Packaging 1: Make A Box

AN EXPLORATION OF BOXES AND ESTIMATIONS

NARRATIVE

You are part of a packaging company that has been tasked with designing packaging for a new, highly anticipated product soon to hit the shelves of sporting goods stores everywhere: an aerodynamic high performance tennis ball, the Slam-O 3000. The Slam-O 3000 is 10% yellower and has even more fuzz than its competitors. We are very excited for your packaging to help us sell this new and improved high-end product. We understand this might be a lot to take on, so we've broken down your work into smaller challenges.

Your first challenge is to create a box, as precisely as you can, by using something besides a ruler to measure the ball. You will make your box by cutting the sides out of cardstock and then taping them together.

STAGING

- Arrange tables for individual student work but in groups of 4.
- Place one multi-pack of tennis balls on the pedestal
- Pass out one sheet of cardstock, one pair of scissors, and one ballpoint pen per student

RULES

1. You have to cut out your box pieces yourself.
2. The Slam-O 3000 must fit completely inside the container.
3. You may put your box together with tape.
4. Your box must be cut out of one sheet of cardstock.
5. All sides must be flat.
6. You may not touch the Slam-O.

MATERIALS

- 1 Slam-O 3000 (tennis ball)
- 1 ball tube packaging of 3 tennis balls

Per student:

- 2 Cardstock sheets
- Tape— one foot

TOOLS

Per student:

- 1 pair of Scissors
- 1 Ballpoint pen

LEARNING OBJECTIVES

- To identify how packaging affects an item's value
- To invent a tool for measurement.
- To create a step-by-step process for building a box.

SKILL OBJECTIVES

- To use an invented measurement tool in a similar way as a ruler.
- To cut precise squares without a ruler.
- To assemble and form a box out of pieces.
- To use limited tape as a structural tool.

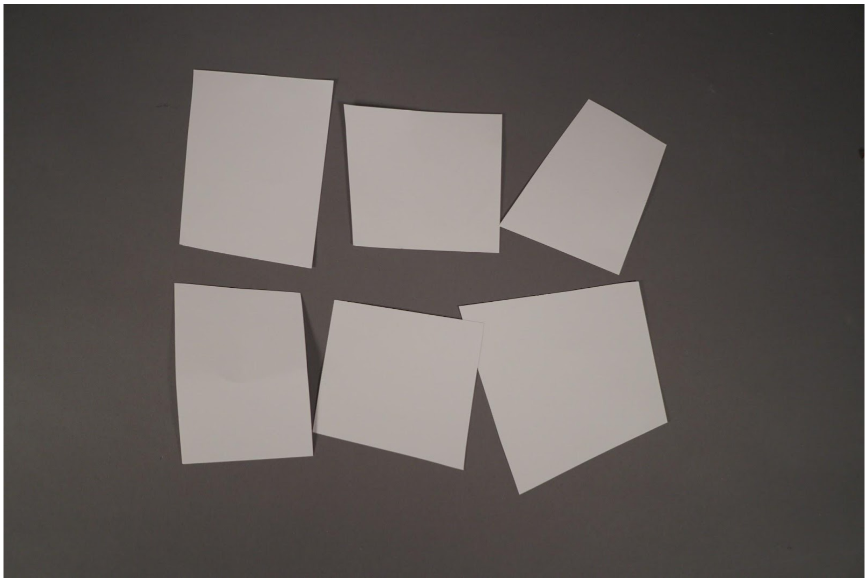
Materials

Materials needed for this procedure

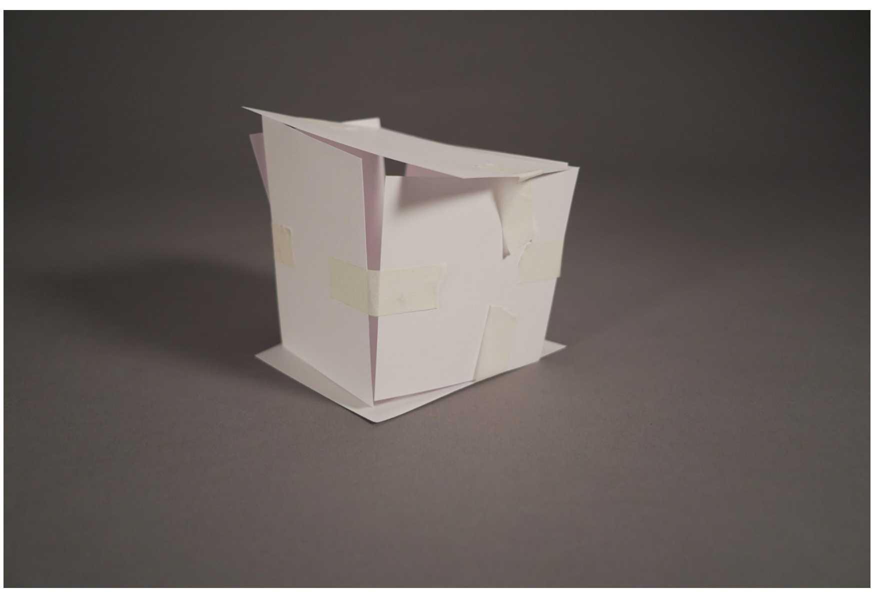
Pictured above: Tennis ball multi-pack, ballpoint pen, tape, scissors, cardstock.

Reference Samples

First Box-Making Example



6 uneven squares cut out of imprecise measurement estimates of the size of the ball.
The squares are imprecise because the measuring tool students invent is imprecise and no square tool was used to make the sides.



An imprecise cube assembled from imprecise squares.
This cube can be used to test whether the ball fits inside. Future cubes will be made with alignment tools that show more precision.

Procedures

Make a Box

In this project, students beginning by thinking about the variety of ways that items are packaged and how their packaging affects their perceived value. They will focus particularly on the aesthetics of packaging in Project 5, but will discuss form throughout the Packaging unit. Students then create a rough version of an enclosed package for the Slam-O 3000.

1. When the students walk into the room, direct their gaze towards the multi-pack of tennis balls on the pedestal.
2. Let the students react to it. Ask the students:
    a. Where have you seen this product being used?
    b. What words would you use to describe the product?
    c. What is “packaging”? (see if group can agree on a definition)
    d. In your notebooks, write down everything you notice about the package.
3. Ask the students to take a stance on how the tennis balls are packaged, without much time to think about it.
    a. Give a thumbs up/thumbs down depending on your opinion.
4. Have a few students on each side share their reasoning.
    a. What is appealing about the packaging? What did you consider when voting?
5. Have the students go to their design notebooks and write down:
    a. What are some interestingly packaged products that you know and remember?
    b. What features of these packages make them interesting?
6. Remove the multi-pack of tennis balls. Place just one ball on the pedestal. Re-engage the students at the pedestal, asking them:
    a. What do you notice about the ball, without the packaging?
    b. What are other products that are sold in single pack and multi pack?
    c. If this were sold separately, what could you expect from the packaging?
    d. What is one way to make the product appear more luxurious or high-end?

This is a good stopping point. If you leave the first class after having introduced discussions about packaging decisions, you can leave the challenge introduction for the next day.

7. Place the Slam-O 3000 on the pedestal. Read the Challenge and the Rules to the students.
8. Say “You are allowed two questions.”
9. Answer their two questions.
10. Ask the class for their first step. Have the class brainstorm the order of operations and write down what you settle on. They should:
    a. Find a way to measure the size of the ball without a ruler.
    b. Transfer that size onto their cardstock to mark out 6 squares (without using a ruler or a square tool).
    c. Cut 6 squares out of cardstock.
    d. Tape their 6 squares into a box.

11. Help the students get started in measuring the ball. Ask them:
    a. What could you use to measure the Slam-O 3000? What makes a good measuring tool?
    b. How could you transfer that measurement from the pedestal to your cardstock?
    c. How can you guarantee that your 6 squares will fit on your one sheet?
12. When drawing squares on their cardstock, ask them:
    a. How many squares do you need to cut if you need to make a box?
    b. What could you do to help make your sides as square as possible?
13. As the students cut their 6 squares, engage them:
    a. Did the sides come out perfectly square? How can you compare them to see how different they are?
    b. What is the importance of all sides being as equal as possible?
    c. How hard was it to cut out the squares to be all the same? What made it hard?

Teacher Tip: Make sure the reflections touch both on the form and the function of the box that has been created. The final reflection questions touch on both of these.

14. Once assembled, go around the room and try the ball inside some of the boxes. In the meantime, have the students reflect on their box in their table groups with the following questions. Before letting the students do it, make sure to stress the need for their observations to be specific and constructive (not helpful to say, "I don't like mine" or "the ball doesn't fit"). Model how to have a successful critique:
    a. Go around and make one observation and improvement suggestions about the box to your left. (For example:
        i. I'm noticing that the squares are not aligned.
        ii. I'm noticing that your ball does not fit inside the box.
        iii. I'm noticing the tape can still be taped more close together.
        iv. I'm noticing a curved side because of tightness in the tape.
        v. I'm noticing your pen marks are all showing.)
    b. How many of you already knew that a box has 6 sides?
    c. If you could use an adjective to describe your box, what would you use?
    d. What is your opinion of how your box turned out?
    e. What tools do you wish you had?
    f. What could have made it a better box in the end?
15. Have the students mark their boxes and store them away so they may access them during the next project.

Break-Outs/Extensions

Use these activities to extend the project or increase the challenge.

Measurement Tool Invention

Have students re-draw the squares, this time with a different measurement tool (still not a ruler). How did the squares change? Are they more or less precise to the size of the ball? Do this for a few different measurement tools and compare across the resulting square boxes. What can explain the differences between these tools? What makes for a better or worse measurement tool?

Comments

Use this space to provide feedback and comment on this lesson

Packaging 2: Make a Nice Box

AN EXPLORATION OF BOXES AND TAPE

NARRATIVE

You are part of a packaging company that has been tasked with designing packaging for a new, highly anticipated product soon to hit the shelves of sporting goods stores everywhere: an aerodynamic high performance tennis ball, the Slam-O 3000. The Slam-O 3000 is 10% yellower and has even more fuzz than its competitors. We are very excited for your packaging to help us sell this new and improved high-end product. We understand this might be a lot to take on, so we've broken down your work into smaller challenges.

Today, you will make a nice box. Actually, you will lay your sides out and make a number of different boxes. This time, you will be given precision tools such as a ruler and a square. First, you will make a box for your ball. Then, you will play with the faces of your box in an effort to discover as many layouts as possible.

STAGING

- Arrange tables for individual student work.
- Place the Slam-O 3000 on the pedestal
- Pass out one sheet of cardstock, 1 pair of scissors, 1 ruler, 1 square, and 1 pen per student

RULES

1. You must dimension your box (give it measurements).
2. You must use a square and a ruler to make the box as cubical as possible.
3. You may use tape to put your box together.
4. The ball must fit completely inside the box.
5. All sides must be flat.
6. Your box must be cut out of one sheet of cardstock.

MATERIALS

Per student:

- 2 Cardstock sheets
- Tape— one foot in length
- Tennis Balls— one for every two students

TOOLS

Per student:

- 1 pair of Scissors
- 1 Ruler
- 1 Square
- 1 Ballpoint Pen

LEARNING OBJECTIVES

- To evaluate precision in creating boxes.
- To identify 11 different cubic box layouts.

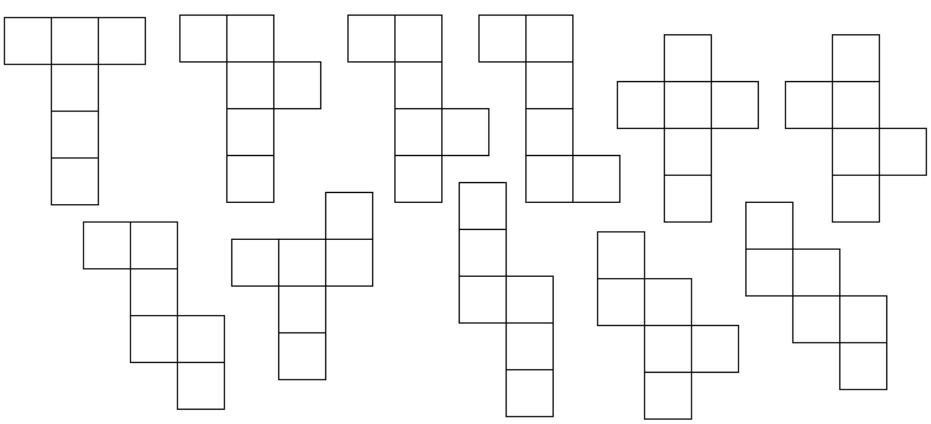
SKILL OBJECTIVES

- To measure with a ruler.
- To dimension a drawing before a cut.
- To use a square tool to draw a square.
- To use parallel and perpendicular lines to create a square.

