Tower of Hanoi Backward Lesson Plan

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Pathway: Foundations of Mathematics 20 **Strand:** FM20.2

Stage 1 – Identify Desired Results

Established Goal(s): G

General Outcome: Establish number sense, spatial sense, logical thinking and mathematics as a human endeavor.

Specific Outcome: *It is expected that students will be able to:*

FM 20.2: Demonstrate understanding of inductive and deductive reasoning including: analyzing conjectures, analyzing spatial puzzles and games, providing conjectures, solving problems.**[C, CN, PS, R, V]**

Achievement Indicators:

a. Make conjectures by observing patterns and identifying properties, and justify the reasoning **[IA].**

j. Determine, explain, and verify strategies for solving puzzles or winning games, such as:

- guess and check
- analyze a pattern
- make a systematic list
- create a drawing or model
- eliminate possibilities
- solve simpler problems
- work backward. **[IJ]**

k. Create a variation of a puzzle or a game, and describe a strategy for solving the puzzle or winning the game. **[IK]**

Prior Knowledge:

- Grade 1-9 Patterns and Relations General Outcome.
- General understanding of exponential relations.

Adaptive Dimensions:

- Depending on level of prerequisite knowledge, project instructions may need to be adjusted.
- Adapt as necessary to various physical and intellectual disabilities regardless of any possible disability.
- If certain students or groups need extra time, allow them extra time without consequence.

Understanding(s): U

Essential Question(s): Q

• Students will have a definitive understanding of the patterns, relations and solutions regarding the Tower of Hanoi. **[PS, R, V, CN, C]** • Students will be able to transfer the above knowledge to other mathematical or life situations. **[C, CN, PS, R, V]** • Students will be able to make educated conjectures regarding pattern recognition and problem solution and be able to justify their reasoning. [**R, PS, CN, C]**	• **[EQ1]** What are the main rules and strategies used to complete the Tower of Hanoi? **[V, T, CN, PS, R]** *Expected Response: You may only move one disk at a time, and you cannot put a bigger disk on top of a smaller one.* • **[EQ2]** What pattern do you see regarding the minimum number of moves required? **[IA][PS, R, CN]** *Expected response: Depending on the number of disks, the minimum number of moves will be 2^n -1.* • **[EQ3]** What are some strategies you can use to justify your reasoning and conjectures in regards to patterns. **[IA, IK] [PS, R, CN, V, T]** *Expected response: Make tables, graphs, etc to provide evidence supporting your conjecture, or show one example that does not work to disprove it.*
Knowledge: K *Students will know…* • The history of the Tower of Hanoi. **[CN, C, V]** • Specific equation for the minimum number of moves. **[ME, PS, R, V, CN][IJ]** • The ways to strengthen their arguments regarding conjectures about pattern recognition. **[PS, R, ME, CN, C][IA]** • Students will be able to apply knowledge of pattern recognition and reasoning to other mathematical	**Skills: S** *Students will be able to...* • Complete the Tower of Hanoi using a program on the computer. **[PS, R, V, T, CN, C]** • Justify their reasoning regarding the completion of the Tower of Hanoi. **[R, PS, CN, C]** • Expand problem solving skills. **[PS, R]**

and life situations. **[CN, C, PS, R][IK]**	

Stage 2—Determine Acceptable Evidence

Performance Task(s): T	**Other Evidence: OE**
• **[PT1]** Using the computer to attempt/complete the Tower of Hanoi. **[IJ][T, PS, R, V]** • **[PT2]** Having students write down their thinking processes during the whole lesson. **[IA][R, PS, C, CM, V]** • **[PT3]** Students will be marked on their thought process and cognitive development, rather than their answers.**[PS, R, C]**	• **[OE1]** Using visual assessment and visual clues to ensure that students understand the patterns and concepts of the game, and also to ensure they are keeping on task while using the computers. • **[OE2]** Using direct assessment by completing the handout.

Stage 3—Plan Learning Experiences & Instruction

Set:

- Show students a short video of someone completing the Tower of Hanoi. http://bit.ly/H9tVtr
- Ask students what strategies they saw the person using in order to complete the Tower of Hanoi using a brainstorming chart in front of the class. **[EQ1]**

Development:

- INQUIRY BASED LESSON **[PS, R, T, C, CM, V]**
- Brief history of the Tower of Hanoi. **[CN]**
- Handout computers to students and allow them to explore the Tower of Hanoi at their own pace for a few minutes. http://www.mazeworks.com/hanoi/
- Handout worksheet to students to complete. Students will answer essential questions on the worksheet and document their thinking processes along the way. **[PS, R, T, C, CN, V][EQ2, EQ3]**
- After each student individually has done this, they will get into partners and share their discoveries and thought processes. Together, they will put their ideas

together and make a generalization regarding the solution of the Tower of Hanoi.

Closure:

- Partners will share discoveries and thought processes with class. **[CN,C, ME, R]**