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ABSTRACT

Presented is the Process/Inquiry Module, the first of a series of science modules (Appendix A) which were designed to be used in a research project at Central Michigan University. The focus of this project was the development, evaluation and revision of competency-based materials in science methods education for elementary school teachers. The Process/Inquiry Module is divided into three parts. Part 1 is designed to help preservice teachers acquire specified process skills. Part 2 involves planning activities for elementary children, utilizing each skill. Part 3 requires preservice teachers to implement a planned activity involving a process skill with elementary children. A flow chart and answer sheets are provided. (PEB)

Science Modules
Science/Social Studies Methods
ELE 340 (431)

PROCESS/INQUIRY MODULE

This is your first module. In completing this module you will participate in activities which were designed to help you acquire specified skills necessary for achieving competence in the area of Process-Inquiry. This module is divided into three parts. Part One is designed to help you acquire the specified process skills; Part two involves planning activities for elementary children utilizing each skill and Part three requires you to implement a planned activity involving a process skill with elementary children.

In some of the activities you will be involved in small group work, while in others, you will work alone. Your instructor will serve as a resource person. The assigned textbook is to be used as the primary source of information.

It is important that you read the directions carefully and follow the specified sequence of the activities. Participating as a contributing member of a small group and maintaining a continuing dialogue with the instructor are both essential to the successful completion of the module.

A flow chart is provided with the module. You are to use it like a road map. It tells you where you are going and how to get there. You will want to refer to it frequently while completing the module.

Answer sheets are provided with the module. You record your responses on the appropriate answer sheets and turn them in to your instructor for approval. The answer sheets will be returned to you after your instructor has checked them. Individual prescriptions will be given if you do not receive the instructor's approval.

The same general format described above is used in all of the modules that you will be completing for this course.

INTRODUCTION

Scientific processes, which are modes of behavior or investigator's actions, are stressed currently in elementary school science. Teachers must be able to use these processes in order to teach them effectively. Once a teacher is able to use these processes effectively, he must incorporate them into his teaching. This is the only way in which process teaching becomes effective.

This laboratory exercise consists of a series of activities dealing with the processes of observation, using spatial relationships, measuring, classifying, communicating, predicting, inferring, and experimenting. Note how directions are given and how questions are stated. The learnings from these activities are most likely to come from your interaction with the equipment rather than from the words. Note the roles of the learner and teacher.

GOAL

You will demonstrate competency in:

