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**Content Area** Mathematics

**Learning Segment Topic** Applying theorems to solve triangles

**Learning Task** Students complete an anticipation guide with some subtle or confounding claims about triangle theorems.

1. As a result of this lesson, students will be able to accurately state AND justify that given information specifies 0, 1, (finitely) several, or infinitely many triangles.
2. This lesson would be appropriate for students taking a first high school course in analytic geometry, typical in grades 9-10.
3. - Anticipation guide with confounding triangle claims.
   - Example problem for demonstration of triangle-solving and justification technique.
   - Group worksheet challenging students to: create triangles that match given parameters and offer evidence and reasoning that these are the only triangles that fit, and provide minimal amounts of information that uniquely specify a triangle.
4. - I'm Mike Sorice, future math teacher. Today, we'll look at a task from a geometry lesson from a segment on using the theorems the class has proven to "solve" triangles – to find the missing parts or determine triangles that fit given rules. In particular, we want students to consider the limitations and applicability of these techniques, i.e. to understand when and why the rules as we know them specify a unique triangle, or fail to do so.

- The activity I'm going to show you is meant to kick off that lesson. It's an Anticipation Guide, versatile introductory task in which a teacher presents students with statements relevant to the lesson – ideally interesting or controversial statements – and students indicate what they think about these. Additional parts, such as revisiting of views after the lesson, or sections to provide examples or reasoning, may also be included.
- Anticipation guides are generally understood as ways to get a read on students thought about controversial or subtle material. They also serve to focus student minds the material in the coming lesson, especially if we can find interesting and relevant statements for students to consider.
- In a geometry context, it makes sense to have our Anticipation Guide statements be mathematical conjectures that students can claim are either true or false, with space to give some reasoning or examples. I like to present counterintuitive or surprising claims – I sense that students often find these very interesting and satisfying to resolve during our lesson. Maybe this is because they show some of the distinctive subtlety and creative mystery of mathematics, which sometimes students don't get a chance to see.
- We should state our claims using academic language that students are familiar with, so that students read and process that language in the course of completing the guide – though, of course, this depends on their engaging with the guide authentically. You can see that in my own guide, as students deal with heavy-duty technical terms like `law of sines` and `Pythagorean theorem`, but also terms with a technical meaning in mathematics like `triangle` and even `true` and `false`. In addition, if a guide has space for reasoning and justification, like mine does, students have a chance to make their own statements using academic language.
- Students' true/false answers will provide some evidence of their achievement.

However, in our case, since the statements are subtle, I'm mainly interested in student reasoning about their claims. This reasoning can provide good evidence for mathematical thinking and precise communication.

- We could broadly divide students into three classes based on the results of this diagnostic. Students who are able to correctly answer each prompt and provide completely cogent reasoning should be considered for extension activities. Given the subtlety of these statements, we expect to have few students in this group, so if many students are there, it may be necessary to revise or even skip the lesson. Students who answer some questions right and some wrong and provide partially successful reasoning are ideal for this lesson, as by doing so they demonstrate that they're equipped with the vocabulary and language skills to contend with this lesson. We can expect most students to fall in this class. Finally, we must probe and consider remediating students who provide incoherent or no reasoning, regardless of the correctness of their true/false replies.

  The written reasoning also provides a rich source of information on students' academic language use in general and possible performance in general. For example, we can find patterns of sound or fallacious reasoning, or proper or improper use of technical terms, throughout the class, which we can then correct or build upon as appropriate.

- For guides with subtle questions, such as the one I've produced, it's important not to get caught up in the correctness of students' true/false answers, which is a tendency of some teachers of this content. Rather, student reasoning is much more important, as delineated above. It is well and even necessary for a true understanding to study the interesting, tough cases in math – they can shed a great deal of light on the true inner workings of things.

  A related concern is that some conventional wisdom about anticipation guides is that their main purpose is to gauge feeling about controversial subjects. However, this is not generally useful in mathematics so, to the extent that someone has that limited view of these instruments, they may fail to see how we can apply them to our subject, as I claim that I have successfully done here.