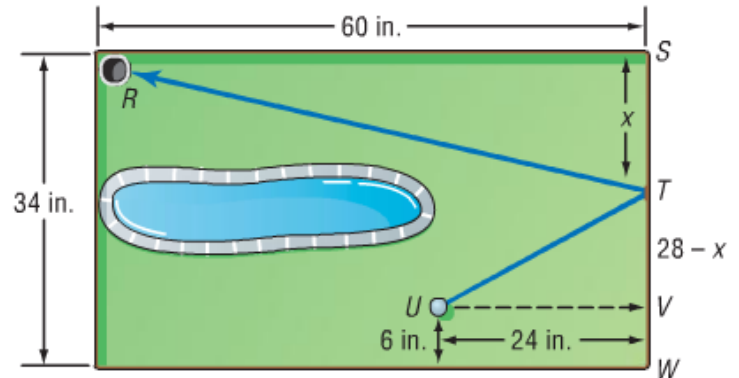


When I Let Them Own the Problem

From our textbook:

- 24. GOLF** Jessica is playing miniature golf on a hole like the one shown at the right. She wants to putt her ball U so that it will bank at T and travel into the hole at R . Use similar triangles to find where Jessica's ball should strike the wall.

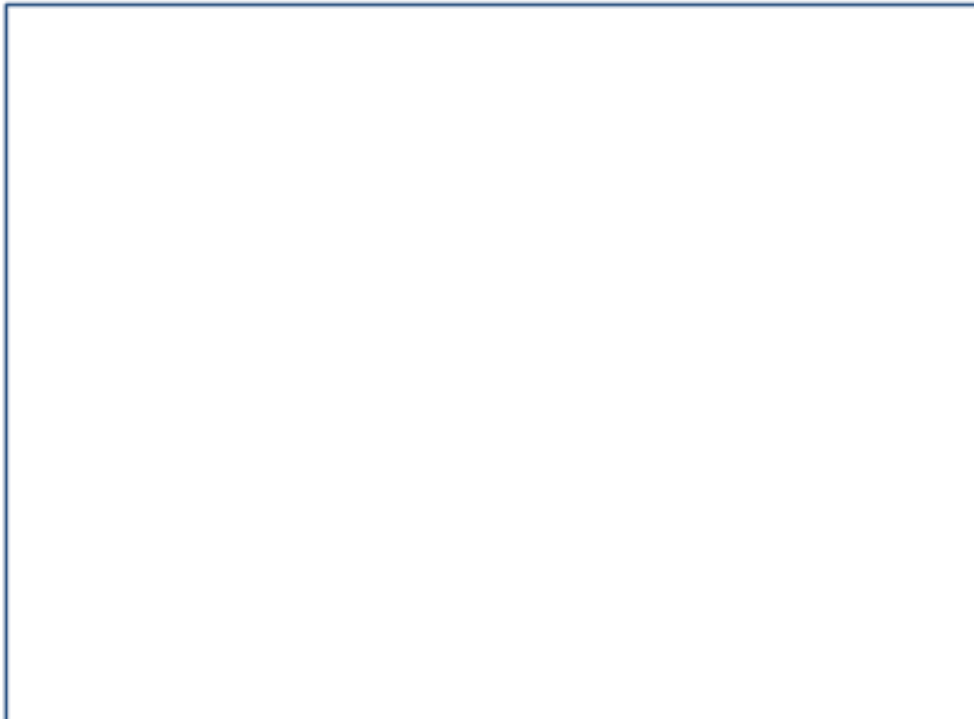


Stuff like this makes my heart sink. There is essentially nothing left in this problem for students to explore and figure out on their own. If anything, all those labels with numbers and variables conspire to turn kids *off* to math. Ironically even when the problem tells kids what to do (*use similar triangles*), the first thing kids say when they see a problem like this is, "I don't get it."

