SHADOWSPECT

Lesson Plans

PLAYFUL JOURNEY LAB

Shadowspect is a puzzle-based geometry assessment game designed for 7-10th grade students. Students progress through the puzzles by constructing 3D figures that match given 2D silhouettes.

While students play, Shadowspect gathers data to assess students' spatial reasoning, creativity, and persistence, as well as the following skills from the Common Core:

- CCSS.MATH.PRACTICE.MP5: Use appropriate tools strategically.
- CCSS.MATH.CONTENT.HSG.MG.A.1: Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder
- CCSS.MATH.CONTENT.HSG.CO.A.3: Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
- CCSS.MATH.CONTENT.HSG.GMD.B.4: Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

Included Lesson Plans:

1. **Introducing Shadowspect to Your Classroom**

   Give your students a quick introduction to the Shadowspect tools with this activity.
2. **Modeling with Shadowspect (Part I)**

   Students build models of objects that appear in a series of photographs using Shadowspect.
3. **Modeling with Shadowspect (Part II)**

   Students build models of an imagined dwelling (e.g., house, cave, etc.) using Shadowspect.
4. **Transformations with Shadowspect (Part I)**

   Students create transformation puzzles for each other using Shadowspect.
5. **Transformations with Shadowspect (Part II)**

   Students solve given transformation puzzles created using Shadowspect.
6. **Shadowspect Sandbox Activities**

   Explore how Shadowspect can be utilized in a variety of content areas.

To play shadowspect, visit **shadowspect.org/play**. If you would like to inquire about setting up a teacher account so that students can log in and save their progress, please contact assessmentgames@mit.edu.

These lesson plans were created by Kate Moore during the 2019 Summer Journeyer Fellowship.

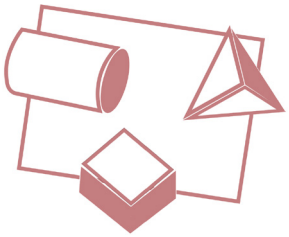
PLAYFUL JOURNEY LAB

Introducing Shadowspect to Your Classroom

Give your students a quick introduction to the Shadowspect tools with this activity.

Materials:

- Shadowspect
- List of two-dimensional shapes: square, triangle, circle
- Two-dimensional model worksheet



Time:

Part I, 15-20 minutes
Part II, 30-45 minutes

Common Core Geometry Standard: CCSS.MATH.CONTENT.HSG.GMD.B.4
Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects

Part I

1. Have your students log into Shadowspect and select the **Sandbox** option.
2. Instruct your students to select each of the geometric shapes - one at a time - and use the rotation tool to move the 3D object into a position that shows one of the two-dimensional shapes written or drawn on the board.
3. Model how to rotate a three-dimensional object using Shadowspect.
4. Students work independently for 10 minutes. Teacher circulates and provides support as needed.

Assessment:
Have students use the screenshot function on their computer to document the orientation of their shape. They can load this evidence of mastery to, for example, their online portfolio.

Part II

1. Have students cut out the 2D objects from the 2D model worksheet.
2. Instruct students to rotate the objects in front of them and imagine this rotation as a slow-motion movie that blurs the movement of the rotation, from the start to the finish, so that every second of the rotation appears as a part of a solid, continuous object.
3. Model how to rotate the two-dimensional object. Think aloud your observations as it rotates.

Assessment:
Build a model. Have students construct three-dimensional shapes - cone, cylinder, sphere - by cutting the two-dimensional shapes in half and taping the halves together at rotated angles. Have students label their model with the name of the 3D object formed by the rotation of the 2D object.

Make It Collaborative!

For both Part I & Part II, have students distribute the shapes between group members so that each member of the group creates a screenshot of a 2D shape and a 3D object. Bring students together to share their shapes and models. Prompt group members to explain how they rotated the object or the shape to get the desired result.

Modeling with Shadowspect Part I

Students build models of objects that appear in a series of photographs using Shadowspect.