Reference Samples

Materials and Information

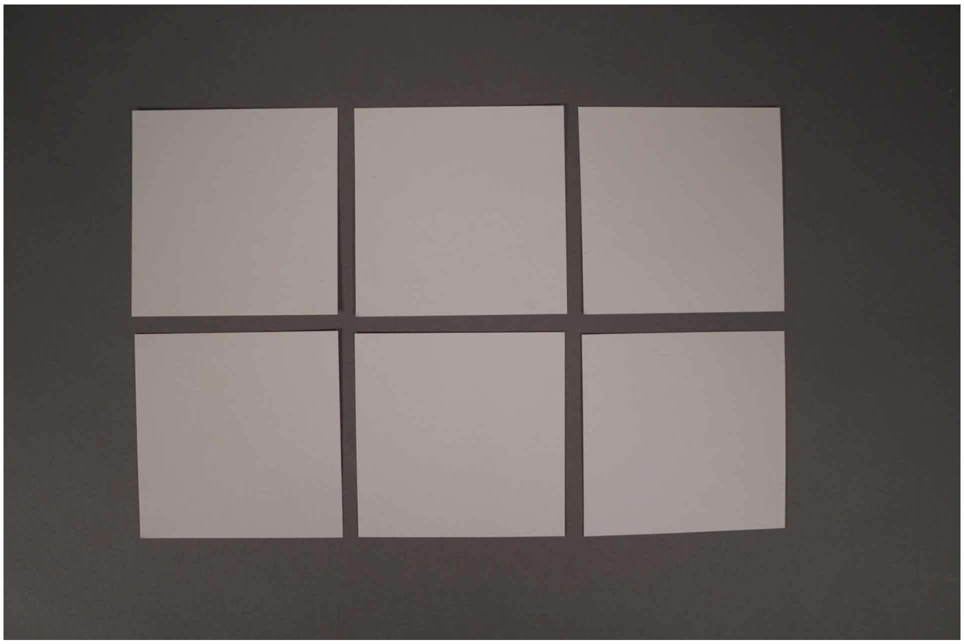
Materials needed for this procedure.
Pictured above: square tool, ruler, ballpoint pen, tape, scissors, cardstock, Slam-O 3000



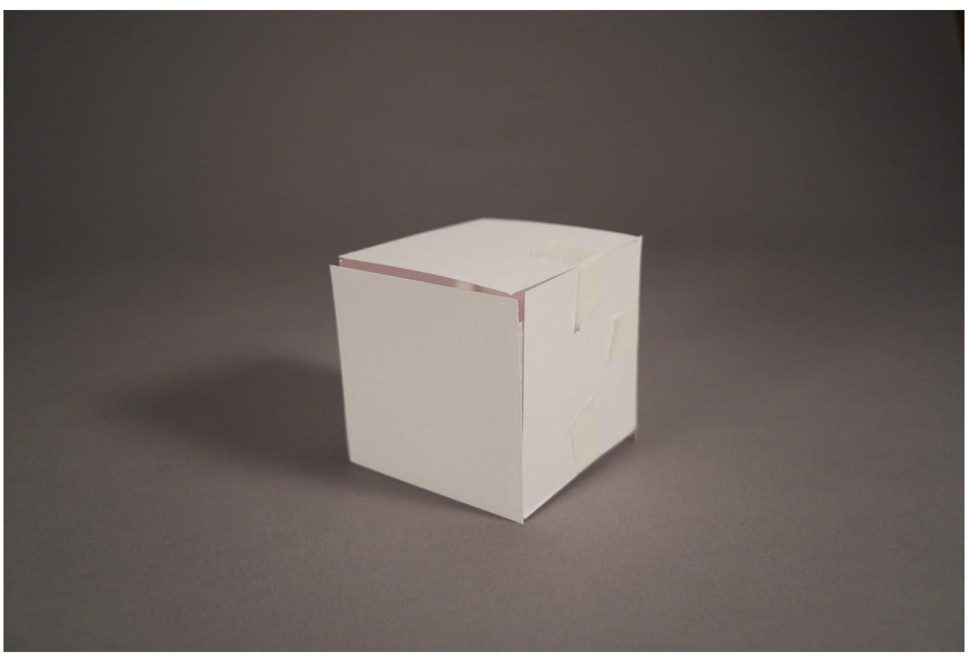
11 of the Possible Layouts that Assemble into a 6-sided Cube
(Source:
http://www.onlinemathlearning.com/image-files/volume-of-a-cube_planificacao_cubo.gif)

Reference Samples

Second Box-Making Example



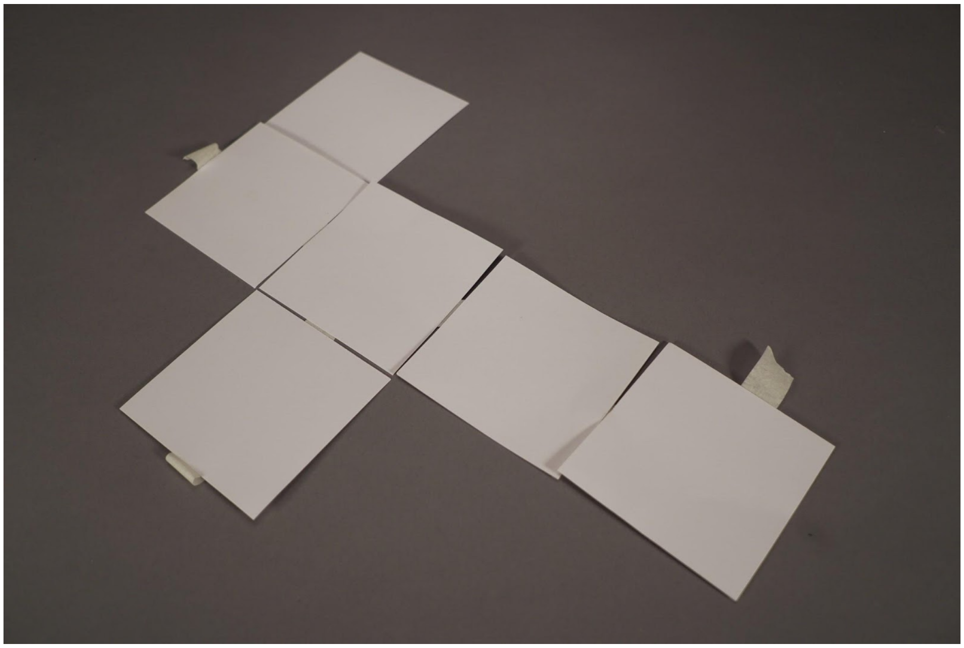
6 perfectly cut squares to serve as the faces of a box.
Cut with the aid of the ruler and the square tool, these squares are much more exact.



A nearly perfect cubic box taped together by some nearly perfect squares as faces.

Reference Sample

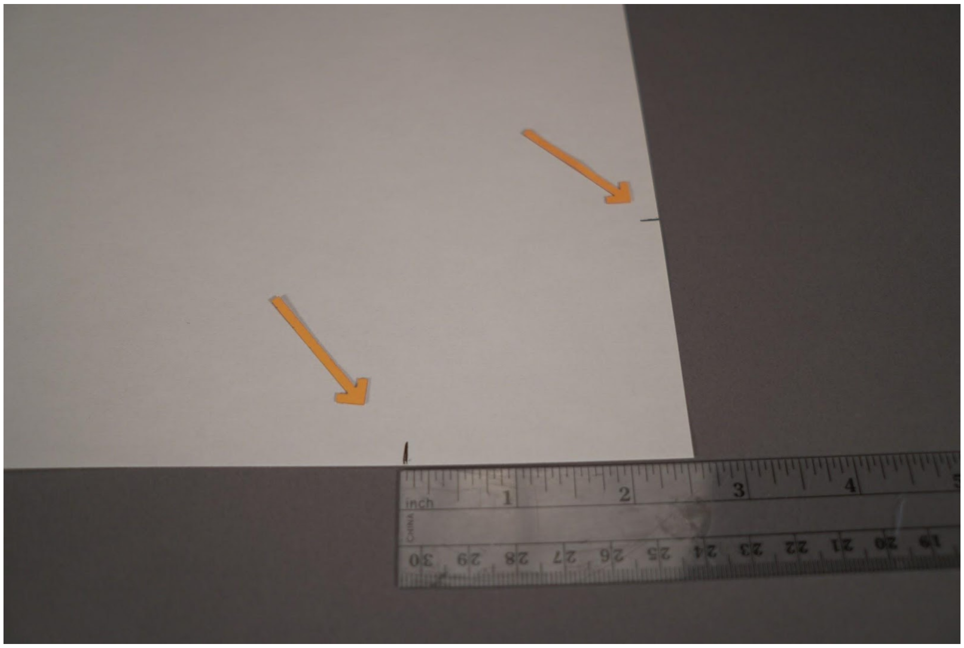
Deconstructing a box to make various layouts



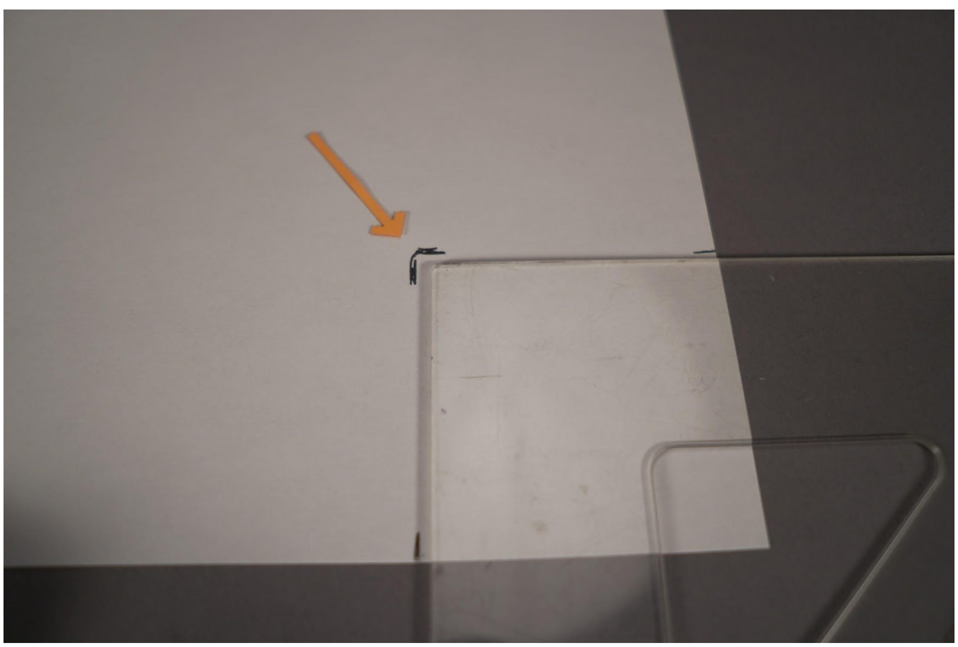
An example box that has been untaped and laid out flat.
This is just one of the 11 layouts that can be discovered by taking apart a box.

Demo Instructions

Using a square tool to mark a corner



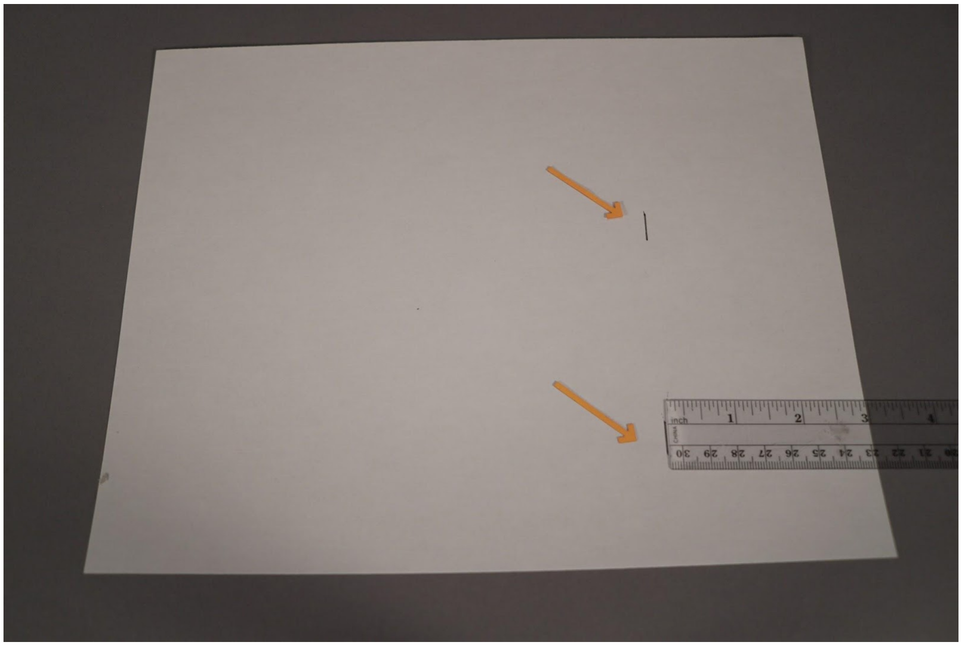
Marking two sides to make a square that is 2.5” on all sides.
Here, the ruler is used to mark two perpendicular sides.



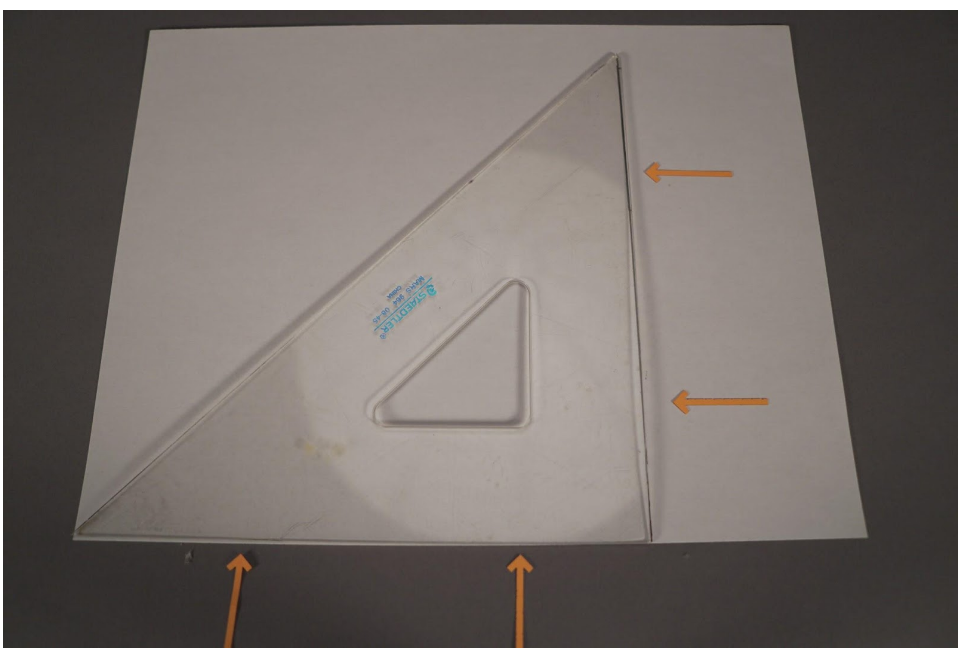
The square tool lines up with the two markings and results in a corner marking a new square.