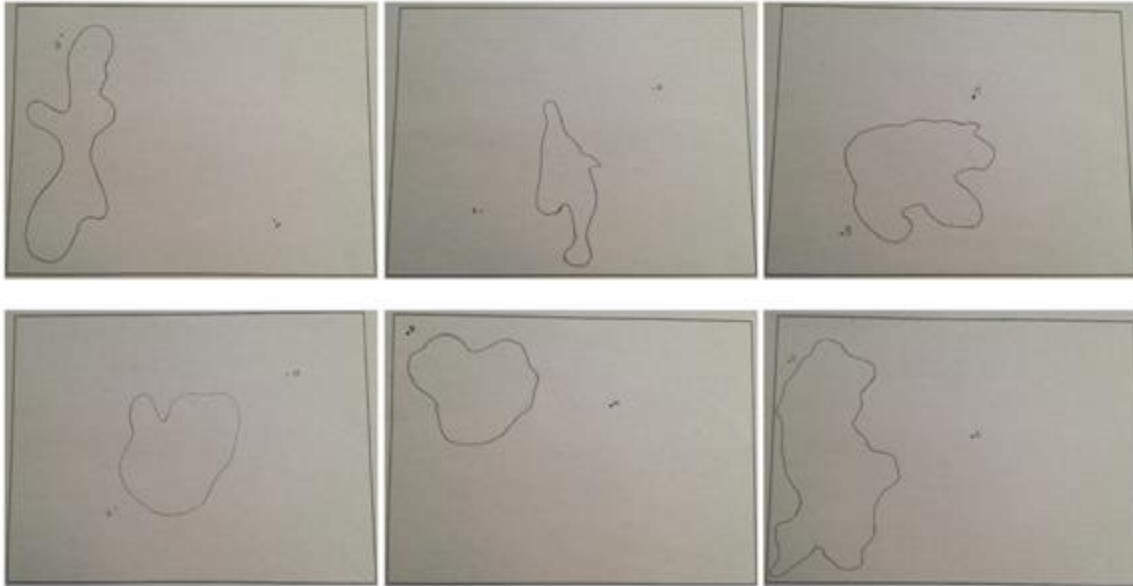
They say they don't get it because they never got to own the problem.

I wiped out the entire question and gave each student this mostly blank piece of [paper](#) and the following verbal instructions:

Name: _____ Date: _____



1. Make sure you have a sharpened pencil. Write your name and date.
2. Inside this large rectangular border, draw a blob — yes, blob — with an area that's approximately $\frac{1}{5}$ of the rectangle's area. No one will die if it's not quite $\frac{1}{5}$.
3. Next, draw a dot anywhere inside the rectangle but outside the blob. Label this dot H .
4. Now, draw another dot — *but listen carefully!* — so that there's **no** direct path from this dot to the first dot H . Label this second dot B .



I asked the class if they knew what they just drew. After a few silly guesses, I told them it was a miniature golf course: blob = water, point B = golf ball, point H = hole location.

The challenge then was to get the ball into the hole. Since you can't putt the ball directly into the hole due to the water hazard, you need to make a bank shot.

(Some students may have drawn the blob and points in such a way that this was not really possible, at least not in one-bank shot. I let them just randomly pull from the stack of copies to pick a different one. I made a copy of their sketches first before they started their work.)