A. The acquisition of the process skills

B. The ability to plan activities for elementary children utilizing each skill

C. Implementing a planned activity involving a process skill with elementary children.

BEHAVIORAL OBJECTIVES

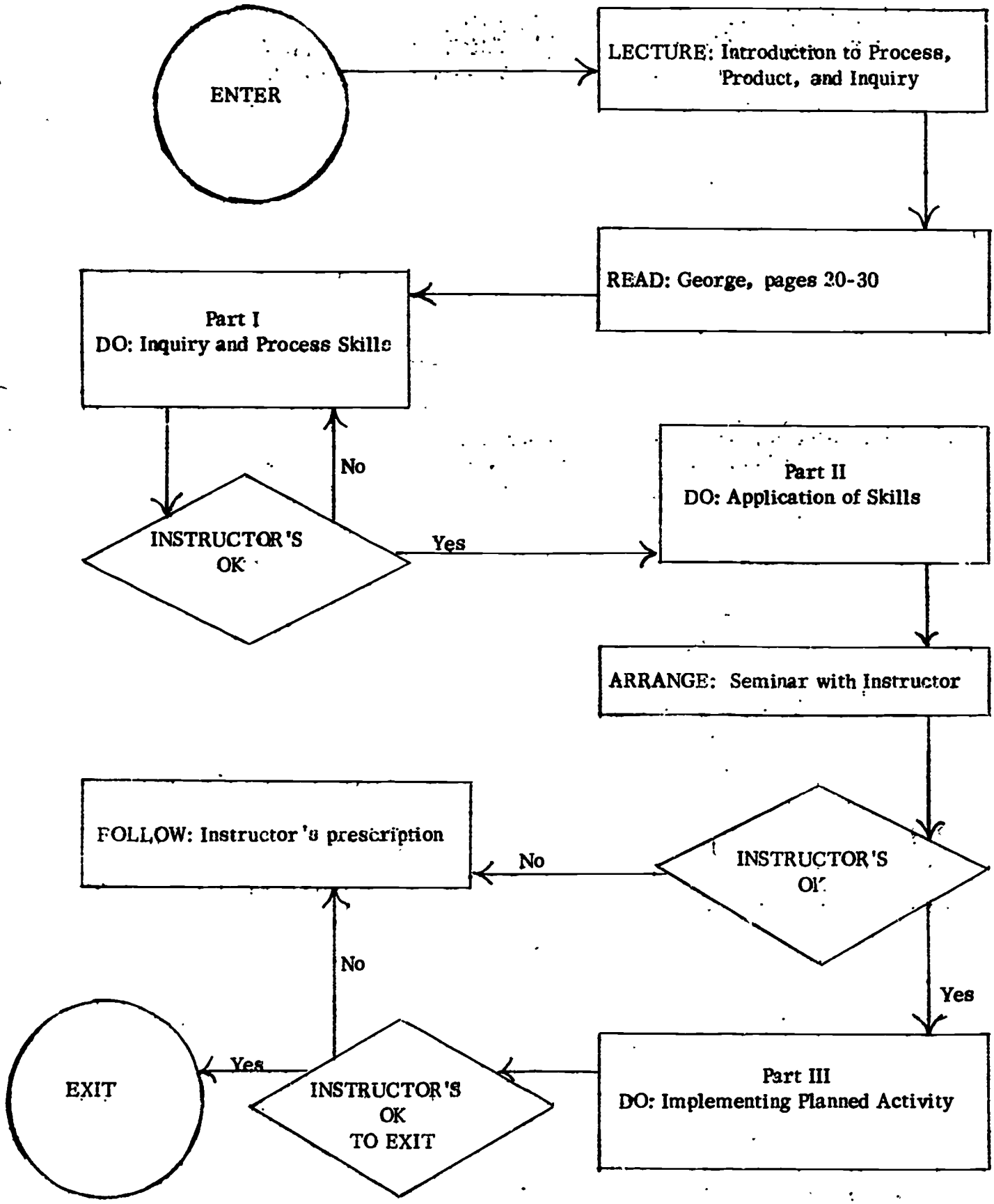
1. Using the direction and materials provided, you will demonstrate the following scientific process skills by successfully completing at least one activity utilizing each skill:

   A. Observing
   B. Classifying
   C. Measuring
   D. Using spatial relations
   E. Communicating
   F. Predicting
   G. Inferring
   H. Integrated Processes

2. You will plan activities for use with elementary children utilizing each of the process skills.

3. You will implement a planned activity utilizing a process skill with elementary children.

FLOW CHART: PROCESS/INQUIRY



PART I: PROCESS/INQUIRY SKILLS

Record your answers for each activity on the answer sheets on p. 7-14. Use the self-check cards to check your results before going on to the next activity. Submit the answer sheets to your instructor after you check your results.

Activity One: Observing

A. Select an object from those provided and list ten properties that you can observe.

B. Select a box from those provided and list as many observations as you can about the object(s) in the box.

Activity Two: Classifying

A. Select a box and separate the contents into two groups. Label each group according to the property used to separate the groups.

B. Can you find another way to separate the contents of the box into two groups? Label the two new groups.

C. Take about 3 minutes and see how many different ways you can divide the contents of the box into two groups. Label each group. How many different groups of two did you make?

D. Separate the contents of the box into three groups.

E. Can you find other ways to make three groups? Label these.

F. If you were the teacher, what question(s) might you ask to encourage the learners to investigate further? Remember the role of the teacher thus far.

Activity Three: Measuring

A. Using the contents of the envelope, place them in some order by length. (Use pictorial or written descriptions for answer sheet.)

B. Can you find any relationships among the different lengths of paper? (Please do NOT mark or tear the paper strips.)

C. Select one paper strip. (1) Identify it by some means. (2) Measure some object or distance in the room using the selected paper strip. (3) How long or far is the distance you measured?