Demo Instructions

Using a square tool to draw a line perpendicular to an edge of the page



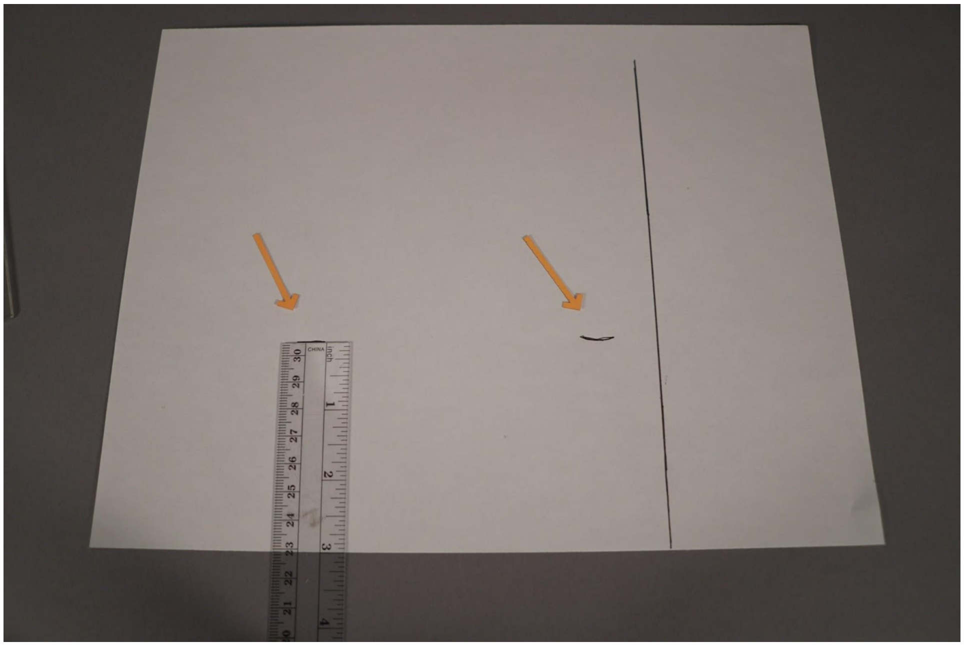
Marking twice to define a line that will be perpendicular to the bottom of the page



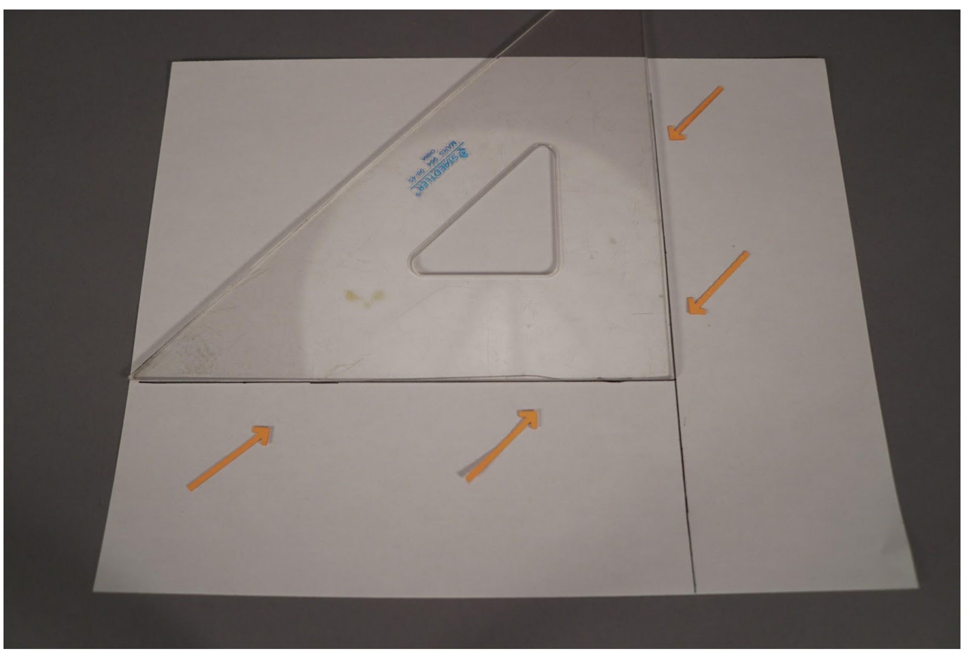
Using the square to align with the bottom of the page and use as a guide to the connect the new perpendicular line

Demo Instructions

Using a square tool to make a line perpendicular off another line



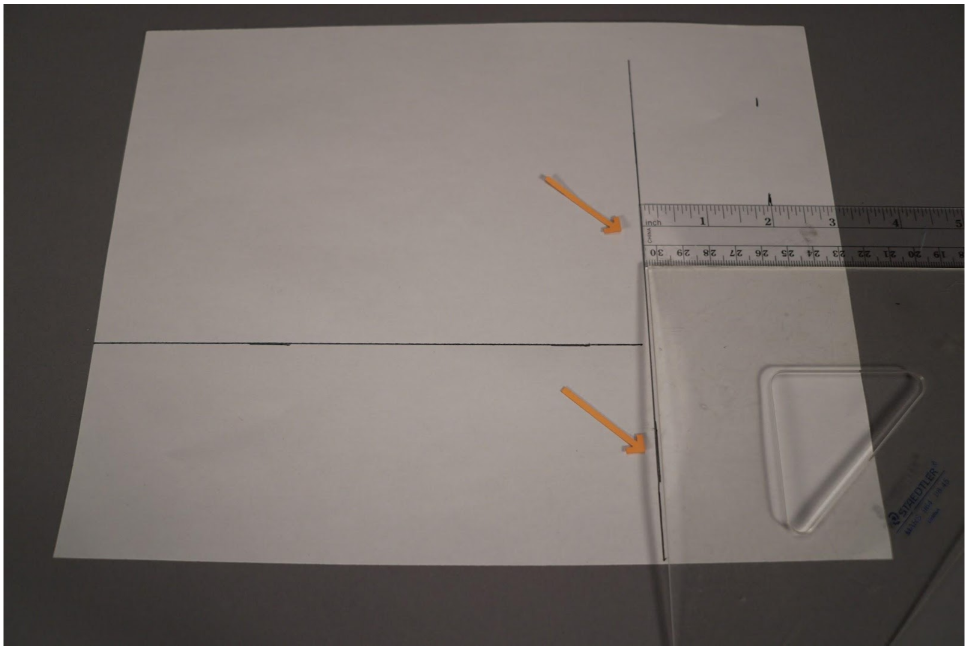
Marking two points that will define a new line, perpendicular to the line on the right



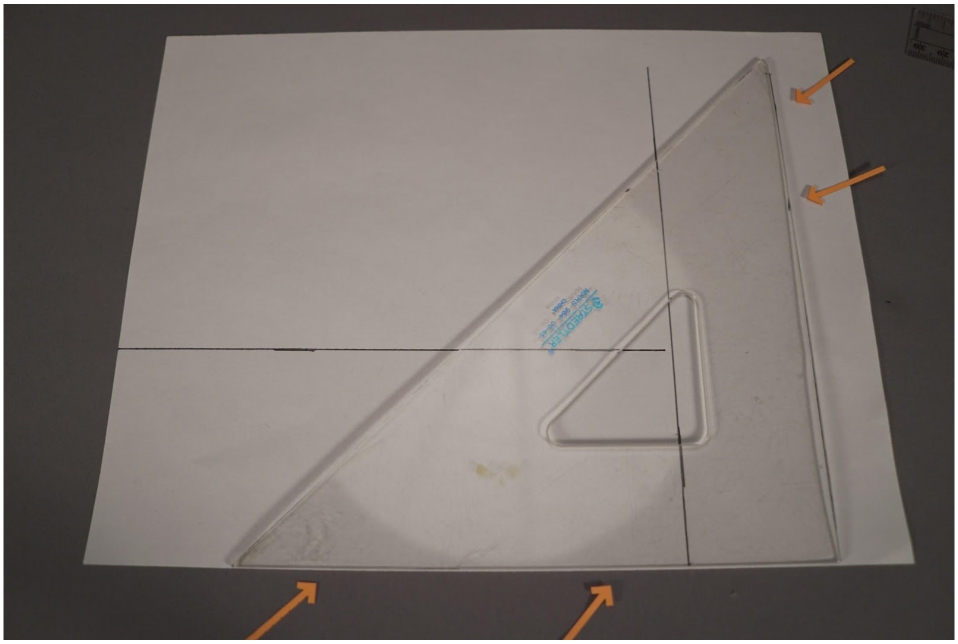
Using the square against the first line to guide the making of the second line from the two markings

Demo Instructions

Using a square tool to make a parallel line off another line



Using the square to line up against the reference line, the ruler uses the square to make two marks on the page that are parallel, equidistant from the reference line



The square lines up to the edge of the sheet and to the two marks in order to make a line that's parallel to the first one

Procedures

Make A Nice Box

In this procedure, students make a dimensioned box for the Slam-O 3000 and discover the 11 other layouts that make a box when assembled. They will compare their precise boxes to their previous, unmeasured boxes.

1. Read the students their Challenge and their Rules.
2. "You are allowed two questions."
3. Answer two student questions.
4. In order to help them get started, ask:
   Now that you are given new tools, what is the expectation of your solutions?
   What do you think we mean by "nice box", stated in the challenge?
   In your groups, make a game plan: What will your process be? What will you do first? ...And then?
   a. Go around asking groups for their plan. Their process should be something like:
      i. Take measurements of the ball
      ii. Measure out the first square to dimension.
      iii. Use the square tool to draw parallel lines and perpendicular lines to make the other squares.
      iv. Cut the 6 squares and rip tape into small pieces to tape them together.
      v. Tape the 6 squares in various two-dimensional layouts to make all 11 possible ones (see Reference Samples above)
5. First, have the students sketch the ball and where they will measure it from. As they show you their sketch, pass out one tennis ball per pair of students. Try to get them to explain how they'll use a square and a ruler to measure more precisely. Ask them:
   "What part of the Slam-O 3000 do you need to measure? What part is important for the box you need to make? How can your two new tools (ruler and square) help you measure it precisely?"

Demo the tools: At the board, demo how to use a ruler and a square tool. Use the Demo Instructions above to teach them the four main functions of a square:

- Marking a corner
- Marking a line perpendicular to the edge
- Marking a line perpendicular to another line
- Marking a parallel line

6. Let the students get to work making their squares. They should cut 6 squares and tape them together into a box.
7. When they are done with their first box, ask them to compare the two boxes:

a. How does the measured box compare to the last, unmeasured box you made?
b. What do you notice about the sides of each box?
c. Is your box more disturbed by the size of the faces or by the taping?
d. Where do you see similarity between your boxes?
e. Which was more challenging to make?

This is a good stopping point. If your class is nearing the end of the day, this is a good place to pick it back up tomorrow. Have students mark their boxes so they can recover them tomorrow.

8. Now transition them into box-layout exploration. Choose one of the students' cubes. Talk about how when the box is opened and each square laid flat, that would be a box layout, or stencil, of the cube. Show them an example of one orientation by spreading out one of the boxes.(See Reference Sample) As you take it apart, draw each square on the board. Then, challenge them by saying:
"There are 11 different layouts of the squares that fold up to make a cube. Try to find them all by removing the tape and moving the squares around."
9. While students are working, engage them:
    a. What could be one approach to finding different solutions?
    b. How could you use the already uncovered solutions to find new ones?
    c. Are there any rules you discovered about the layouts? (i.e. No more than 4 squares in one line; No more than three squares in a gridded layout.)

On display: As the different orientations are discovered, tape the 11 unique ones to the board and showcase the variety of them. Be careful not to put repeat ones that are just rotated versions of others already on the board.

10. When the 11 are discovered or when there's a good stopping point, de-brief with the students:
    a. What surprised you about the 11 different layouts?
    b. What did you learn from using the ruler and the square?
    c. What was the hardest part of using the square tool?
    d. When is it useful to use a square tool?
    e. **Which of the box sizes is closest to being an exact match?**

Break-Outs/Extensions

Use these activities to extend the project or increase the challenge.

Digital Shapes

Show students geometric forms from the computer on the screen. Ask the students to deconstruct the form into 2D by predicting and sketching what these forms would be in a 2D sheet of cardstock. To test, ask the student to build their cardstock stencil into a 3D form and compare with what they see on the screen.

Tessellation Creation

Using the 11 layouts possible with the cube, tessellate them on kraft paper. Have students predict which is going to tessellate into the most space-optimal layout (which is going to leave the least amount of space unused). Which is going to leave the most space unused? Have the students tessellate the various options. Can they calculate the amount of space unused?

Does it fit?

Calculate which of the 11 different layouts can be used to make a cube out of a 8.5” x 11” sheet of cardstock. Which of the shapes does not fit a cube with 2.5” sides? By nature of the layouts, only some of the box stencils will fit. Can you figure out which won’t?

Tightest Fit.

When all the boxes are done being made, try each ball inside the box, looking for the tightest fit. Find the box that fits the ball the most exact and prize this one for being the closest fit. What factors contribute to this tight fit?

Comments

Use this space to provide feedback and comment on this lesson

Packaging 3: Deconstruct

AN EXPLORATION OF BUILT BOXES & THEIR TABS

CHALLENGE

You are part of a packaging company that has been tasked with designing packaging for a new, highly anticipated product soon to hit the shelves of sporting goods stores everywhere: an aerodynamic high performance tennis ball, the Slam-O 3000. The Slam-O 3000 is 10% yellower and has even more fuzz than its competitors. We are very excited for your packaging to help us sell this new and improved high-end product. We understand this might be a lot to take on, so we've broken down your work into smaller challenges.

