

# “ES Complex”

## A Reality Show About Enzymes

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Before ever discussing enzymes, substrates, reactions, or products, I begin a class discussion by telling students about a new reality show that I discovered. Of course, in reality, there is no show, and the characters represent enzymes and enzymatic reactions. We have never acted out the show; I have simply described it to the students. The discussion goes along these lines:

*“I watched a reality show last night that was really interesting! It started with a huge pool of potential contestants. It must have been the first episode, because they were just trying to thin out the contestants.*

*The night before the show, they had a pre-challenge contest, and some people had won ‘special helpers’ for the challenge. It was funny; the special helpers had names that sounded like the contestants. The one I was rooting for was named Sara, and her helper was called ‘SaraTomWinTheRace.’ (She kept calling him ‘SaraTomAse,’ she said it was easier to remember!)*

*The contestants were all brought to a beach, and it was huge, there had to have been 2,000 people there. They were told that to get a point, they had to find their match, and their match was determined by their name. So, any girl named Sara, had to find a guy named Tom (hmmm, her special helper was called SaraTOMase...); any girl named Katrina had to find a guy named Bill, and so on. Every single girl name had a different match.*

*To find out someone’s name, the girl had to stand face-to-face with a guy, place one hand on his shoulder and say, ‘Hi, my name is Sara, what is your name?’ before the guy could tell her his name. There were no name tags, so it took a lot of time and effort (remember they were running around in deep sand on the beach) to meet people and find their match. Once they found their match, they could keep their grip on each other’s shoulder and run to the judges’ stations (lifeguard towers) and check in and get released to look for another match. Only people who got enough points were allowed to continue in the game.*

*The special helpers turned out to be huge helps, because they knew everyone’s names. So, Sara’s helper turned out to be a helper for anyone named Sara, and the helper could pick out of the crowd anyone named Tom. So instead of having to run around like crazy, Sara just held her helper’s hand and got led right up to a guy, and when the helper took his hand, they were face to face, and she could put her hand on his shoulder and say ‘Hi, my name is Sara, what’s your name?’ and he could put his hand on her shoulder and say ‘It’s Tom! Let’s go get a point!’ and they would let go of the helper’s hands and run to the judges’ station.*

*The people with special helpers were the ones who got the most points, and they weren’t so worn out at the end from all the running around they had to do.”*

This isn't really delivered as a monologue, but for the sake of this document, it's written out that way. In class, it ends up being more of a discussion, with student questions and comments during the description. We sometimes get talking about the helper names, and people making up the names of what their own helper would be called and stuff like that. The main thing is for the students to understand that each person had to find matches with very specific names and they had to present themselves just so in order to find out the names, and they had to stay joined to run and get points.

I go on to tell them that a couple funny things happened that messed up the special helpers. First, at one point there were so many Sara & Tom pairs that one helper had joined, that they were all trying to thank her at once, and one couple came up from behind and hugged her. But, they were hugging her so tight that her arms were all squished and crowded, and she couldn't help any other Saras or Toms as long as they were standing there hugging her. It was sort of unfair, because it slowed down the pairing up of any other Saras and Toms waiting for help.

Also, one helper messed up, because she thought she saw a Sara, but apparently there were some twins there, because she grabbed the hand of what she thought was a Sara, but it turned out her name was Terri. The rules said that she couldn't let go of anyone's hand unless they were paired up. But a girl named Terri needed to match up with a guy named Rob, and the helper only knew who the ones named Tom were. That helper was out for the rest of the contest, because she couldn't let go of Terri's hand.

Once the class hears those stories, we get a little sidetracked talking about if those things are fair or not. At that point I usually have one or two asking if that's really a show, and what channel it was on and stuff like that. So, that brings us around to discussing the true point of the show. I tell them that it's not a real show, but that the characters represent things from their assigned reading. I hate to admit it, but often times, nobody makes the connection right away. I have had a few who have read the chapter and make the associations right away.

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This brings us to discussing basic enzyme function. I introduce the terminology and a basic reaction catalyzed by an enzyme. Then, I have them point out how the show relates to enzymes. The character list follows:

Substrates: Sara and Tom

Enzyme: Special Helper (SaraTomAse)

Enzyme-Substrate Complex: The three holding hands/shoulders (the name of the show)

Product: Sara & Tom as a pair

Product function/purpose: Judges station

Class discussion involves students deciding what each character represents in terms of enzymes and enzymatic reactions. I try to keep this student-let, with just a little guidance if they aren't quite getting it.

I give it a few minutes, and if nobody asks, I bring up the complications that had occurred and we start looking at enzyme inhibition, both competitive and feedback. The feedback inhibition discussion focuses on the fact that they hugged the helper from behind, not where they were initially joined; this is an allosteric site. For competitive inhibition, the special helper thinks Sara's sister is Sara; in other words, she has a binding site that matches the substrate's binding site. This causes the enzyme, or helper, to bind with the wrong substrate, inhibiting activity.

Concepts that the reality show demonstrates:

Specificity: Each enzyme, or special helper, catalyzes only one specific reaction

Lowering of activation energy: The contestants expended much less energy trying to find matches when helped out by someone who lined them up carefully with the right person.

Binding sites/active site: The contestants held hands with the special helpers to get lined up

Enzyme unchanged in reaction: The special helper could let go of one couple and move on to help another couple.

Feedback inhibition: When joined couples started hugging the helper, she was unable to continue helping new couples join up.

Competitive inhibition: When the helper was holding hands with Sara's twin, she was unable to continue helping new couples join up.

I have found this way of introducing enzymes clicks with students and helps them apply it to how enzymes work. They sometimes bring it up later in the semester, during metabolism, and point out the enzymes are the "special helpers" for certain reactions.

The best application of this at a later time was when a student asked, "If the ATPsynthase is the special helper, and they ADP and phosphate are the couple, what are the  $H^+$  ions?" That opened up a good discussion about providing energy for the reaction and we decided that the hydrogen ions were the energy drink the special helpers needed to drink in order to have the energy to keep pairing up couples!

If you have any questions or comments, or better yet, suggestions to improve the "show," please contact me!

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