D. Compare your measurement with those of others.

E. Suggest a method for reducing the confusion in measurement.

Activity Four: Using spatial relationships

A. Using any two geometric shapes from the envelope, produce a third geometric shape--square, rectangle, parallelgram, or triangle.

B. Construct a geometric shape using four shapes from the envelope.

C. Use all seven shapes from the envelope to construct a larger geometric shape.

Activity Five: Communicating

A. Using the white cube provided, describe it by listing all the observations you can make.

B. Drop the white cube into a glass of water and describe as many physical changes as you observe.

C. Describe any characteristics that you observe which remain unchanged while the object itself is changing.

Activity Six: Predicting

A. You will need the set of beakers labeled 1, 2, 3 and 4, and a candle for this exercise. Light the candle and place Beaker 1 over it. Measure how long the candle will burn. Make three trials and obtain an average time. Record these data on the answer sheet.

B. Repeat the above procedure using Beaker 3.

C. Using the data gathered thus far, predict the length of time the candle will burn under Beaker #2. Record this prediction on the answer sheet and graph. Now make your measurements as before, and compare your prediction with actual results.

D. Repeat the proceeding in C. using Beaker 4.

Activity Seven: Inferring

A. Select three of the boxes used in Activity Two (observing) and infer the identity of the objects concealed in the boxes.

B. List the properties observed separately for each of the three objects that you used in making each inference.

Activity Eight: Integrated Process (e.g. defining operationally, formulating hypotheses, interpreting data, controlling variables, experimenting)

A. With one or two classmates, select a question from those provided and design and conduct an experiment to answer the selected question.

(Continued on next page)

B. Identify the variables, controls used, hypotheses tested, and conclusion reached.

C. Consult with your instructor before completion of the experiment for feedback.

D. Submit results.

PART II: APPLICATION OF SKILLS

A. Plan one activity for children based upon each of the processes listed below. You may refer to the activities completed, your text, or resource books located in the IMC. Variations of the activities that you did are acceptable, but not the same activity.

a. Observing
b. Classifying
c. Measuring
d. Using spatial relations
e. Communicating
f. Predicting
g. Inferring
h. Integrated Processes

B. All your activities may deal with the same subject matter or each activity may deal with a different subject area.

C. Use the same type of format that was used in Part I, i.e., tell what the child is to do and/or questions to be asked.

D. Record your answers on the answer sheet for Part II.

E. When you are finished get together with three other people to share and discuss your activities. When your discussion is completed, ask your instructor to meet with your group briefly.

Part III: IMPLEMENTING PLANNED ACTIVITY

A. See your instructor about opportunities for implementing a planned activity using process skills.

B. Present your activity at the time and place agreed upon with your instructor.

Name _____

Section _____

Module _____

Answer Sheet for Activity One: Observing

A. Object chosen _____

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

B. Box selected # _____

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Name _____

Section _____

Module _____

Answer Sheet for Activity Two: Classifying

A. _____ _____

B. _____ _____

C. _____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

D. _____ _____ _____

E. _____ _____ _____

_____ _____ _____

_____ _____ _____

F. 1.

2.

3.

4.

Name _____

Section _____

Module _____

Answer Sheet for Activity Three: Measuring

A. Show or tell how you arranged the strips.

B. Describe the relationship.

C. 1. Identify your chosen strip: _____

_____

2. What did you measure? _____

3. What was the distance measured? _____

_____

D. Compare your measurement with others made by your classmates. (No written answer necessary.)

E. How would you reduce the confusion?

Name _____

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Module _____

Answer Sheet for Activity Four: Using Spatial Relationships

A. Draw the shape, indicating component shapes with dashed lines.

B. Draw the shape (see above).

C. Draw the shape (see above).

Name _____

Section _____

Module _____

Answer Sheet for Activity Five: Communicating

A. Observations of cube

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

B. Observations of physical changes

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

(Continued on back)