You have a box in front of you. Your challenge today is to investigate the way that box was made. First, we'll predict what it will look like laid out. It is your job -- after some predictions and when we say so-- to take apart this box and lay it out in the way it was made in the factory. Be gentle to the box so you do not tear it apart. Focus on the glued tabs.

STAGING

The day before, ask the students to bring in a box from home, one that they can take apart. Make sure the box has some glued sides on it. , i.e. Wheat Thins, cereal boxes, cracker boxes. Bring one in for yourself to serve as the demo box.

- Place the demo box on the pedestal.
- Arrange the desks for individual student work.

RULES

1. You must open your box while still trying to preserve its structural integrity as much as possible.
2. No cutting open your box. No tearing sides apart.

MATERIALS

Per student:

- 1 Box to take apart (brought by student)
- 1 sheet of paper

TOOLS

N/A

LEARNING OBJECTIVES

- To visualize how a box comes apart and lays flat.
- To identify structural features of a tabbed box.
- To demonstrate the role of tabs in holding a box together.

SKILL OBJECTIVES

- To take apart boxes while conserving their structural integrity.
- To sketch a prediction of a 3D shape in a 2D layout.

Reference Samples

Taking apart a box

An example box that can be brought in to be taken apart

Carefully tearing apart at the seams of the box where the tabbing has been glued

Reference Samples

Taking apart a box

Carefully tear apart at the bottom tabs of the box

The box, deconstructed, and laid flat to see its stencil

Procedures

Deconstruct a Box

In this project, students predict what the two-dimensional layout (or "stencil") of a box will be. Then, they will take it apart and observe the flaps and tabs used to put it together.

Teacher Prep: The day before, ask the students to bring in a box from home, one that they can take apart. Make sure the box has some glued sides on it. , i.e. Wheat Thins, cereal boxes, cracker boxes. Bring one in for yourself to serve as the demo box.

1. Deliver the Challenge and Rules to the students.
2. Select a student at random and have that student repeat the challenge to you.
3. Then say to the students:
   "You are allowed two clarifying questions."
4. Answer only two questions of the group.
5. Take your demo box and introduce students to the use of tabs:
   How is this box put together?
   Do you see any tape?
   Instead of tape, what is holding these boxes together?
   Why do you think these boxes are held with glue and not tape?
   What is holding these boxes together? Where is that glue applied? (on tabs)
6. **Predict.** Have the students take out their design notebooks and prompt them:
   Sketch the outline of what you think you will see when you take the box apart. This two-dimensional sketch is called a layout, or a stencil.
   - Mark where you think tabs of glue were used to put the box together.
   - Mark where you think tabs are being used to open and close the box.
7. **Exchange.** Have students trade and defend their outline with each other. Let them make changes to their outlines if they wish.

Do it first. Demo how to take the box apart by doing it yourself to a box of your own. Show the care you should take to gently tear at the glued flaps so they come apart while staying as most intact as possible.

8. **Unglue.** Guide the students to deconstruct their box by just tearing at the seams of the glued flaps. Have them lay it out flat as the factory intended it.
9. **Discuss.** Share different example boxes so students see the variety of tabs in the boxes. Ask the students:

a. How does your box layout compare to your sketch?
b. What do you notice about all the box stencils on the table? Where are they similar and where are they different?
c. Which stencils have tabs going all the way across? Which have tabs meeting halfway?
d. What are the three ways that tabs are used? (glue tabs, tuck tabs, and flap tabs)
e. Tomorrow, you will add tabs to your very own boxes. What can you learn from these boxes that will help you make yours tomorrow? (notice the tapering, or sloped cuts in the tabs so they fit together smoothly; notice the flaps below each tuck tab for rigidity, support, protection, etc.)

10. Ask students if they know how boxes are made. After initial discussion, explain: "When boxes are made, they are cut out of flat sheets and then assembled. A cut sheet will have multiple stencils of that box and be cut all at once. Efficient tessellation means that the stencils on the cut sheet are so tight together, the least amount of material goes unused. In other words, as many box stencils fit on the cut sheet as possible."
11. Finally, discuss with the students the real-world implications of their work. Challenge them:

"What else in the world is made out of cutting 2D flat layouts and then forming them?

Hints: All boxes, Car bodies, Kitchen stoves, table legs, etc.

Break-Outs/Extensions

Use these activities to extend the project or increase the challenge.

Digital Shapes

Show students geometric forms from the computer on the screen. Ask the students to deconstruct the form into 2D by predicting and sketching what these forms would be in a 2D sheet of cardstock. To test, ask the student to build their cardstock stencil into a 3D form and compare with what they see on the screen.

Comments

Use this space to provide feedback and comment on this lesson

Packaging: Make a Nice Box with No Tape

AN EXPLORATION OF BOXES AND GLUE

CHALLENGE

You are part of a packaging company that has been tasked with designing packaging for a new, highly anticipated product soon to hit the shelves of sporting goods stores everywhere: an aerodynamic high performance tennis ball, the Slam-O 3000. The Slam-O 3000 is 10% yellower and has even more fuzz than its competitors. We are very excited for your packaging to help us sell this new and improved high-end product. We understand this might be a lot to take on, so we've broken down your work into smaller challenges.

Today, you will create the most perfect box possible, held together by glue, not tape. It is your job to first create a stencil of your box and then design tabs so you can apply glue onto them and close the box.

STAGING

- Arrange tables for individual student work but group them into teams of 4.
- Place one cube held by glue on the pedestal. Place the Slam-O 3000 on the pedestal, next to the cube.
- Pass out two sheets of gridded cardstock for each student, 1 ruler, 1 square, 1 pair of scissors, and one pen per student. Do not pass out the glue until you've seen their boxes ready for gluing.

RULES

1. You will not use any tape. Instead, you will use glue to put the box together.
2. You must create tabs for your box to glue together.
3. You must be able to insert and remove the Slam-O 3000 from your packaging.
4. Your box has to be as cubic as possible.
5. All sides must be flat.
6. Every fold must be scored with a pen.

MATERIALS

- Gridded Cardstock sheets— a few per student
- Glue— one bottle per group of four students
- 1 Slam-O 3000 (tennis ball)

TOOLS

Per student:

- 1 Ruler
- 1 Square
- 1 pair of Scissors
- 1 Ballpoint Pen

LEARNING OBJECTIVES

- To mark a layout that folds into a box.
- To calculate and draw tabs needed to hold a box together.

SKILL OBJECTIVES

- To measure and dimension a 2D object to make a 3D shape.
- To design integrated flaps and tabs for a box.
- To score lines with a ballpoint pen in order

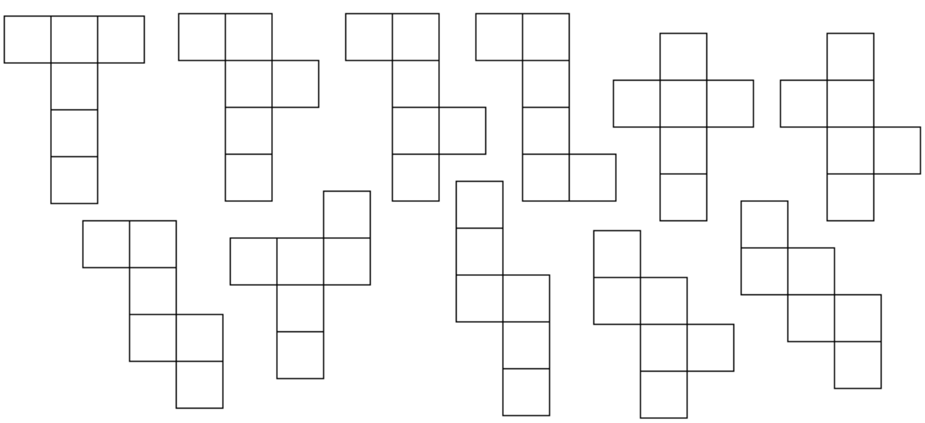
	to fold more readily.

Reference Samples

Materials and information.

Materials needed for this procedure.

Pictured above: A square tool, ruler, Slam-O 3000, ballpoint pen, scissors, glue, and gridded cardstock.

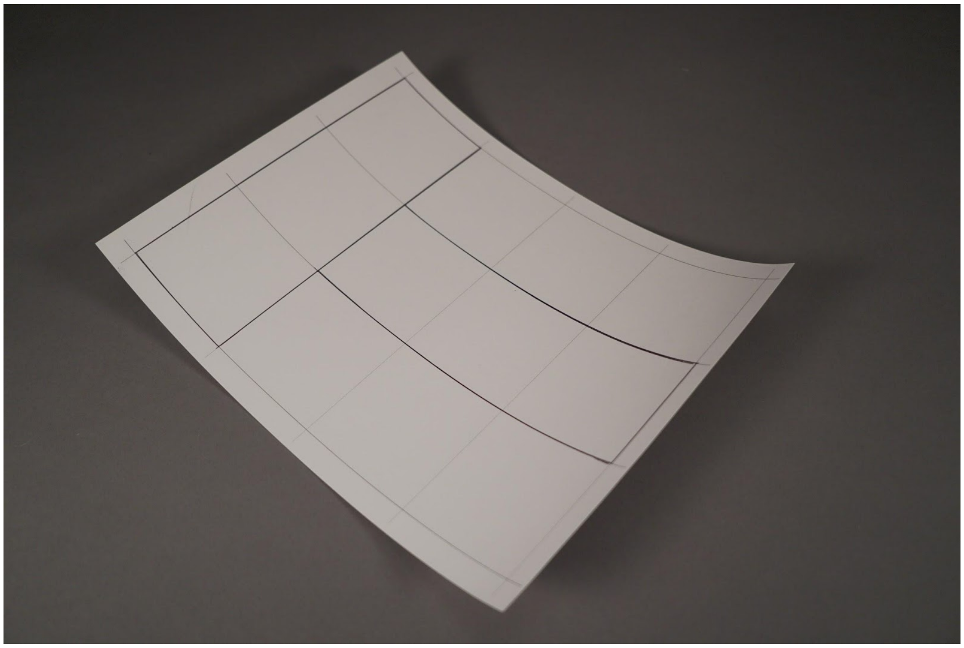


11 of the Possible Layouts that Assemble into a 6-sided Cube

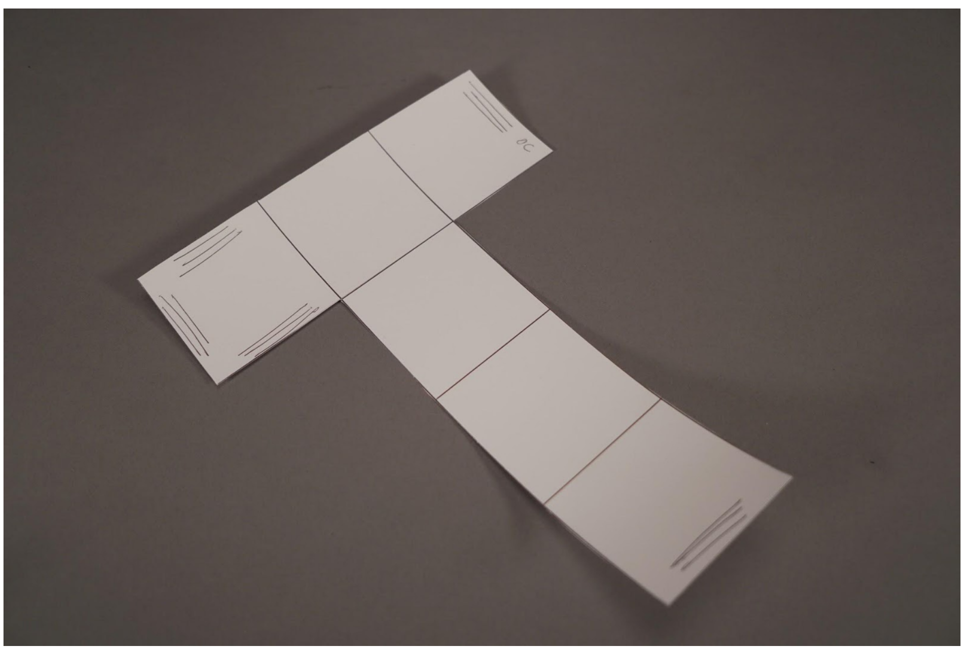
(Source: http://www.onlinemathlearning.com/image-files/volume-of-a-cube_planificacao_cubo.gif)

Reference Samples

Box-making steps towards designing with tabs.



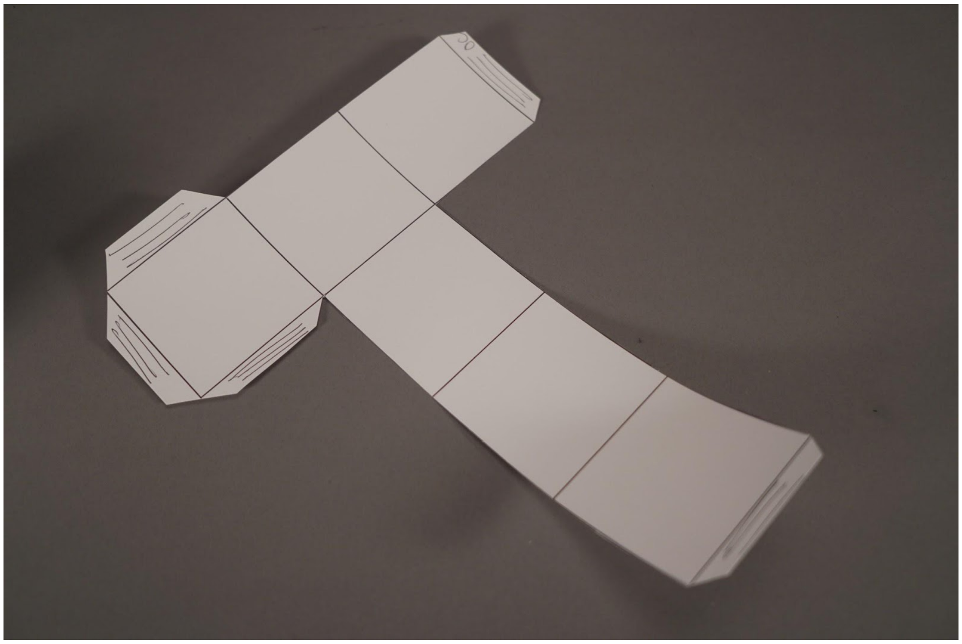
Step 1- Marking the stencil that is to be cut out from cardstock.



