the possibilities of analyzing maps that present a position or exhibit a bias. He may then provide the impetus for a truly interesting investigation into the human psychology of maps.

7. Conduct with your children an in-depth study of your community or neighborhood. Factors that might be considered are physical, political, ethnic, religious, social, consumer, and economic.

"How long do families usually stay in your part of town? What is the longest any family has lived there? What is the average? How old are the houses themselves?"

"Would you say that the families in your school district are young or old? How can you tell? What effect does this have on your school? Will your school enrollment be growing larger or smaller in the next few years?"

"How will your voting precinct vote in the next election? What issues do the voters feel are most important? How does this compare with the national polls?"

"What services does your neighborhood seem to need? More houses? More apartments? More or different stores? What kinds? Better roads? A new school? How do people feel about their neighborhood? Do adults think the same improvements are needed that children do?"

"How much garbage does each block in your area produce each week? How much, then, is produced by the whole city? How much space is needed in the next 10 years to take care of the problem of garbage disposal? Specifically, what are the habits of these consumers? Do they use plastic waste bags, nonreturnable bottles, more than 10 gallons of water per person per day, or more than one new car each three years?"

Comment: Surveys can be a fascinating search into a fairly easily available, relevant source of information. As always, I encourage you not to force children into such investigation but to be ever ready with suggestions and support for such inquiry.

Surveys are especially desirable in an inquiry-oriented curriculum because of their interdisciplinary nature, their relevance, and their open-endedness. Children can develop thinking, speaking, listening, writing, and reading skills, yet need not be greatly hampered when one of these skills is much weaker than the others. This is especially true of reading. Polls are flexible in that they can be random or complete,

they can search out fact or opinion, they can be carried out by interview or by questionnaire, via phone, mail, or personal visit. They involve the child and deal with real data.

An Annotated List of Mapping Resources: Agencies, Books, and Materials

Agencies Which Might Have Free or Inexpensive Map Resources

1. Gas stations. Maps are free at gas stations and will provide you with a variety of local, state, and regional maps. Children can be encouraged to bring them to class to heighten involvement.

2. The local Chamber of Commerce. Your Chamber of Commerce has city maps and local area information you might wish to use in conjunction with map making or map study. Materials are free.

3. Travel bureaus. Maps, pictures, and commentary on interesting places all over the world make local travel bureaus a good resource to use.

4. City and county offices. Local governmental offices can be helpful with community maps and other information. Of most help might be offices such as the city engineer department, county commissioner, street department, park board, and building permits and inspections.

5. The local weather bureau. The day-old maps that the weather bureau might provide you will help in unifying map study with weather study. Its emphasis on live data may greatly stimulate some special interests in this area.

6. Bell telephone. The telephone book itself is a tremendously important document concerning your local community. It includes a city map. Also Bell's research and development work on the growth of the community and region can provide helpful resources for your map work.

7. Bookstores and libraries. Resource books (see list below) of course are available in either bookstores or libraries, but maps of

various sorts are available too. For instance, in a search through a downtown bookstore, a college bookstore, a public library, a university library, and a university geology library, I was able to locate dittoed maps, wall maps, historic early United States maps, geologic maps, topographic maps, aerial photographs, raised relief maps, atlases of all sorts, and informational (e.g., National Geographic) maps. All these resources were within a two-mile radius in a city of population 40,000. Most material was available to be checked out or could be purchased inexpensively.

8. Local printers. If you can determine who does the printing for the city (maps and photography), you may have found a source for classroom resources. While this could be an expensive source of maps and photographs, you might be able to borrow or use seconds of prints or map runs. Also the printer might be willing to explain to your class the map-making process from the printer's point of view.

9. Local construction firms. Firms constructing homes or larger buildings may furnish blueprints or other kinds of floor plans for classroom study.

10. Insurance companies. A number of insurance companies are known to furnish United States road atlases. These could be a useful resource and it is free for the asking.

11. Automobile clubs. If you or your children's parents are members of the American Automobile Association, the American Motor Club, or any other such clubs, you have a direct line to a good source of maps and related travel information.

12. Magazines. A number of travel magazines may have useful pictures, commentary, and maps appropriate for classroom use.

National Geographic, in addition to maps, commentary, and pictures of localities across the globe, includes seven times per year a wall map of very high quality containing a great deal of interesting information. Separate National Geographic maps are available at $1.00.

13. Educational supply houses. Aero Service Corporation (210 Courtland St., Philadelphia, Pa. 19120) and Hubbard (Box 105, Northbrook, Ill. 60062) both advertise catalogues of raised relief topographic maps which they can provide for around $10. American Map Company (3 W. 61st St., New York, N.Y. 10023) can furnish classroom map supplies as well as can most other educational supply houses which try to deal comprehensively with classroom needs.

14. State departments of education. Your state department of education might be very useful if some state collection of maps or guide to map activities is available. Local school systems may have assembled useful materials as well.

15. The United States Department of the Interior--Geological Survey (Distribution Section, Federal Center, Denver, Colo. 80225 if west of the Mississippi River or Distribution Section, Distribution Center, Washington, D.C. 20240 if east of the Mississippi River). This agency is able to provide state index maps (free) and topographic maps ($.75) for most locations in the United States. The scale of the 7.5' quadrangle maps is one inch equals .35 mile and one inch equals .70 mile for the 15' quadrangle maps. Coverage, east to west is approximately seven and 14 miles respectively. A free booklet about topographic map interpretation is included upon request.