Materials:

1. Shadowspect
2. A collection of 3-5 photographs of objects from the real world, for example, (1) the base of a tree trunk, (2) a starfish, (3) a person, (4) the U.S. Capitol building, (4) a car. (Note: this list is designed for increasing difficulty)

Time:

45 minutes

Common Core Geometry Standard: CCSS.MATH.CONTENT.HSG.MG.A.1
Use geometric shapes, their measures, and their properties to describe objects
(e.g., modeling a tree trunk or a human torso as a cylinder)

Lesson:

1. Have your students log into Shadowspect and select the **Sandbox** option.
2. Display one of the photographs for all students to see.
3. Instruct students to use the objects in Shadowspect to recreate a model of the object in the picture.
4. Briefly model, using Think Aloud, how you might use the objects in Shadowspect to create a model of the object in the photograph. Remind students that there is no one correct answer.
5. Direct students to where they can find more challenging photographs when they finish modeling the object in the first photograph. Option: Gather photographs from students in advance of this lesson!
6. Students work independently for 15-25 minutes. Teacher circulates and provides support as needed.

Assessment:

Have students write / type instructions on how to create their model and then share their instructions with a classmate, who then attempts to create the original model using only the directions.

Reflection:

Invite students to share what was challenging about this activity. Ask them, “How did you handle the loss of information that happens when modeling real world things with 3D shapes?”

Make It Collaborative!

Give your students the opportunity to view the work of the other students. This could be a Gallery Walk - during which students can comment on each others work with post-its - or share student screenshots with another peer or a group of peers. Prompt students to comment on the different strategies they observe in their peers work. Instruct them to comment on the designer’s choice to include more or less shapes; balancing accuracy, complexity, and simplicity of form.

Modeling with Shadowspect Part II - Sandbox & Critique

Students build models of an imagined dwelling (e.g., house, cave, etc.) using Shadowspect.

Materials:

- Shadowspect
- Pictures / photographs of dwellings: house, apartment building, castle, cave, tree house, etc.

Time:

45 minutes

Common Core Geometry Standard: CCSS.MATH.CONTENT.HSG.MG.A.1
Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder)

Lesson:

1. Have your students log into Shadowspect and select the **Sandbox** option.
2. Instruct students to use the objects in Shadowspect to create a model of a dwelling.
3. Show a few pictures of dwellings. Ask students to name the dwelling and share what geometric shapes they might use to model each dwelling in Shadowspect.
4. Briefly model, using Think Aloud, how you might use the objects in Shadowspect to create a model of your dwelling or a dwelling where you would like to live. Remind students that there is no one correct answer.
5. Have students work independently to design their own dwellings in Shadowspect for 30 minutes. Teacher circulates and provides praise, encouragement, and instruction as needed.

Assessment:
Project students' final / draft of their dwelling for the class to view. Set-up rules in advance to structure this viewing as a formal "critique"

The designer speaks about their piece (5 minutes), the audience asks non-leading questions (e.g., "What guided your choice of color?" or "How did you make decisions about the number of objects to use?") (5 minutes), audience offers comments about the complexity vs. simplicity of the design (2 minutes), designer closes the critique with reflections on what they would do next if they had more time.

Make It Collaborative!

If your students are able to independently perform a "critique", then have them work in pairs to present their models to each other. Remind them of the steps of a "critique": (1) designer talks, (2) audience asks questions (and designer answers), (3) audience makes observations about the complexity vs. simplicity of the model, (4) designer talks about next steps.

Transformations with Shadowspect Part I

Students create transformation puzzles for each other using Shadowspect.

Materials:

» Shadowspect
» Notebook paper

Time:

45 minutes

Common Core Geometry Standard: CCSS.MATH.CONTENT.HSG.CO.A.5
Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

Part I

1. Briefly review the meaning of the following vocabulary terms: rotation, reflection, translation
2. Have your students log into Shadowspect and select the **Sandbox** option.
3. Instruct students to choose one of the objects in Shadowspect and write its name at the top of a piece of notebook paper. Then, instruct students to transform the object in Shadowspect. With each transformation, they should write down the change on their notebook paper as a list. When they are done, they

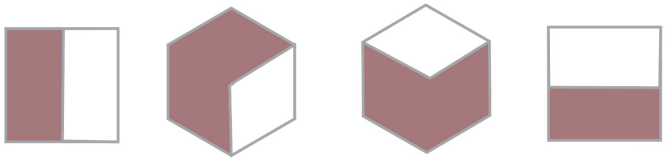
Assessment:
When they are done, their partner checks their work. If the partner's Shadowspect model is not identical to the creator's, then the two students must work together to debug the instructions.