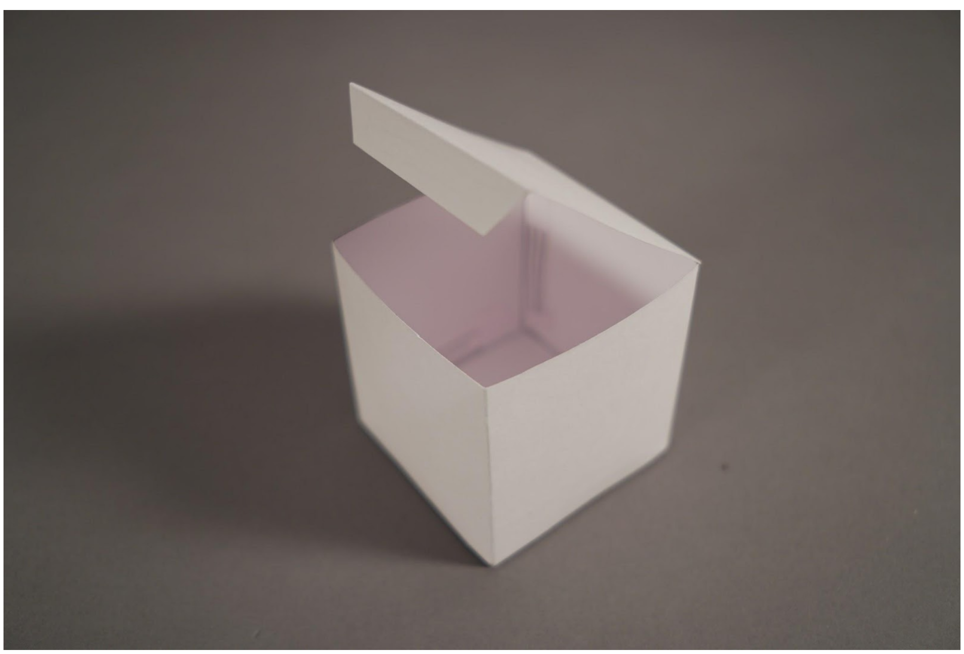
Step 2- Using the assembly of the cube to mark where tabs are needed.

Reference Samples

Box-making steps towards designing with tabs.



Step 3- Remaking the stencil, this time with tabs where they were marked out.



Step 4- Gluing together the final box with tabs

Procedures

Make A Nice Box With No Tape

In this procedure, students will no longer cut squares to make a cubic box. Instead, they will use a gridded sheet to layout a stencil for a box. Then, they will add tabs to this box that will allow it to glue the sides of the box together.

1. Read the students their Challenge and the Rules.
2. "You can ask two clarifying questions."
3. Answer their two questions.
4. Disclose to the students that the perfect measurement for a box that is tight around the ball is made of 2.5" squares. Their gridded cardstock is dimensioned with 2.5" squares in order to fit a box out of just one sheet of cardstock.

Teacher Tip: Project the 11 layouts on the board (See Reference Sample above).

5. **Layout.** Have students choose a box layout that they are going to draw as a stencil on their cardstock. They should make sure to choose one that fits on the page. Ask them:
    a. Which of these 11 box layouts would fit in a 8.5"x11" sheet of cardstock if our box has sides of 2.5"?
    b. Which of these would not fit? How do you know?

    Have them trace the box layout onto their stencil.
6. **First box, no tabs.** Have students measure out and cut out their first box out of a stencil. This box will not have tabs but will help them visualize where the box needs tabs for glue and tabs for opening and closing (see Reference Samples steps 1-3).

Scoring. As students begin to assemble their box, remind them that every fold should be scored so that folding is easier. Every fold should be scored by pressing down, as hard as possible, with a ballpoint pen.

7. **Adding tabs.** Using their first box to size, have them hold the box in their hands in a loosely assembled configuration, as close to box-like as possible.
    a. Decide which side will open and close to let the ball inside. That side should have a tab that will not be glued. Mark that side with an OC.
    b. Tabs go where two sides meet each other and there is a gap. Use a pen to mark the places where a tab will be used to glue them together.
8. When done, they can unfold the box and have the markings of where the tabs go. Be sure that students are not mating tabs to tabs, but instead using just one tab at each junction.
9. **Tab sizes, calculated.** Draw on the board an 8.5"x11" rectangle. Draw the 3x4 grid resembling the cardstock the students have been using. Now ask the students:
    a. What size tabs can we fit on the cardstock?
    b. Note that you need tabs in the top and bottom of the grid, so each stencil can fit two 0.5" tabs in each direction.

10. **Second box, with tabs.** Now, have the students re-make the box stencil, this time accounting for the 0.5" tabs that they decided they needed. Have students mark where the tabs will go and then re-draw the stencil and cut it out. Ask the students:
    a. What are some possible designs for the tabs?
    b. What makes some designs better than others?
    c. What are some advantages of slanting the corners of the tabs?
    d. How does removing a small amount of material from the corners help the tabs' function?
11. As students are working, engage them:
    a. What are you learning about working with tabs?
    b. What is one takeaway lesson from making your box stencil?
    c. Was anything harder than expected to make or replicate?
12. Before giving them any glue, have the students show you how their tabbed box will go together- including how it will open and close for the ball to come in and out. When the box is satisfactory, give them a bottle of glue. Remind them to use the bottle frugally- not a lot of glue is needed.

Glue it together. Demo how to use small amounts of glue with the students. Show that you can squeeze a little and then use a piece of paper to spread the rest of the glue. Show that when you glue the tab together, you should press down on the tab in order to get a better hold.

13. When the boxes are complete, de-brief with the students:
    a. What was the hardest part of making a box with tabs for glue?
    b. How does this box compare with your previous box that was to size and taped together?
    c. Is there anything that is not satisfactory about this box? How would you like to improve it?

Break-Outs/Extensions

Use these activities to extend the project or increase the challenge.

Comments

Use this space to provide feedback and comment on this lesson

Packaging 5: Vertical Faces

AN EXPLORATION OF ENCLOSURES AND EXPOSURES

NARRATIVE

You are part of a packaging company that has been tasked with designing packaging for a new, highly anticipated product soon to hit the shelves of sporting goods stores everywhere: an aerodynamic high performance tennis ball, the Slam-O 3000. The Slam-O 3000 is 10% yellower and has even more fuzz than its competitors. We are very excited for your packaging to help us sell this new and improved high-end product. We understand this might be a lot to take on, so we've broken down your work into smaller challenges.

Today, you will make a packaging enclosure for the Slam-O 3000. You will design cutouts for the sides of this box to match your branding strategy for the product.

STAGING

- Arrange desks to allow for groupings of 4 students who will work individually.
- Create groups of students and set out nametags at each desk.
- Set out 1 ruler, 1 ballpoint pen, 1 pair of scissors, 1 straight edge, and 2 sheets of gridded cardstock per student. Do not pass out the glue until you've seen their boxes ready for gluing.
- Setup 2 Cutting Stations with X-Acto knives and self-healing mats.
- Place the Slam-O 3000 on the pedestal.

RULES

1. You will work individually on your packaging.
2. Your package must fit on one sheet of cardstock.
3. All sides must be flat.
4. You must be able to insert and remove the Slam-O 3000 from your packaging.
5. You must make windows into your box on every vertical face.
6. You may not use tape but you may use glue.
7. Every fold must be scored with a pen.

MATERIALS

- 2 Sheets of gridded cardstock per student
- 1 Slam-O 3000 (tennis ball)
- 1 bottle of glue per group

TOOLS

Per student:

- 1 Ruler
- 1 Ballpoint pen
- 1 pair of scissors
- 1 Square

2 X-Acto knives in the Cutting Station

LEARNING OBJECTIVES

- To accurately dimension an existing object.
- To dimension a sphere with a flat ruler.
- To design a package from dimensions taken for an existing project.
- To learn how the thickness of the packaging material affects the packaging design.

SKILL OBJECTIVES

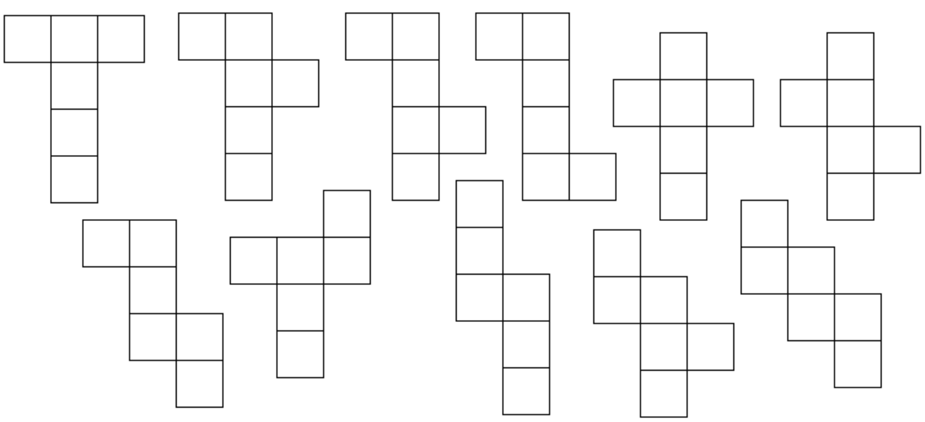
- To build resealable lids with tabbing in the packages.
- To cut precisely into a vertical face with an X-Acto knife.
- To score lines in preparation for folds.

• To include design features in accordance with a branding strategy.	

Reference Material

Materials for this procedure

Pictured above: A Square, Ruler, Slam-O 3000, X-Acto knife, Ballpoint pen, Scissors, Glue, Gridded Cardstock

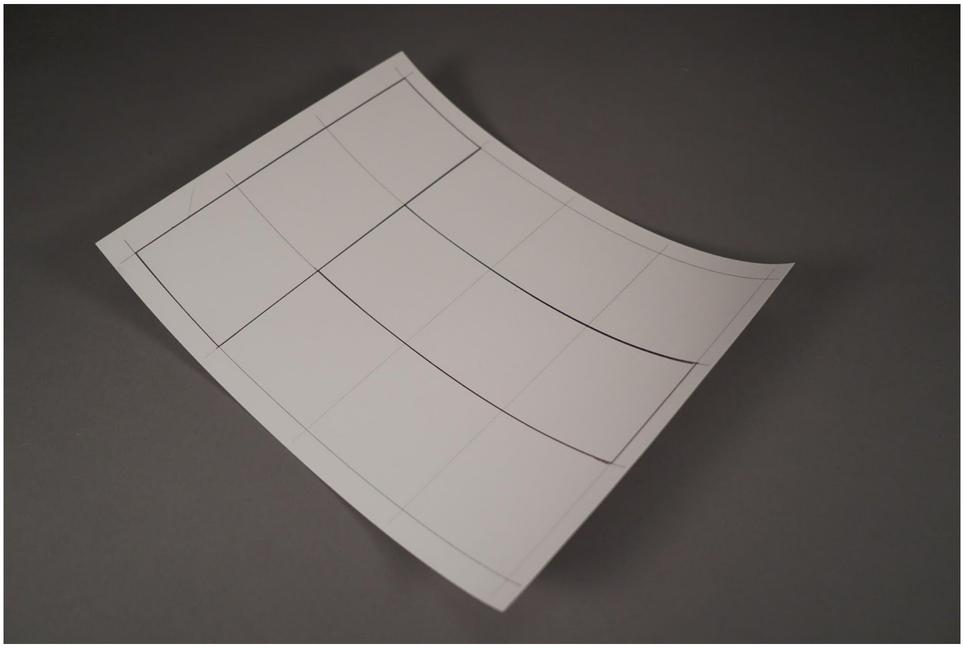


11 of the Possible Layouts that Assemble into a 6-sided Cube

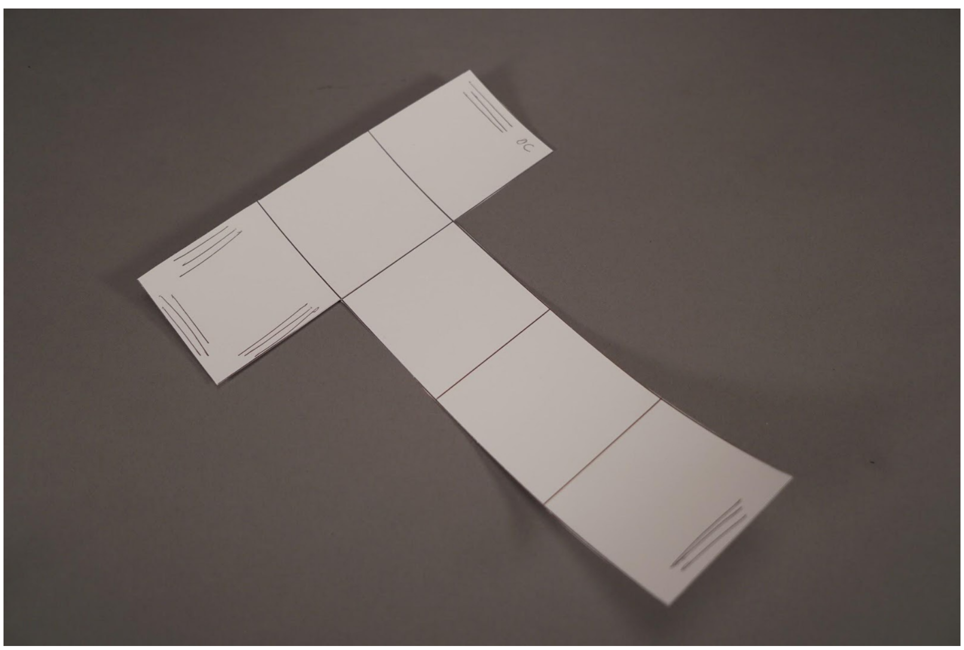
(Source: http://www.onlinemathlearning.com/image-files/volume-of-a-cube_planificacao_cubo.gif)

Reference Samples

Box-making steps towards designing with tabs.