16. The Superintendent of Documents (Government Printing Office, Washington, D.C. 20402). This federal office can supply a great number

of documents that could be of use in the field of mapping. I recommend two especially. They are "Types of Maps Published by Government Agencies" for $.15, stock number 2401-00258 and the price list for "Maps," #53 which is free. The first lists the large variety of maps that the various governmental agencies can provide and also lists complete addresses. The second is the current list of publications in the field available from the Superintendent. One can order from the Superintendent any document listed in this 24 page booklet complete with the costs and stock numbers.

17. United States Department of Agriculture (Western Aerial Photography Laboratory, Compliance and Appeals Division, ASCS-USDA, 2505 Parley's Way, Salt Lake City, Utah 84109, and for states east of the Mississippi, Eastern Aerial Photography Laboratory, Compliance and Appeals Division, ASCS-USDA, 45 South French Broad Avenue, Asheville, N.C. 28801). The USDA can supply, at an expense of $1.75 and up, aerial photographs of any area of the country at a scale of one inch equals 330 feet to one inch equals 3334 feet, and in a size of 9.5 inches square to 38 inches square.

18. Other governmental agencies. Agencies such as the Department of Commerce (Washington, D.C. 20233), the Department of Interior (Washington, D.C. 20240), the Department of Agriculture (Washington, D.C. 20250), and the United States Army Corps of Engineers (Public Affairs Office, Office of the Chief of Engineers, Washington, D.C. 20310) can provide additional governmental documents and maps. More specifically, you may write to the Bureau of the Census or the National Weather Service (c/o Commerce), the National Park Service or the Geological Survey (c/o Interior), and the Forest Service or Agricultural Stabilization and Conservation Service (ASCS) (c/o Agriculture).

Books and Materials

An annotated list of general inquiry readings and curricular materials for teachers and students:

1. Blosser, P. E. Ask the right questions. National Science Teachers Association how to . . . Instructional Aid, 1975, Stock No. 471-14698. Order this pamphlet for $.50 from NSTA, 1742 Connecticut Avenue, NW., Washington, D.C. 20009. It is a good source for question types, teaching tips, and self-evaluation. 8pp.

2. Sanders, N. M. Classroom questions: What kinds? New York: Harper and Row, 1966. A popular and readable paperback, this volume is well worth adding to your library. It takes the Bloom taxonomy and presents it in a most useful form for the daily considerations of teachers. 176 pp.

3. Silberman, M. L., Allender, J. S., & Yanoff, J. M. (Eds.) The psychology of open teaching and learning: An inquiry approach. Boston: Little, Brown and Company, 1972. This book is a paperback text full of excellent readings and activities for training teachers. The content concerns the learning environment, cognitive functioning, and the teaching process. 307 pp.

4. Rowe, M. B. Teaching science as continuous inquiry. New York: McGraw-Hill Book Co., 1973. This textbook contains a very exciting presentation of the scientific background and teaching technique. 593 pp.

5. Kuslan, L. I., & Stone, A. H. Teaching children science: An inquiry approach. Belmont, Cal.: Wadsworth Publishing Company, Inc., 1968. A basic textbook for elementary science teachers, this book is useful for its statement of history, philosophy, and practice of the inquiry technique. 464 pp.

6. Massialas, B. G., & Cox, C. B. Inquiry in social studies. New York: McGraw-Hill Book Company, 1966. A basic textbook in social studies teaching, this volume presents a strong case for inquiry, or reflective thinking, as a methodology. An extensive section on evaluation is included. 353 pp.

7. Bloom, B. S. (Ed.) Taxonomy of educational objectives, Handbook I. Cognitive domain. New York: David McKay Company, Inc., 1956. Available in most libraries, this volume is the definitive work on levels of questions. 207 pp.

8. Wentworth, D. F., Couchman, J. K., MacBean, J. C., & Stecher, A. Mapping small places. Minneapolis: Winston Press, 1972. This teacher's guide to examining the environment is entirely organized around making local maps of the school area. It is activity oriented and very well illustrated. It is available from the publisher at 25 Groveland Terrace, Minneapolis, Minn. 55403 for $3.00. 106 pp.

9. Elementary Science Study. Teacher's guide for mapping (also Making maps and Mapping games). New York: Webster Division, McGraw-Hill Book Company, 1971. The ESS Teacher's Guide to Mapping, Making Maps, and Mapping Games compose a good activity and project-oriented mapping experience. The complete kit is expensive but its potential for inquiry may seem worth the price. 82, 24, and 40 pp.

10. Epstein, S., & Epstein, B. The first book of maps. New York: Franklin Watts, Inc., 1959. This volume is perhaps too simple for intermediate students but its coverage is clear and complete. It deals mainly with interpretation of maps. 63 pp.

11. Tannenbaum, B., & Stillman, M. Understanding maps: Charting the land, sea and sky. New York: McGraw-Hill Book Company, 1969. The authors have written a very clear book describing the various kinds of maps and how they are prepared. Topographic maps are included. 159 pp.

12. Marsh, S. All about maps and mapmaking. New York: Random House, 1963. Susan Marsh writes a book for young people that clearly describes mapmaking and map types that even includes topographic and geologic maps. 143 pp.

13. Comparative World Atlas. Maplewood, N.J.: Hammond Incorporated, 1975. Hammond has published this inexpensive yet very informative paperback atlas for school use. It has a great potential for investigative learning. 48 pp.

14. Pictorial World Atlas. Eau Claire, Misc.: Rand McNally & Company, 1968. This atlas is a well prepared, clear volume which includes a great variety of maps. Included are statistical, physical, and cultural maps in addition to the pages of world facts, pictures, and commentary. 160 pp.

15. Chapman, J. D., & Sherman, J. C. (Eds.) Oxford regional economic atlas--United States and Canada. Oxford: Clarendon Press, 1967. A large variety of map types--physical, transportation, population, and products is to be found in this atlas. Gazetteer included. 128 pp.