

## Paper Pool Sample Scoring

A teacher who used the Paper Pool game in her classroom had this to say:

*I had students work in pairs, but each wrote their own report. I used the schedule of one class period for investigation, and then half a class period three days later. This allowed students who needed more time to investigate the situation and look for patterns to do so at home. The half period was used to discuss and revise reports as partners shared what they had written. Most of my students found this project interesting and were very engaged in the mathematical investigation.*

Students' reports came in several forms and varying levels of quality. Shown below are two examples of student work from the class (the students' activity sheets and any additional drawings they did are not included). Each sample was scored using the suggested rubric, and an analysis of each sample is provided.

### Sample Student Work – Mary Beth

Mary Beth's received 8 points for the mathematics in her report. She earned 4 points for her sophisticated rule describing the pocket in which the ball would stop. Her rule for the ending pocket covers all possible cases. She notes that it makes a difference whether the table is odd by even or even by odd, but she does not tell whether she is giving the horizontal or the vertical dimension first. Her drawings and organizational tools (she made tables to organize her information) made it possible to determine what she meant, so full credit for her rules were given. She also earned 4 points for her sophisticated rule for the number of hits that would occur. Her rule identifies the sum of the dimensions of the table as the important relationship, but she did not state that it is the sum of the dimensions *when expressed as a ratio in simplest form* (or what she calls earlier "basic" form).

Mary Beth received 4 points for problem solving and reasoning. When her written summary, drawings, and organizational tools are considered, the reasoning for her rules is complete. She received only 3 points for communication because of the effort the reader needs to make to sort out which side she is referring to in her odd-by-even and even-by-odd rules, and because of the lack of clarity and completeness in her written description of her rule for the stopping corner.

Mary Beth

We discovered that before you can really find rules you have to convert the paper pool tables into basic tables, or smallest form. As we did that we realized that there would be no even by even dimensions because they can be broken down. The possible dimensions are odd by odd, odd by even, and even by odd. Odd by even and even by odd dimensions are different because the pockets would be in different corners. The odd by odd dimensions always end in the C pocket, odd by even in B, and even by odd in D. To find how many hits there will be, add the dimensions. The total will also include the starting and finishing pockets.

Mary Beth's new table, activity sheet, and organizational tool were included in her report, and she received full credit for this section due to their quality and completeness. She received 20 points out of a possible 21, and she earned an A.

### Sample Student Work – Heather

Heather's project received 5 of 8 points for the mathematics. She earned 3 points for six basic rules and one sophisticated rule that identifies the stopping corner. She earned only 2 points for her three basic rules for the number of hits (a fourth rule for "two hits" was started but not completed). Her rules for the stopping corner cover several possibilities, and her rule of "On an odd by odd it will always end up at corner C" is considered a sophisticated rule. She does not address the orientation of the rectangle, and the reader must make inferences from her drawings and organizational tools. The count that she gives for number of hits is incorrect and suggests that she does not understand what counts as a hit. It seems that she has not counted the hit from the cue or the hit at the last pocket.

Because Heather shows no evidence of being able to reason about how many hits will occur, and because the reader's only evidence of her reasoning is through her activity sheets and single organizational chart, she received 2 points for problem solving and reasoning. She also earned 2 points for communication, because the reader must make significant effort to follow her report. Because Heather does not deal with the orientation of the rectangles, one must make an effort to sort through her work and make sense of the rules she has given.

**Heather**

- \* For a 1 by any odd number it will end up at C.
- \* For a 1 by any even number it will end up at B.
- \* If one side is twice as big as the other side it will hit once & end up at B.
- \* When it is a square it will not hit a side, but go to diagonal corner C.
- \* On an odd by odd it will always end up at corner C + hit as many times as possibal.
- \* If 1 demention is 4 x larger or | 1/4 the other, it hits 3 times and lands in B.
- \* Nothing ends up in A.

Heather's tables were complete, and she received 2 points for them. Her activity sheets were also complete; she received 1 point for including these. She received 1 point for her organizational tools, which included only a table that organized the information about the stopping corner. She did not include an organizational tool addressing the number of hits.

Heather earned 13 of 21 points and a grade of C. Her activity sheets show that she is not counting hits correctly. When this project was launched in class, both she and her partner correctly counted the number of hits for the sample Paper Pool tables. Further instruction will probably be needed to help the partners address the issue of hits. A conversation with Heather, and with all students, is probably necessary to discuss how to organize information when looking for patterns.