C. Observations of characteristics which remain unchanged while object is changing

1. _____

2. _____

3. _____

4. _____

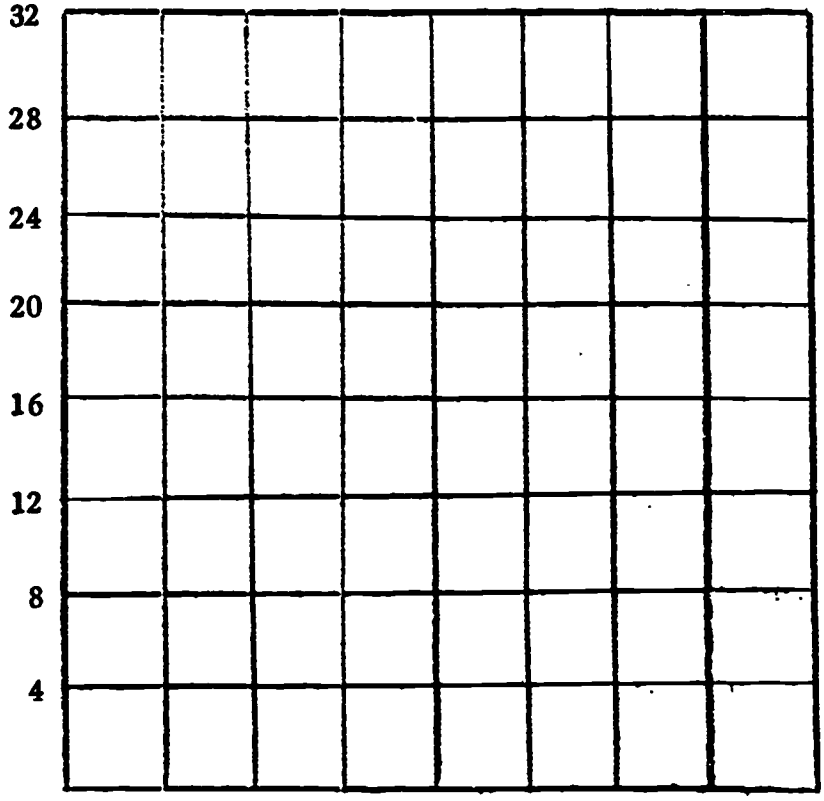
5. _____

Name _____

Section _____

Module _____

Answer Sheet for Activity Six: Predicting



	Predictions	Measurements 1st	2nd	3rd	Avg.
Beaker 1					
Beaker 2					
Beaker 3					
Beaker 4					

How were the data used to make your prediction using Beaker 2? _____

_____

How were the data used to make your prediction using Beaker 4? _____

_____

Name _____

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Module _____

Answer Sheet for Activity Seven: Inferring

A. Box # _____ Identity of object _____

Box # _____ Identity of object _____

Box # _____ Identity of object _____

B. Box # _____

Properties observed:

Box # _____

Properties observed:

Box # _____

Properties observed:

Name _____

Section _____

Module _____

Answer Sheet for Activity Eight: Integrated Processes

A. Question chosen: _____

_____

1. What will you do to answer this question? (Be specific.)

B. 1. Variables

2. Controls used

3. Hypothesis tested

4. Conclusions reached

5. Implications for further experimentations

Name _____

Section _____

Module _____

Answer Sheet for Part II: Application of Skills

1. Observing:

2. Measuring:

3. Classifying:

4. Using Spatial Relationships:

5. Communicating:

6. Predicting:

7. Infering:

8. Experimenting (Integrated Processes):

What are some good ideas that you obtained from others in your group?

1.

2.

3.

POSTTEST FOR PROCESS INQUIRY MODULE (Form A)

(Do not write on the test. Mark your answers on the answer sheets provided.)

A. Objective Questions (5 points)

1. Inquiry is the term used for the process whereby a child tries to solve his problems.

   a. True

   b. False

2. The best way for a teacher to help a child resolve an inconsistency that he perceives is by answering the child's question directly.

   a. True

   b. False

3. George states that you can utilize teaching techniques that encourage children to inquiry, and therefore, make their own discoveries. This is called:

   a. Discovery teaching
   b. Discovery learning
   c. Accommodation
   d. Assimilation

4. The ability to collect data through the use of the five senses best describes:

   a. Observing
   b. Comparing
   c. Identifying
   d. Verifying

5. One advantage of teaching science didactically, rather than as inquiry, is that science learned didactically can better be used in situations that are different from the situations in which the material was learned.

   a. True

   b. False

6. Inferring is the ability to:

   a. Construct a graph from a table of data
   b. Interpret a table of data
   c. Discriminate among factors that will, and will not, affect the outcome of an experiment
   d. Qualify an observation using a frame of reference.