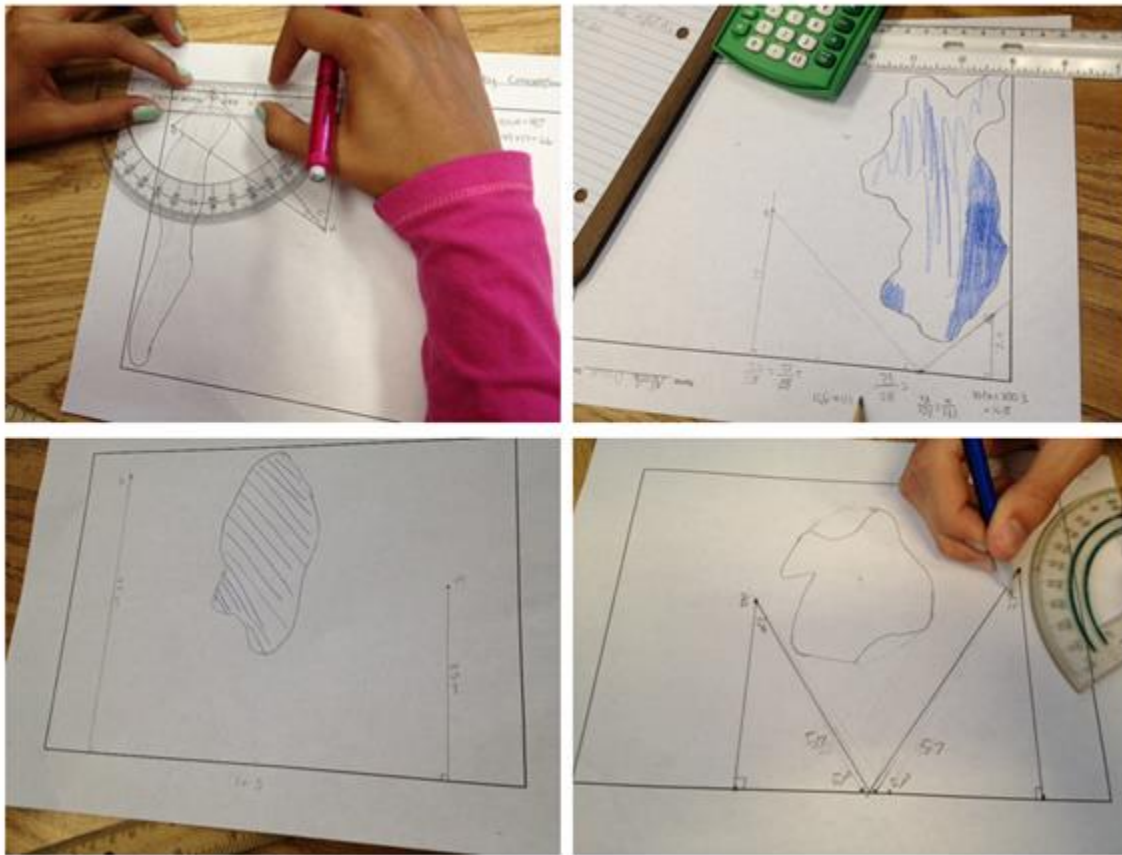
The discussions began as they started drawing in the paths. One student drew hers in quickly and asked, "Is this right?" I replied, "I'm not sure, but that's my challenge to you. You need to convince me and your classmates that the ball hitting the edge *right there* will bounce out and travel straight into the hole. Does it? What can you draw? What calculations are involved?"

What I heard:

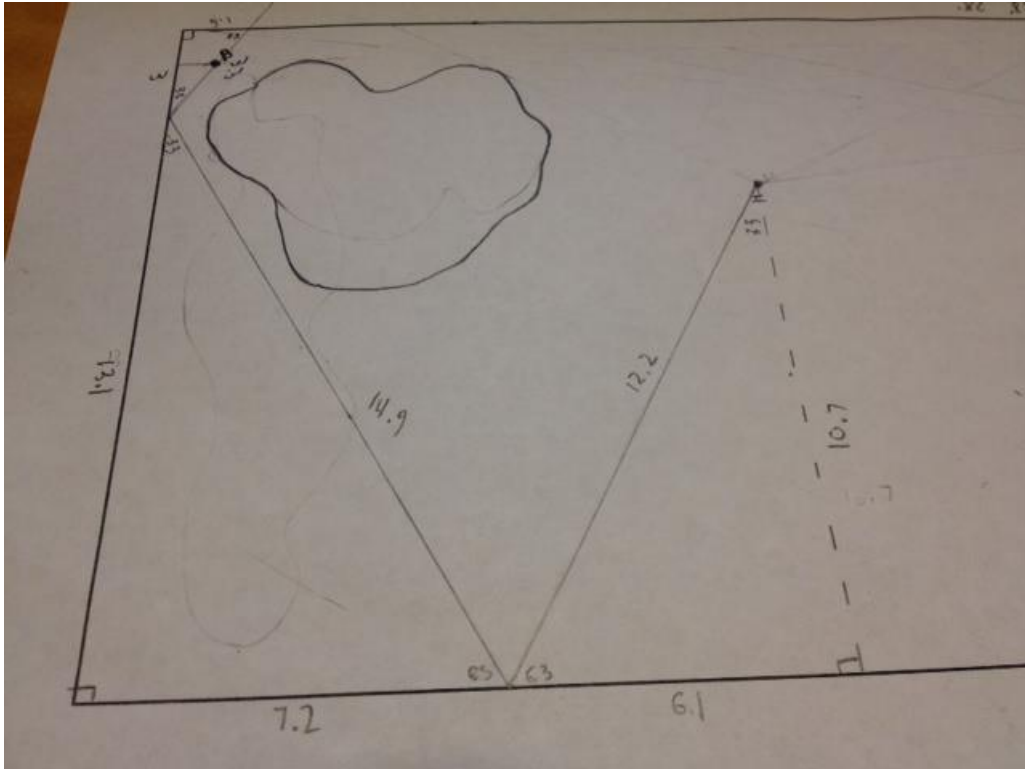
- The angle that the ball hits the border and bounces back out must be the same.
- Because we're talking about angles, something about triangles.
- This is like shooting pool.
- Right triangles.
- Similar right triangles.
- Do we need to consider the velocity of the ball?
- This is hard.
- I can't figure out how to use the right triangles.
- Similar *right* triangles because that'll make things easier.