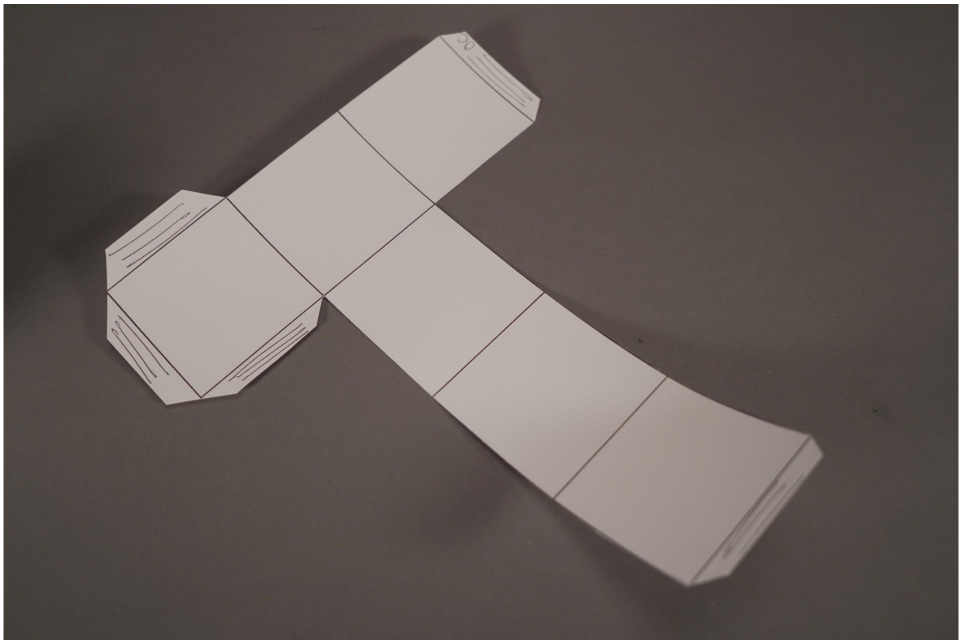
Step 1- Marking the stencil that is to be cut out from cardstock.



Step 2- Using the assembly of the cube to mark where tabs are needed.

Reference Samples

Box-making steps towards designing with tabs.

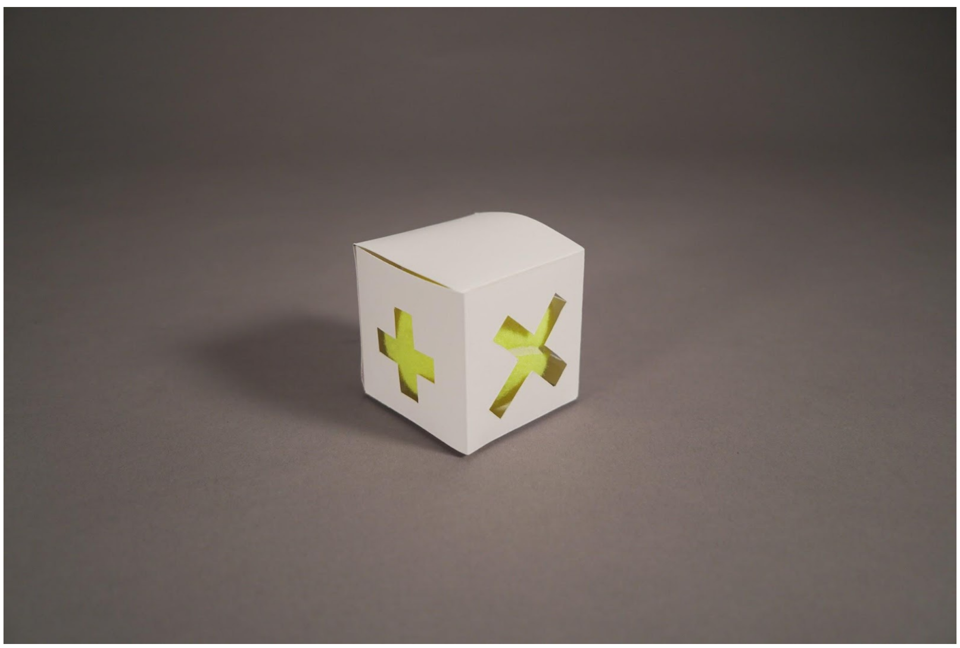


Step 3- Remaking the stencil, this time with tabs where they were marked out.

Reference Samples

Examples of packaging the Slam-O 3000

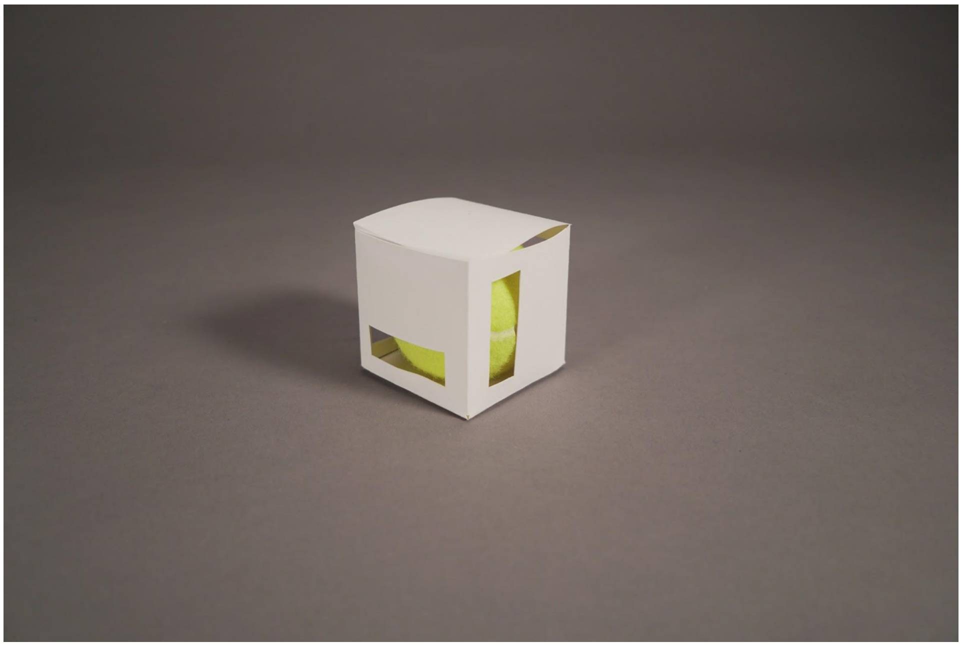
Box Enclosure 1 with Open Cut Sides for The Slam-O 3000



Box Enclosure 2 with Open Cut Sides for The Slam-O 3000

Reference Samples

Examples of packaging the Slam-O 3000



Box Enclosure 3 with Open Cut Rectangular Sides for The Slam-O 3000

Procedures

Vertical Faces

This project has students think about the variety of ways that items are packaged and how their packaging affects their perceived value. Students then create an enclosed package for the Slam-O 3000.

1. When the students walk into the room, direct their gaze towards the Slam-O 3000 on the pedestal.
2. Present the Challenge and the Rules to the students. Call on a student to restate the challenge and constraints.
3. "You can ask 2 clarifying questions."
4. Respond to two questions.
5. Disclose to the students that the perfect measurement for a box that is tight around the ball is made of 2.5" squares. Their gridded cardstock is dimensioned with 2.5" squares in order to fit a box out of just one sheet of cardstock.
6. Have the students create a branding strategy for their box. Ask them to sketch the designs they'd like to cut into the faces of the box:
    a. What are a few words you want your customers to feel when they see this packaging? Write these down in your notebook.
    b. What are a few design attributes you would like to strive for in your design? Sketch these in your notebook.
7. Engage the students by having them write down their answers. Write these questions on the board:
    a. What shape will it be? How many sides will it have?
    b. Which of the 11 box layouts will you choose to make?
    c. What will you do first?
8. Let the students work for a bit. At a glance, they should:
    i. Mark out a box with no tabs out of the gridded cardstock,
    ii. Cut the box out,
    iii. Using the assembled but unglued box, mark the sides that are going to get tabs,
    iv. Make a second box, this time with tabs,
    v. Cut the box out, with tabs,
    vi. Using the assembled but unglued box, mark the sides that are going to end up vertical and are going to get cut,
    vii. Open the box flat. Cut out designs in the box stencil while it is still lying open and flat,
    viii. Glue the box together.

Teacher Tip: Project the 11 layouts on the board (See Reference Sample above).

9. **Layout.** Have students choose a box layout that they are going to draw as a stencil on their cardstock. They should make sure to choose one that fits on the page. Ask them:

a. Which of these 11 box layouts would fit in a 8.5”x11” sheet of cardstock if our box has sides of 2.5”?
b. Which of these would not fit? How do you know?

Have them trace the box layout onto their stencil.

10. **First box, no tabs.** Have students measure out and cut out their first box out of a stencil. This box will not have tabs but will help them visualize where the box needs tabs for glue and tabs for opening and closing (see Reference Samples steps 1-3).

Scoring. As students begin to assemble their box, remind them that every fold should be scored so that folding is easier. Every fold should be scored by pressing down, as hard as possible, with a ballpoint pen.

11. **Adding tabs.** Using their first box to size, have them hold the box in their hands in a loosely assembled configuration, as close to box-like as possible.
    a. Decide which side will open and close to let the ball inside. That side should have a tab that will not be glued. Mark that side with an OC.
    b. Tabs go where two sides meet each other and there is a gap. Use a pen to mark the places where a tab will be used to glue them together.
12. When done, they can unfold the box and have the markings of where the tabs go. Be sure that students are not mating tabs to tabs, but instead using just one tab at each junction.
13. **Tab sizes, calculated.** Draw on the board an 8.5”x11” rectangle. Draw the 3x4 grid resembling the cardstock the students have been using. Now ask the students:
    a. What size tabs can we fit on the cardstock?
    b. Note that you need tabs in the top and bottom of the grid, so each stencil can fit two 0.5” tabs in each direction.
14. **Second box, with tabs.** Now, have the students re-make the box stencil, this time accounting for the 0.5” tabs that they decided they needed. Have students mark where the tabs will go and then re-draw the stencil and cut it out. Ask the students:
    a. What are some possible designs for the tabs?
    b. What makes some designs better than others?
    c. What are some advantages of slanting the corners of the tabs?
    d. How does removing a small amount of material from the corners help the tabs’ function?
15. As students are working, engage them:
    a. What are you learning about working with tabs?
    b. What is one takeaway lesson from making your box stencil?
    c. Was anything harder than expected to make or replicate?
16. **Vertical Cuts.** While held together loosely, notice the sides that will be vertical when your box is glued together. Mark those sides. Unravel the box and, while holding the box flat, use an X-Acto knife to make cuts on the vertical sides. Make sure the students do not use an X-Acto knife in the air to cut into the sides of the box while assembled— this is very dangerous.
17. Before giving them any glue, have the students show you how their tabbed box will go together- including how it will open and close for the ball to come in and out. When the box is satisfactory, give them a bottle of glue. Remind them to use the bottle frugally- not a lot of glue is needed.

Glue it together. Demo how to use small amounts of glue with the students. Show that you can squeeze a little and then use a piece of paper to spread the rest of the glue. Show that when you glue the tab together, you should press down on the tab in order to get a better hold.

18. After the cuts on the vertical sides are done, glue the box together.
19. During this time, good check-in questions include:
    a. What makes your design a good solution?
    b. What surprised you about your process?
    c. What's your next question?
    d. How does the thickness of the material affect your design?
20. Pick an example package and challenge the students:
    a. In what ways can this package be opened more? What cuts can be made to this package that will uncover the tennis ball some more?
    b. What happens to the structural integrity of the box when the faces are cut into it?
    c. Does the tightness of the box around the ball change with the cuts?

    Have every student to make cuts to open their own enclosing packaging. Remind them they can work at the X-Acto Knife cutting station as needed.
21. When students are finished, mark their packages with student initials and review the packages at the pedestal. Gather all the packages at once so they are together and you are able to choose from them:
    a. Choose a select few to showcase alone on the pedestal and have a discussion. Recall some of the original discussion questions:
        i. What do you notice about this package?
        ii. What words would you use to describe the product?
        iii. What do you notice between the two packages?
        iv. Which package seems more prestigious? How do you know that?
22. Before the end of class, leave time for reflecting in their notebooks. Prompts include:
    a. If you had more time, what would you pursue next?
    b. If you could have more materials, what do you wish you had?
    c. What's one thing you learned regarding how to make boxes?

Procedures

Digitizing the Cut Sheet

This project has students use computer software to digitize their cut sheet into something that can be laser cut. A digital file of the gridded cardstock sheet is provided for them to get started.

