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# LEARNING GUIDE

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## FORMAL REASONING PATTERNS: PIAGET'S DEVELOPMENTAL THEORY

*With*

**Robert Karplus, Ph.D.**

*And*

**Rita Peterson, Ph.D.**

(32 minutes)



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# FORMAL REASONING PATTERNS

## Introduction

The video presents four different tasks to adolescents between the ages of 12 and 17 to demonstrate the thinking processes necessary to the attainment of Formal Reasoning Patterns.

The tasks are adaptations of those developed by Jean Piaget and Barbel Inhelder. They are presented by Robert Karplus and Rita Peterson to eight adolescents, most of whom are in transition from the thinking processes of concrete operations, the earlier stage in Piaget's analysis of the development of cognitive development.

## Outline

### Contrast between Concrete Operations and Formal Reasoning:

- Children who have attained Concrete Operations can do tasks involving serial ordering of actual data, do simple classification tasks and can conserve. (These skills are shown in our CONSERVATION, CLASSIFICATION and CONCRETE OPERATIONS videos.)
- All of the students in this video have attained Concrete Operations.
- Formal Reasoning involves the ability to handle hypothetical events and concepts, not just the real or "concrete" phenomena of the earlier stage. Formal Operations tasks often involve multiple analyses and the ability to use ratios as opposed to simple differences.

### Task One- Proportional Reasoning- Using Ratios:

- The task is to estimate the length of a larger drawn figure using non-standard measurement (big paper clips versus smaller ones) when the subject knows the measurement of both the smaller and larger figures in large paper clips and the measurement of the larger figure using the smaller clips. Students still using Concrete Operations are unable to use ratios to determine the size of the larger figure with the smaller clips.

### Task Two-Separation and Control of Variables:

- The task involves a series of rods (called piers) made of different materials and of different diameters. The rods are also of different lengths. There are three sets of washers of varying weights (called fishermen) who weigh down the rods making them touch the surface of the table. The task involves identifying the factors involved in the differences of placing the weights on the var-

ious rods. The students are asked to make experiments to prove their hypotheses about how the factors interact (length, material differences, diameter of the rods and the different weights used.)

### **Task Three: Combinatorial Logic**

- The task involves identifying the combination of liquids that cause a clear liquid to turn amber. The students are presented with five vials of clear liquids marked 1 to 4 and “G”.
- Vial 1 contains dilute sulfuric acid, Vial 2 contains water. Vial 3 contains hydrogen peroxide and Vial 4 contains sodium thiosulfate. Vial G contains sodium iodide. The students must determine which combination of the first four liquids turns the “G” liquid amber. They have to keep track of the variables involved.

### **Task Four: Proportional Thinking and Separation of Variables**

- The task involves using a balance beam with varied weights placed at different positions on the balance beam. The presenter places one set of weights on one side of the balance beam and challenges the students to place another set of weights to make the beam balance. The task, as in Task One, involves the use of ratios. It also requires that the subject is aware that both placement and heaviness of the weights are factors to be considered.

### **Results:**

- One student, “Katie”, is still clearly at the Concrete Operational stage and cannot deal with any of the tasks presented to her. Others of the students are in transition, being able to do some of the tasks but not others. Some of these students are able to self-correct their original formulations or use hints which point to their transition towards higher levels of thinking. The attainment of Formal Reasoning Patterns does not occur all at once, one achieves different aspects of formal reasoning over the course of time and not in a definitive order.

### **Relevance:**

- Teachers dealing with adolescents need to be aware of the level of their students’ thinking in order to present them with tasks that are within their capabilities. Drs. Peterson and Karplus suggest that teachers observe the ways students handle tasks. As is apparent in this video, the attainment of Formal Reasoning Patterns is not perfectly correlated with age; some obviously younger students were able to do tasks that older students were not yet able to conquer.

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## RELATED FILMS

*Also Available from Davidson Films*

### *Classic Piaget Collection I*

*CLASSIFICATION* (1968) 16 minutes

*CONSERVATION* (1968) 29 minutes

*GROWTH OF INTELLIGENCE IN PRESCHOOL YEARS* (1974) 31 minutes

### *Classic Piaget Collection II*

*FORMAL REASONING PATTERNS* (1978) 32 minutes

*JEAN PIAGET: MEMORY AND INTELLIGENCE* (1973) 44 minutes

*MORALITY: THE PROCESS OF MORAL DEVELOPMENT* (1978) 28 minutes

*CONCRETE OPERATIONS* (1993) 25 minutes

*MORALITY: JUDGMENTS AND ACTION* (2002) 31 minutes

*ADOLESCENT COGNITION: THINKING IN A NEW KEY* (1999) 31 minutes

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