- Even though it's more than one bounce off the edges, I'm still just hitting the ball one time.
- I think I got this.
- I have an idea.
- Wish my golfer is Happy Gilmore.

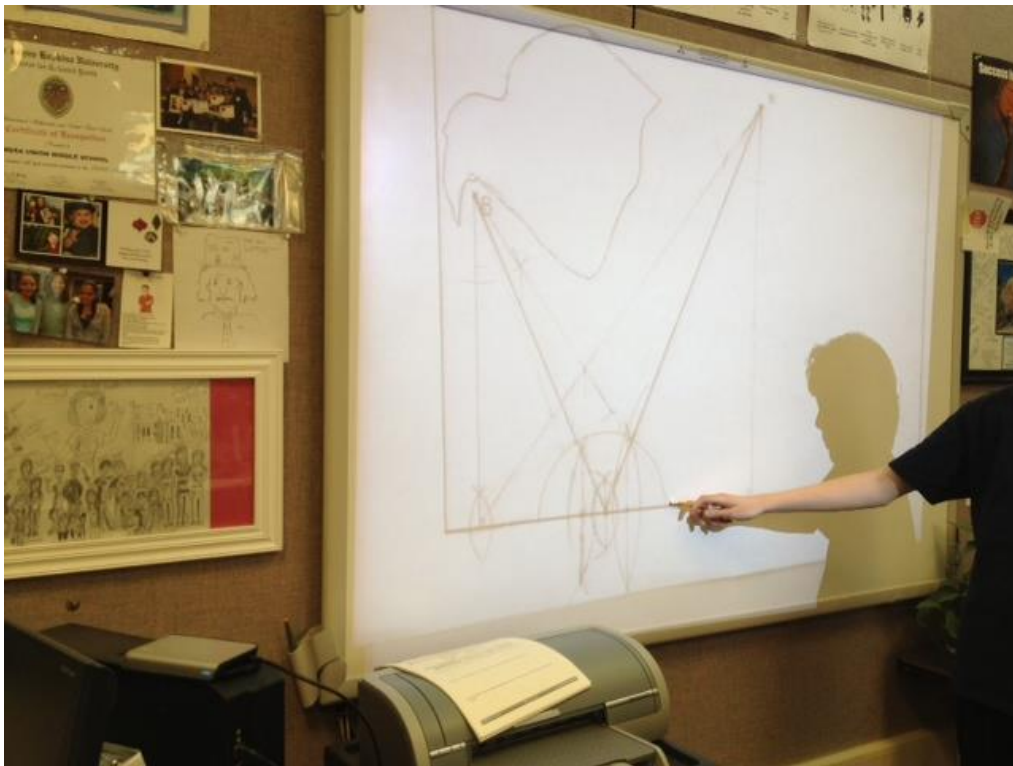
BIG struggles, so I was happy and tried not to be too helpful. (I struggled big time too on some of their papers! And I think this made *them* happy.)



Jack took a different approach. Instead of measuring the sides and finding proportions to find more sides to create similar triangles like Lauren did, he started with an angle that he thought might work [via eyeballing] and kept having the ball bounce off the borders at paired angle until it went into the hole. (His calculation was off — or his protractor use was inaccurate — as he had angles of 90, 33, and 63. Or maybe if he had a better teacher, he'd know the sum of the interior angles of a triangle was 180.)



Gabe was quieter than usual today. When he finally shared, his classmates realized he was the only one to solve the entire problem using just constructions with a straightedge and compass. He walked us through his [series of constructions](#) until he found point C on the bottom border where the ball needed to bank off and end up in hole H .



Imagine none of this thinking and sharing would have occurred if I had given them problem #24 in the book.

Half of my kids were still struggling and working to find the correct bank shot(s), but they were *given* the chance to struggle. And none of them said, "I don't get it."