1. Present the new challenge and the rules to the students:
    a. You have been tasked with designing a computer file to cut your boxes on the laser cutter. You must turn in a file that has your box in a file that is ready to be laser cut.
    b. Call on a student to restate the challenge and constraints.
2. "You can ask 2 clarifying questions."
3. Respond to two questions.
4. Students should use the preferred computer program to make a digital version of their box layout. Have students begin with the pre-loaded file of the gridded cardstock sheet.
5. To get students started, engage them with questions:
    a. How might we utilize the grid in this file to our advantage? (e.g. locking it in a layer and drawing over it in a new layer)
    b. How might we accomplish on the laser cutter what we accomplish by scoring the lines with a ballpoint pen? (e.g. dashed lines)
6. Let students work, taking care to provide them with the specifications for the laser cutter (e.g. stroke size, color, etc.).
7. As students finish their assignment, go around and de-brief with them:
    a. What was the hardest about translating from a physical medium to a digital medium?
    b. Did you learn anything about your box from having to digitize it?

Extensions

Use these activities to extend the project or increase the challenge

Inner supports

- Challenge each student to create inner supports for their ball to stay in place. These supports can be embedded into the box or inserts that go into the box after the ball is inside.

Sales Pitch

- Give each group of students a target audience for the marketing of their packaging:
    - Young children, ages 6-12
    - Parents
    - Artists
    - Contractors
- Ask students to modify their packaging design for their intended audience. Focus on the branding, font usage, and graphics on the packaging.
- Have each group present their design variations to the class. Students should prepare a 60-second elevator pitch that includes how their design specifically caters to their target audience.

+/- a Face

- Challenge the students to make an enclosure that has one more or one less face than this standard, 6 faced cube. Students can make triangular enclosures or pentagonal enclosures around the Slam-O 3000.

Comments

Use this space to provide feedback and comment on this lesson

Packaging 6: To Color or Not to Color

AN EXPLORATION OF COLOR AND BRANDING

CHALLENGE

You are part of a packaging company and have been tasked with designing the new packaging for a new product that is going to be released soon: a new aerodynamic high performance tennis ball- the Slam-O 3000. The Slam-O 3000 is 10% yellower and has even more fuzz than it's competitors, so we are very excited for your packaging to help us sell this new and improved high-end product.

Your challenge today is to design a brand packaging out of two colors provided to you through cardstock.

STAGING

- Arrange desks to allow for groupings of 4 students who will work individually.
- Create groups of students and set out nametags at each desk.
- Set out 1 ruler, 1 ballpoint pen, 1 pair of scissors, and 1 straight edge per student. Do not pass out the glue until you've seen their boxes ready for gluing.
- Setup 2 Cutting Stations with X-Acto knives and self-healing mats.
- Place the Slam-O 3000 on the pedestal along with one sheet of each color.

RULES

1. You will work individually on your packaging.
2. Your package must fit on two sheets of cardstock.
3. All sides must be flat.
4. You must be able to insert and remove the Slam-O 3000 from your packaging.
5. You may use color or make cuts on any of the faces of the box.
6. You may not use tape but you may use glue.
7. Every fold must be scored with a pen.
8. You must use two colors of cardstock in your design.

MATERIALS

- 2 Sheets of color cardstock per student
- 1 Slam-O 3000 (tennis ball)
- 1 bottle of glue per group

TOOLS

Per student:

- 1 Ruler
- 1 Ballpoint pen
- 1 pair of scissors
- 1 Square

2 X-Acto knives in the Cutting Station

LEARNING OBJECTIVES

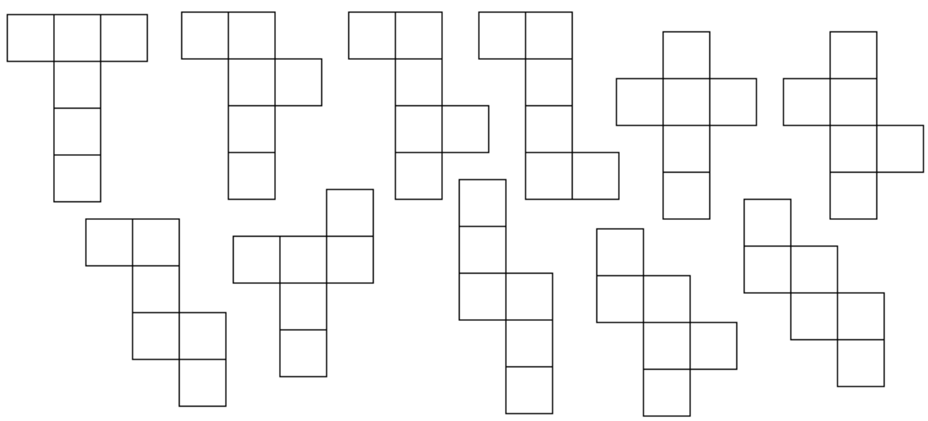
- To strategically combine multiple colors into one design.
- To include design features in accordance with a branding strategy.

SKILL OBJECTIVES

- To dimension and build a box out of cardstock.
- To build resealable lids with tabbing in the packages.
- To score lines in preparation for folds.

Reference Samples

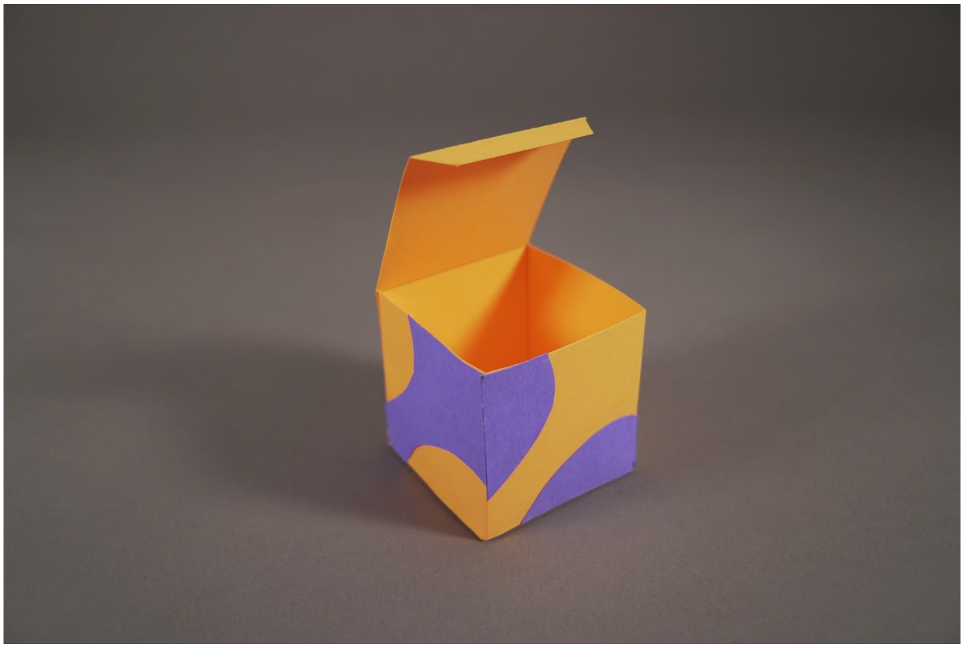
11 Layouts for a Cubic Box



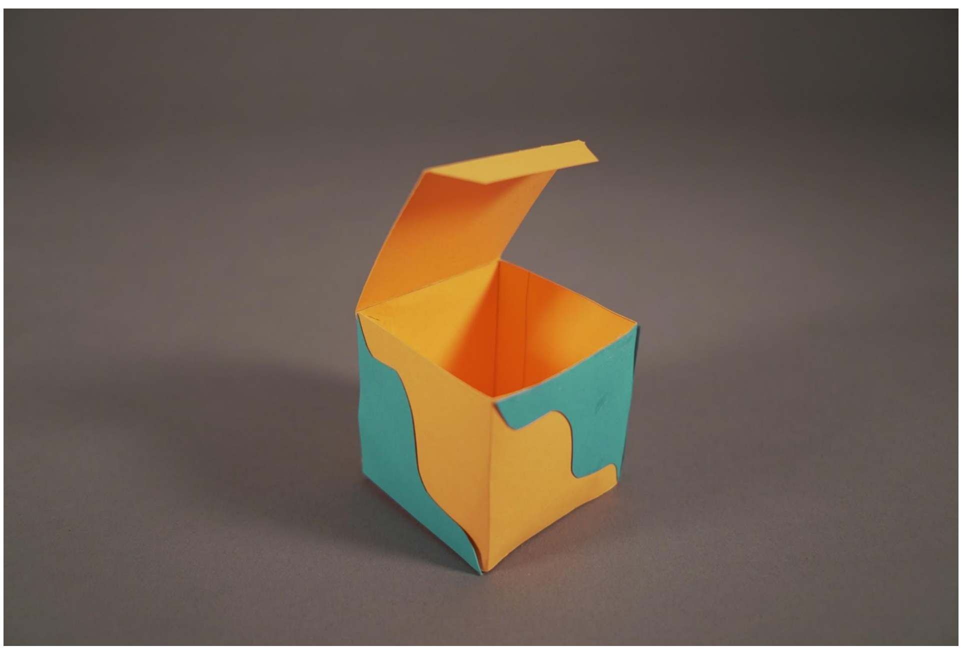
11 of the Possible Layouts that Assemble into a 6-sided Cube
(Source: http://www.onlinemathlearning.com/image-files/volume-of-a-cube_planificacao_cubo.gif)

Reference Samples

Example color boxes made out of two colors



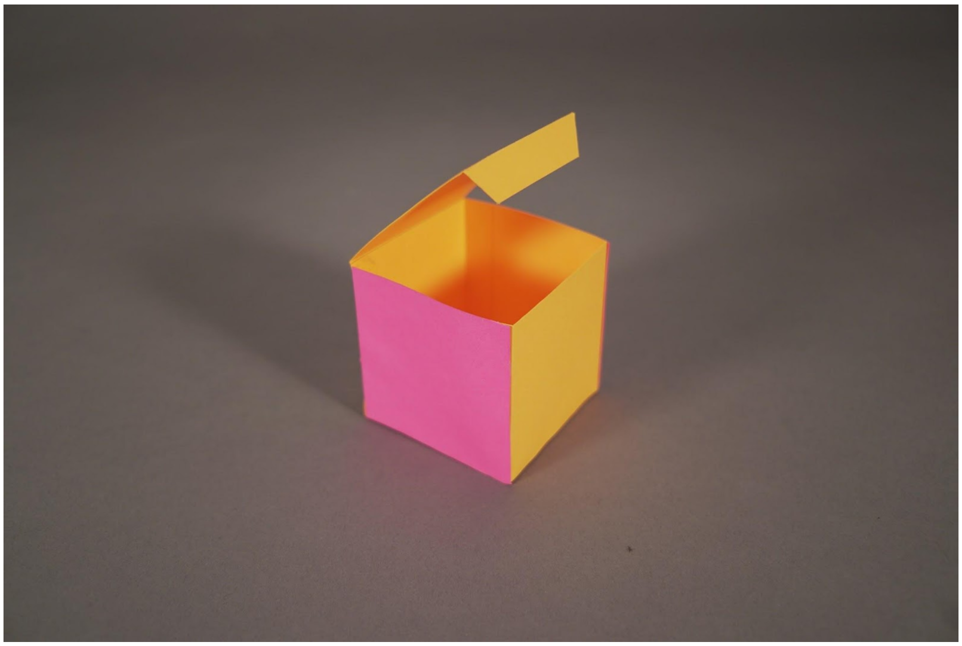
A purple-infused orange box with a design that plays with the positive and negative of the purple markings



A teal-infused orange box with a design that adjusts two halves of the same design

Reference Samples

Example color boxes made out of two colors



A pink-infused orange box with a monolithic design of an entire face made a different color

Procedures

Making a bi-color box.

1. When the students walk into the room, direct their gaze towards the Slam-O 3000 on the pedestal.
2. Present the Challenge and the Rules to the students. Call on a student to restate the Challenge and constraints.
3. "You can ask 2 clarifying questions."
4. Respond to two questions.
5. Have the students begin by sketching what they would like to design on the faces of the box.
    a. How many faces will be colored?
    b. What color will be used for which design feature?
    c. Is the color being applied to a structural feature or to a design feature?
6. Let students choose their two colors of cardstock. Since gridded cardstock is not provided in this project, the students will mark out and make their own boxes out of cardstock.
7. **Layout.** Have students choose a box layout that they are going to draw as a stencil on their cardstock. They should make sure to choose one that fits on the page. Ask them:
    a. Which of these 11 box layouts would fit in a 8.5" x 11" sheet of cardstock if our box has sides of 2.5"?
    b. Which of these would not fit? How do you know?
8. **First box, no tabs.** Have students measure out and cut out their first box out of a stencil. This box will not have tabs but will help them visualize where the box needs tabs for glue and tabs for opening and closing.

Scoring. As students begin to cut their box, remind them that every fold should be scored. That is, every tab that will be folded should be scored first by pressing hard with a ballpoint pen, in order to fold easier.

9. **Adding Tabs.** Using their first box to size, have students mark the sides of the box that need to have tabs, both for gluing together and for opening and closing. When done, they can unfold the box and see the markings of where the tabs go. Be sure that students are not mating tabs to tabs, but instead using just one tab at each junction.
10. **Second box, with Tabs.** Now, have the students re-make the box stencil, this time accounting for the 0.5" tabs that they decided they needed. Have students re-draw the stencil and cut it out, this time with the new tabs included. Ask the students:
    a. What are some possible designs for the tabs?
    b. What makes some designs better than others?
    c. What are some advantages of slanting the corners of the tabs?
11. Before giving them any glue, have the students show you how their tabbed box will go together- including how it will open and close for the ball to come in and out. When the box is satisfactory, give them a bottle of glue. Remind them to use the bottle frugally- not a lot of glue is needed.

Glue it together. Demo how to use small amounts of glue with the students. Show that you can squeeze a little and then use a piece of paper to spread the rest of the glue. Show that when you glue the tab together, you should press down on the tab in order to get a better hold.