Part II

1. Instruct students to create a puzzle for another partner (or the same partner). Students should choose a second object in Shadowspect and, again, transform it. This time, they should only record the number of transformations they performed (limit = 5) and the name of the object.

Assessment:
When they are done, their partner tries to transform the object to look the same way as the creators using exactly the number of steps written by the creator

Reflection:
Invite students to share (1) which translations were easiest to interpret and which were more difficult, (2) areas where more detail was needed in instructions, (3) strategies they used to debug them.



Transformations with Shadowspect Part II

Students solve given transformation puzzles created using Shadowspect.

Materials:

» Shadowspect
» Transformation Worksheet Packet

Time:

45 minutes

Common Core Geometry Standard: CCSS.MATH.CONTENT.HSG.CO.A.6
Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.

Lesson:

1. Briefly review the meaning of the following rigid geometric motions: rotation, reflection, translation
2. Explain that students will complete an activity similar to the Transformations with Shadowspect (Part I), but this time they will be given (1) three pictures of 3D objects, (2) three pictures of three transformed 3D objects and (3) a list of three rigid geometric transformations. Instruct students to select which of the three pictures represents the first object, the final orientation, and the the rigid transformation required to make this transformation.
3. Briefly model how students might complete this puzzle on the given worksheet using the teacher sample. Then, invite a student to complete the student sample with teacher guidance.
4. Students work independently for 20 minutes to solve the transformation puzzles in the Transformation Worksheet Packet. Teacher circulates and provides support as needed.

Assessment:
Students submit their Transformation Worksheet Packet as today's assessment. You may also have your more novice students pass their packet to their neighbor for feedback before submitting.

Make It Collaborative!

Set-up a station for each page of the Transformation Worksheet Packet in your classroom. You can do this by pushing desks together to form small groups around each packet. Students can work together to complete each page of the packet at one of these stations for 10-15 minutes. Then, when a timer goes off, they must move to a different group and work with a new group of students to complete the next puzzle. Continue this rotation until all students have had an opportunity to work on all pages of the Transformation Worksheet Packet!

Collaborative work should be structured. Instruct students to self-assign roles at each station such as the Generator, the Builder, the Questioner. Feel free to change these names. Essentially, one student works to get the team to generate as many ideas as possible (the Generator), saying, "What are your ideas?" or "How would you solve this problem?". One student works to add a new idea onto one that's already been shared (the Builder), saying, "What if you did this, too?" or "Yes, and…". One student works to question what the group is doing (the Questioner), saying, "Ok, but would that work all the time?" or "Sure, but does that really do what we want it to do?

Shadowspect Sandbox Activities

Students use the Shadowspect's Sandbox to build models for a variety of content areas.

Chemistry

Use the sphere Shadowspect's Sandbox to construct 3D models of molecules. Use the paintbrush tool to color code each sphere to represent different elements.

English Literature

Use all shapes in Shaowspect's Sandbox to design a model of the home of the main character or the site of a major scene in the text.

Art / Studio

Create a 3D model of a sculpture in Shadowspect's Sandbox in preparation for creation of the physical sculpture in clay, plaster, metal, wood, glass, and plastic. Use color to explore the effects of hue and shade on form. Include this 3D model in classroom critiques and final portfolio as indicators of plans and execution.

Engineering

Use all shapes in Shadowspect's Sandbox to design a model of a bridge that demonstrates the shape and form of engineering terminology, such as: arch bridge, truss bridge, suspension bridge, abutment, beam, brace, buttress, cable, etc.

Computer Programming

Create a string of written directions that describes how to create a 3D model in Shadowspect's Sandbox. Pass this string of directions on to another classmate, who then attempts to follow these directions and create the 3D in Shadowspect's Sandbox. Once complete, compare final output to the coder's original plan / design. Working collaboratively, identify errors / bugs in the code, make corrections, and submit the final code as final product for this assignment.