Mathematics: The Language of STEM
Light Painting Triangles
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CONTENT AND TASK DECISIONS

Grade Level(s): 5th Grade

Description of the Task: Students will use an art creation of light painting to construct types of triangles based on properties.

Indiana Mathematics Content Standards:
5.G.1 – Identify, describe, and draw triangles (right, acute, obtuse) and circles using appropriate tools (e.g. protractor & technology). Understand the relationship between radius and diameter.

5.G.2 – Identify and classify polygons including quadrilaterals, pentagons, hexagons, and triangles (equilateral, isosceles, scalene, right, acute, and obtuse) based on angle measurements and sides. Classify polygons in a hierarchy based on properties.

Indiana Mathematics Process Standards:
CCSS.Math.Practice.MP1 – Students will have to create the geometric triangles based on angles and sides. They will use programming skills to draw the triangle using technology and evaluating accuracy.
CCSS.Math.Practice.MP2 – Students will make models of triangles with given abstract properties.
CCSS.Math.Practice.MP3 – Students will plan and present their painting with evidence that supports the type of triangle they create.
CCSS.Math.Practice.MP4 – Students will make their triangle and program to create a light painting with long exposure.
CCSS.Math.Practice.MP6 – Students will attend to the precision within the confounds of the classroom environment. Error is inevitable for students as they create in the real world, however, to what extent of deviation from perfect is agreeable will be debated within the class.

Mathematics Content Goals:
Students will be able to identify, classify, and create triangles based on a specific triangle classified by angles or sides.

Language Objectives:
Students will use the property terms in blueprint descriptions as well as in presentation of painting to the class.

Materials: iPad Mini, tripod, Lightning Lab app, LongExpo app (or something that can do long shutter), Sphero

THE LESSON

Before:
Driving Question: "How can we create light painted triangles of various classifications that closely represent the model?"

Discuss what students already know about triangles (basic three side shape, any special names, and angles) and come to the conclusion that not all triangles are the same.

Explain the task of programming a Sphero to draw a triangle by painting with light. The triangle created must meet the requirements of a specialized triangle by measuring the angles with a protractor, measuring the length of the sides, and diagraming before capturing the triangle photo.

Students must identify the separate triangles based on angles. They will then have to create the blueprint path that the Sphero will travel to accurately meet the requirements to be an acute, obtuse, or right triangle (based on angles) and an equilateral, isosceles, or acute triangle (based on sides). With evidence to support a correct path for the Sphero based on the triangle being created, go through the process of programming a long exposure light photo.

During:
Students will be introduced to the topic using enVisionmath2.0 Topic 16-1, Classifying Triangles. This basic practice will launch students to work in pairs to create the triangles classified by angles and/or sides.

In pairs, students then will create a blueprint (small scale) version of the triangle that they will create. They will determine measurement of angles and sides as well as classify the triangle that will be created. The blueprint will be presented to the teacher, as a progress check, and then given clearance to move forward in creating a full version of the triangle to photograph. Regardless of the triangle they choose to represent, they are to include the measurement of angles and sides.

The teacher will need to spend time teaching students the basic programming of Sphero. This can be done as a whole class or when students are ready. Students will utilize the free “Lightning Lab” app on their iPads. This will allow them to program the Sphero to make the movements that follow the triangle plan engineered. Teaching and giving students a chance to explore programming with Sphero will take time and you cannot rush this essential piece. In addition, the teacher will need to show students the free app “LongExpo” and how to change shutter speed to capture light in a dark room to create the image.

Students will then need a dark room to capture the movement of Sphero using a long exposure to create their triangle light painting. These paintings can be displayed and presented along with mathematical thinking that supports the classification of triangle that the pairs created.

Support that students when helping them check their blueprints and that all the properties of the triangle is accurate. If mistakes are made, the teacher can reteach and have students correct their mistakes before moving on to the creation phase. Another area of support will be in programming the Sphero. Encourage students to experiment and take existing programs to modify based on the design of their creation. The long exposure can be tended to when issues arise.

Extensions for students can look in the way of creating additional triangles that focus on a different classification of triangle (sides or angles).

After:
Students will present their light paintings with evidence and justification to showcase the triangle classification. Each pair will bring up front their image and evidence to share.

The presented project will be a print of the photo created along with notecards/information tags around the photo that will share the angle and side measurements to support the type of triangle created. Students will identify based on the properties they intentionally created as their design.

In lieu of the blueprint check as a formative assessment of student progress, the teacher's role at the end for presentations will to evaluate accuracy and thoroughness of the properties that make the triangle being presented the correct classification. In addition, the teacher will be looking for vocabulary words that show mastery of the content. This will provide an opportunity for reviewing misunderstandings in concepts that arise.

Giving peers a chance to respond after presentations will be a platform for connecting triangles and assessing the similarities or differences. The teacher can attempt to build rules/generalizations based on the evidence provided and allow students to determine if more information would be needed or if another example could exist that isn't being displayed.

The driving question provides a purpose for the students and gives them a direction with a goal in mind. The blueprint check and constant observation of discourse that takes place within teams, will provide the needed assessments for empowering students. Those highlight moments that take place can be shared within or at closing to reinforce the learning that takes place.

ASSESSMENT

Observe:
The teacher's role is in large part a listener. Visiting and conferencing with teams as they make progress on the driving question will bring about meaningful conversations that can correct student paths as well as reinforce the learning being explored.

The teacher must be looking for vocabulary connected to the topic (angles, degrees, length, unit, equal, etc.) in correct context. This can also be done at the end during presentations to measure student mastery.

Ask:
Tell me about the triangle you are creating?
What is the objective/driving question that you are working towards?
How do you know this triangle is _____?
Can the angles/sides be of any other measurements and still fit the type of triangle?
Is there a range of angles/sides that would still make this true?
Do the angles/sides have any relationship with one another?
Is there any connection between the angles and sides?
Can you use the information from one or two angles/sides to tell you the third? Based on a type?
Are there any overlaps in triangle classification from angles and sides?
Are there any overlaps that will never happen between triangle classifications because of the angle/sides?