7. In order to solve problems, the child needs:

   a. Certain skills
   b. Certain attitudes
   c. Some information
   d. All three of these.

8. If a child perceives an inconsistency in some event, it means that he is a slow learner.

   a. True

   b. False

9. In order to perceive an inconsistency and to inquire, the child must manipulate material and make observations. According to the ideas of Piaget, which of the following statements is true?

   a. The very young child as well as the older child can manipulate mental concepts.
   b. The child in the concrete operational stage of development can use mental materials but need not have manipulated the actual materials.
   c. The child capable of formal thought can work with the abstract and is not limited to the actual material or mental processing of materials that he has manipulated previously.
   d. All of the above

10. There is no way for a teacher to tell when a child has "discovered."

   a. True

   b. False

B. Problem Solving (5 points)

Ask your instructor for a mystery substance and follow these steps.

1. Make as many observations about the mystery substance as you can.
2. Design and conduct experiments that would help in identifying properties of the mystery substance.
3. Using your observations and experiments, infer the identity of the mystery substance.

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POSTTEST FOR PROCESS INQUIRY MODULE (Form B)

(Do not write on the test. Mark your answers on the answer sheets provided.)

A. Objective Questions (5 points)

1. The term used for the process whereby a child tries to solve his problem is:

   a. Hypothesizing
   b. Inquiry
   c. Observing
   d. Exploration

2. A good teacher should structure the learning environment so that a child does not perceive any inconsistency in relation to observed events.

   a. True

   b. False

3. In order to resolve the inconsistency that he perceives the child needs information. Which of the following statements best describes the inquiring classroom?

   a. The student resolves the inconsistency with a minimum amount of help from the teacher.
   b. The teacher helps the student to resolve the inconsistency by answering questions directly and/or directing the student to a book.
   c. The student resolves the inconsistency with no help from the teacher.
   d. None of the above

4. Children spontaneously develop the inquiry skills necessary to process information and solve problems.

   a. True

   b. False

5. A child made the following observations and inferences when a sugar cube was dropped into a glass of warm water:

   The sugar cube disappeared in the water.
   The sugar cube is gone.
   The water tastes sweet.

   This child is most likely in the concrete operations stage of development.

   a. True

   b. False

6. The ability to form groups based on one or more observed common properties best describes:

   a. Observing
   b. Comparing
   c. Classifying
   d. Hypothesizing

7. When a child suddenly makes sense out of what had been an inconsistent observation he has "accommodated."

   a. True

   b. False

8. Science is a body of content and the methods used to generate, organize and evaluate that content.

   a. True

   b. False

9. As an "inquiry teacher" you should remember that:

   a. Children must be taught the skills of inquiry which can be accomplished with just a few experiences
   b. Your role in the classroom is that of a guide
   c. The children need only to be told to inquire to start their inquiry
   d. All three of the above are true.

10. Didactic teaching is best described as:

    a. Teaching which is under the control and direction of the teacher, book, or curriculum
    b. Teaching in which the learner makes his own discoveries
    c. Teaching combining both a. and b. above
    d. Emphasizing an inductive approach.

B. Problem Solving (5 points)

Ask your instructor for a mystery substance and follow these steps.

1. Make as many observations about the mystery substance as you can.
2. Design and conduct experiments that would help in identifying properties of the mystery substance.
3. Using your observations and experiments, infer the identity of the mystery substance.

POSTTEST FOR PROCESS/INQUIRY MODULE (Form C)

(Do not write on test. Use answer sheets provided.)

