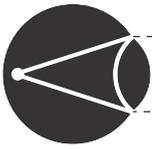




BANK SHOT

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<p>Purpose</p>	<p>Students compare their own reasoning strategies with those of their classmates, focusing on the strategies' usefulness in determining how to make certain bank shots in billiards. This task is intended to involve multiple geometric perspectives and would be appropriate for students with an understanding of similar triangles, rigid motions (reflections), and equations for lines and is designed to develop students' understanding of these concepts.</p>	
<p>Focus on Reasoning and Sense Making</p>	<p>FHSM Reasoning Habits</p> <p>Analyzing a problem—seeking relationships; looking for structure</p> <p>Implementing a strategy—making logical deductions</p> <p>Reflecting on a solution—justifying a solution; reconciling different approaches</p> <p>PSSM Process Standards</p> <p>Problem Solving—apply and adapt appropriate strategies to solve problems</p> <p>Reasoning and Proof—develop and evaluate mathematical arguments and proofs</p> <p>Communication—communicate mathematical thinking clearly; analyze and evaluate the mathematical thinking and strategies of others</p> <p>Connections—understand how mathematical ideas interconnect</p>	<p>CCSS Mathematical Practices</p> <ol style="list-style-type: none"> 1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 7. Look for and make use of structure.
<p>Focus on Mathematical Content</p>	<p>FHSM Key Elements</p> <p>Reasoning with geometry—construction and evaluation of geometric arguments; multiple geometric approaches</p>	<p>CCSS Content Standards</p> <p>G-CO-6. Use geometric descriptions of rigid motions to ... predict the effect of a given rigid motion on a given figure.</p> <p>G-CO-9. Prove theorems about lines and angles.</p> <p>G-SRT-5. Use congruence and similarity criteria for triangles to solve problems.</p>
<p>Materials and Technology</p>	<p>Bank Shot activity sheet</p>	



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Student Activity Sheet

Carom billiards refers to a collection of games typically played on a 5-by-10-foot “pocketless” rectangular table (see fig. 1). In this game, a player scores points by striking a *cue ball* with a cue stick so that the cue ball hits each of two additional billiard balls on the table before the cue ball comes to rest. Some shots may require striking the cue ball so that it hits a cushion (the side of the table) during the shot. Such a shot is called a *bank shot*. Angles matter in these games! In this activity, you will investigate some trajectories of the cue ball when it is alone on the table.

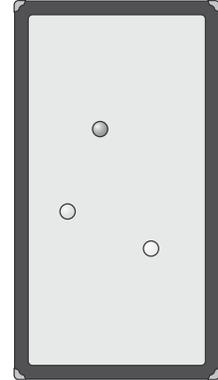


Fig. 1

1. Assume that a single cue ball is placed exactly halfway across the width of the table and two feet from its top end. Your task is to determine where the cue ball should strike the cushion on the long side of the billiard table so that the ball would ricochet and be on a path to hit the lower left-hand corner of the table (see fig. 2). You can assume that whenever the cue ball hits a side cushion, it bounces off in such a way that the angle made by the table’s side cushion and the path of the ball as it hits the cushion is the same as the angle made by the table’s side and the path of the ball as it bounces off the cushion. That is, as is typical of many billiard shots, the *angle of incidence* equals the *angle of reflection*, as labeled in figure 2.

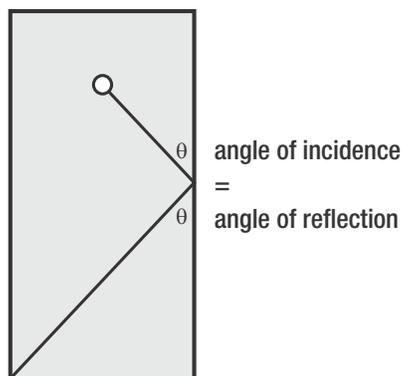
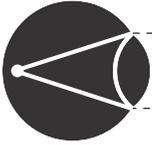


Fig. 2

Try to justify your answer in as many ways as possible and be ready to discuss your solutions.



BANK SHOT

Student Activity Sheet (Continued)

2. On the same billiard table and with the same initial ball placement and same assumptions as in question 1, determine where the ball should strike the long side of the table so that a two-cushion bank shot will put the ball on a path that ends at the upper left-hand corner (see fig. 3).

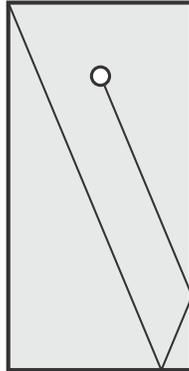


Fig. 3

Try at least two different solution strategies—even if your first strategy is successful. Do you prefer one strategy to the other? Do you think you could use either or both of your two strategies with three or more cushion bank shots? Explain.

3. Suppose that an additional billiard ball is now placed in the center of the table (see fig. 4). The cue ball is in its original position. Rather than hit a corner, the objective now is to determine a bank shot against the right cushion that will result in the cue ball hitting the new billiard ball after it hits the cushion.

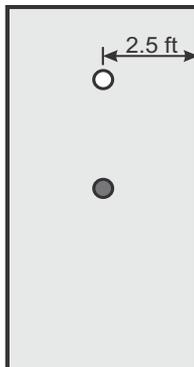


Fig. 4