12. Let students incorporate their colors onto their box. Some may need to use the X-Acto cutting station, others may not.
13. Once all the students are done, have a design critique at the pedestal. Put all the boxes near the pedestal in various groupings. Prompt the students to react to them:
    a. How are these similar?
    b. How are they different?
    c. Which grab your attention the most?
    d. Which make you curious to want to pick them up?
    e. Do any remind you of a different product?
    f. What words would you associate with these product packages?

Comments

Use this space to provide feedback and comment on this lesson

Packaging 7: Immovable Goods

AN EXPLORATION IN IMMOVABILITY

CHALLENGE
You are part of a packaging company and have been tasked with designing the new packaging for a new product that is going to be released soon: a new aerodynamic high performance tennis ball- the Slam-O 3000. The Slam-O 3000 is 10% yellower and has even more fuzz than it's competitors, so we are very excited for your packaging to help us sell this new and improved high-end product.

Your challenge today is to make an oversized box for the packaging. Then, you will make accompanying inserts for the box so that the product doesn't move inside.

STAGING
- Arrange desks to allow for groupings of 4 students who will work individually.
- Create groups of students and set out nametags at each desk.
- Set out 1 ruler, 1 ballpoint pen, 1 pair of scissors, 1 straight edge, and 2 sheets of cardstock per student. Do not pass out the glue until you've seen their boxes ready for gluing.
- Setup 2 Cutting Stations with X-Acto knives and self-healing mats.
- Place the Slam-O 3000 on the pedestal.

RULES
1. You will work individually on your packaging.
2. All sides must be flat.
3. You must be able to insert and remove the Slam-O 3000 from your packaging.
4. You may not use tape but you may use glue.
5. Every fold must be scored with a pen.
6. Your insert may be attached to the box or be removable.

MATERIALS
- 18" x 24" Cardstock sheets- 2 per student
- Slam-O 3000 (tennis ball)- 1 per group
- 1 bottle of glue per group

TOOLS
Per student:
- 1 Ruler
- 1 Ballpoint pen
- 1 pair of scissors
- 1 Square

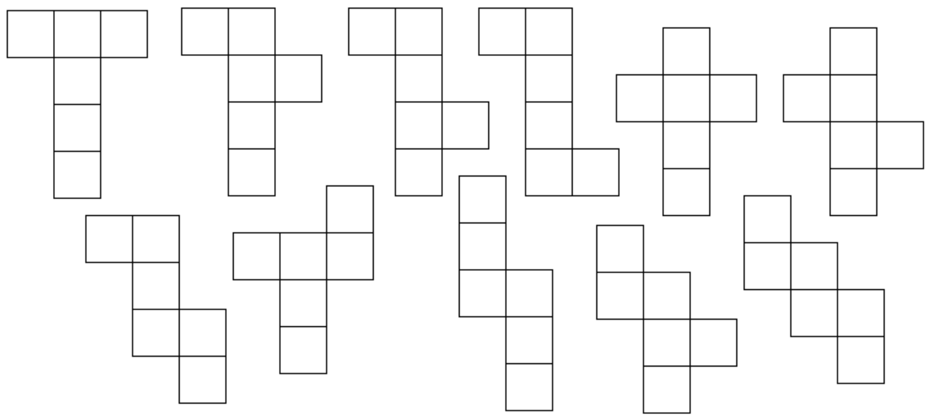
2 X-Acto knives in the Cutting Station

LEARNING OBJECTIVES
- To design a space-occupying insert for a box.

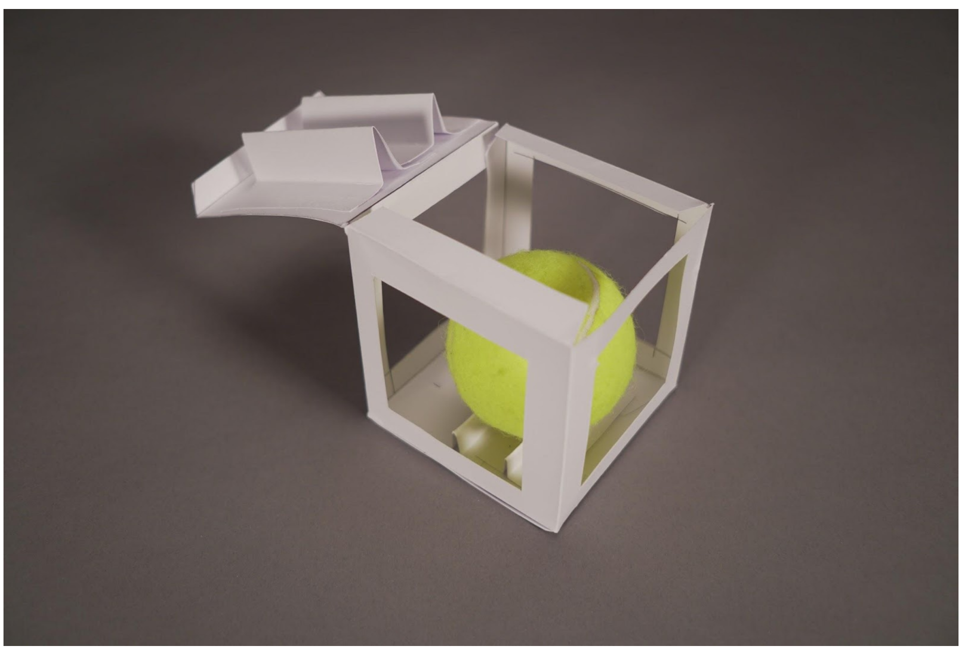
SKILL OBJECTIVES
- To dimension and build a box out of cardstock.
- To build resealable lids with tabbing in the packages.
- To score lines in preparation for folds.

Reference Samples

Stuff That Might Be Useful



11 of the Possible Layouts that Assemble into a 6-sided Cube
(Source:
http://www.onlinemathlearning.com/image-files/volume-of-a-cube_planificacao_cub
o.gif)

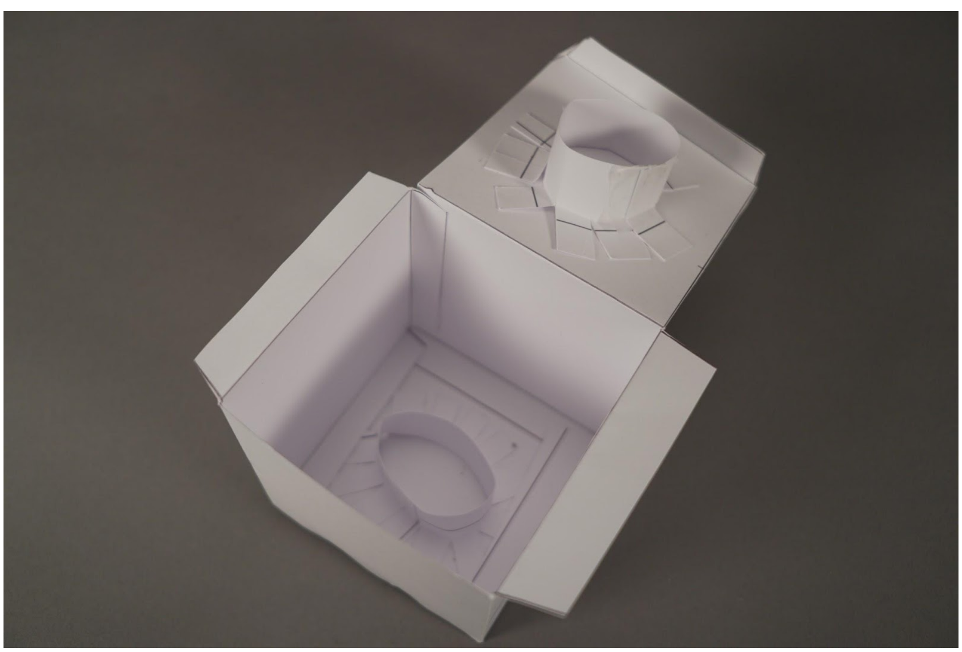


Example 1- Inserts attached to the box from top and bottom.

Reference Samples

Stuff That Might Be Useful

Example 2- Inserts attached to the box from the insides
Each side layers cardstock in different directions to let the ball give into the insert.

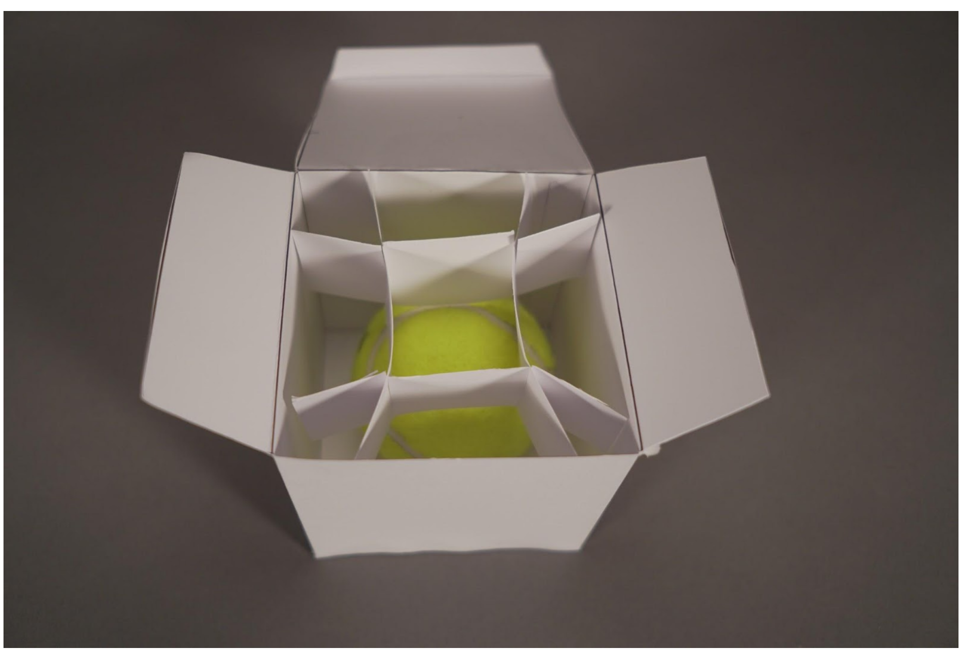


Example 3- Circular, tangential circles holding from the top and bottom.

Reference Samples

Stuff That Might Be Useful

Example 4- Rolled circular inserts at the corners with give.



Example 5- Insert that touches in a quadrilateral tangent at the top.

Procedures

This procedure has students create boxes that are oversized for the Slam-O 3000, and then create inserts for the box that will hold the ball in place.

1. Deliver the Narrative and the Rules.
2. “You have two questions”
3. Answer their two questions.
4. While gathered around the pedestal, lead with discussion:
    a. Why would a company make a package larger than its product?
    b. Do you have examples of this happening in other goods?
5. Tell the students:
   Now you will make a box for the Slam-O 3000 that is 3.5” on all sides. Choose a box layout to replicate. You will first make a box with no tabs and then, again, with tabs that will glue in.

Project the 11 box layouts (see Reference Sample above) on the board so the students can choose from them.

6. **Layout.** Have students choose a box layout that they are going to draw as a stencil on their cardstock. They should make sure to choose one that fits on the page. Ask them:
    a. Which of these 11 box layouts would fit in a 18” x 24” sheet of cardstock if our box has sides of 3.5”?
    b. Would any of these not fit? How do you know? (Note: All layouts should fit with no problem.)
7. **First box, no tabs.** Have students measure out and cut out their first box out of a stencil. This box will not have tabs but will help them visualize where the box needs tabs for glue and tabs for opening and closing.

Scoring. As students begin to cut their box, remind them that every fold should be scored. That is, every tab that will be folded should be scored first by pressing hard with a ballpoint pen, in order to fold easier.

8. **Adding Tabs.** Using their first box to size, have students mark the sides of the box that need to have tabs, both for gluing together and for opening and closing. When done, they can unfold the box and see the markings of where the tabs go. Be sure that students are not mating tabs to tabs, but instead using just one tab at each junction.
9. **Second box, with Tabs.** Now, have the students re-make the box stencil, this time accounting for the 0.5” tabs that they decided they needed. Have students re-draw the stencil and cut it out, now with the new tabs. Ask the students:
    a. What are some possible designs for the tabs?
    b. What makes some designs better than others?
    c. What are some advantages of slanting the corners of the tabs?
10. As students are working, engage them:

    a. What are you learning about working with tabs?
    b. What is one takeaway lesson from making your box stencil?
    c. Was anything harder than expected to make or replicate?
11. Before giving them any glue, have the students show you how their tabbed box will go together- including how it will open and close for the ball to come in and out. When the box is satisfactory, give them a bottle of glue. Remind them to use the bottle frugally- not a lot of glue is needed.

Glue it together. Demo how to use small amounts of glue with the students. Show that you can squeeze a little and then use a piece of paper to spread the rest of the glue. Show that when you glue the tab together, you should press down on the tab in order to get a better hold.

12. When the boxes are complete, de-brief with the students:
    a. What was the hardest part of making a box with tabs for glue?
    b. How does this box compare with your previous box that was to size and taped together?
    c. Is there anything that is not satisfactory about this box? How would you like to improve it?
13. Now have students design inserts for their box such that the Slam-O 3000 does not move when inside the box. Again, the inserts can be removable or attached to the box. As students are working have them try the inserts with the Slam-O 3000 at their table. Questions while they work include:
    a. What was your strategy for making the Slam-O 3000 immovable?
    b. How do you hope to secure it in place when inside the packaging?
14. As students finish, test how immovable the Slam-O 3000 packaging are. Take a few examples to the pedestal and de-brief the solutions with the class at the pedestal. Ask them to consider:
    a. Which of these solutions is the most robust? Which can you expect to work consistently correct as time passes?
    b. Which of these do you expect might fail?
    c. Which of these is the easiest to make?
    d. Do you recognize any of these from other examples of packaging?

Comments

Use this space to provide feedback and comment on this lesson