A. Objective Questions (5 points)

1. In order to perceive an inconsistency and to inquire, the child must manipualte material and make observations. According to the ideas of Piaget, which of the following statements is true?

   a. The very young child as well as the older child can manipulate mental concepts.
   b. The child in the concrete operational stage of development can use mental materials but need not have manipulated the actual materials.
   c. The child capable of formal thought can work with the abstract and is not limited to the actual material or mental processing of materials that he has manipulated at one time.
   d. All of the above

2. In order to solve problems, the child needs:

   a. Certain skills
   b. Certain attitudes
   c. Some information
   d. All three of these

3. One advantage of teaching science didactically rather than as inquiry is that science learned didactically can better be used in situations that are different from the situations in which the material was learned.

   a. True

   b. False

4. Inquiry is the term used for the process whereby a child tries to solve his problems.

   a. True

   b. False

5. If a child perceives an inconsistency in some event, it means that he is a slow learner.

   a. True

   b. False

6. The best way for a teacher to help a child resolve an inconsistency that he perceives is by answering the child's question directly.

   a. True

   b. False

7. George states that you can utilize teaching techniques that encourage children to inquire, and therefore, make their own discoveries. This is called:

   a. Discovery Teaching
   b. Discovery Learning
   c. Accommodation
   d. Assimilation

8. There is no way for a teacher to tell when a child has "discovered."

   a. True

   b. False

9. The ability to collect data through the use of the five senses best describes:

   a. Observing
   b. Comparing
   c. Identifying
   d. Verifying

10. Inferring is the ability to:

   a. Construct a graph from a table of data
   b. Interpret a table of data
   c. Discriminate among factors that will, and will not, affect the outcome of an experiment
   d. Qualify an observation using a frame of reference

B. Problem Solving (5 points)

Ask your instructor for a mystery substance and follow these steps:

1. Make as many observations about the mystery substance as you can.

2. Design and conduct experiments that would help in identifying properties of the mystery substance.

3. Using your observations and experiments, infer the identity of the mystery substance.

POSTTEST FOR PROCESS/INQUIRY MODULE (Form D)

(Do not write on test. Use answer sheets provided.)

A. Objective Questions (5 points)

1. One advantage of teaching science didactically rather than as inquiry is that science learned didactically can better be used in situations that are different from the situations in which the material was learned.

   a. True

   b. False

2. In order to solve problems, the child needs:

   a. Certain skills
   b. Certain attitudes
   c. Some information
   d. All three of these

3. In order to perceive an inconsistency and to inquire, the child must manipulate material and make observations. According to the ideas of Piaget, which of the following statements is true?

   a. The very young child as well as the older child can manipulate mental concepts.
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   c. The child capable of formal thought can work with the abstract and is not limited to the actual material or mental processing of materials that he has manipulated at one time.
   d. All of the above

4. Inquiry is the term used for the process whereby a child tries to solve his problems.

   a. True

   b. False

5. There is no way for a teacher to tell when a child has "discovered."

   a. True

   b. False

6. Inferring is the ability to:

   a. Construct a graph from a table of data

b. Interpret a table of data
c. Discriminate among factors that will, and will not, affect the outcome of an experiment
d. Qualify an observation using a frame of reference.

7. George states that you can utilize teaching techniques that encourage children to inquire, and therefore, make their own discoveries. This is called:

a. Discovery Teaching
b. Discovery Learning
c. Accommodation
d. Assimilation

8. The best way for a teacher to help a child resolve an inconsistency that he perceives is by answering the child's question directly.

a. True

b. False

9. If a child perceives an inconsistency in some event, it means that he is a slow learner.

a. True

b. False

10. The ability to collect data through the use of the five senses best describes:

a. Observing
b. Comparing
c. Identifying
d. Verifying

B. Problem Solving (5 points)

Ask your instructor for a mystery substance and follow these steps.

1. Make as many observations about the mystery substance as you can.

2. Design and conduct experiments that would help in identifying the properties of the mystery substance.

3. Using your observations and experiments, infer the identity of the mystery substance.

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Answer Sheet for Process/Inquiry Posttest (Part B)

You are to obtain a Mystery Powder from the instructor.

Mystery Powder # _____

A. List at least ten properties of your mystery substance based on your observations and experiments.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

B. Make three inferences about the identity of the properties listed above.

1.

2.

3.