

3Dux|Design

Penguin and Polar Bear Ski School

Goal:

k-6 students will learn about and build a variety of simple machines in a winter-themed project.

Suggested Materials: (for up to 25 students working in teams of 3)

- 3DuxDesign GOBOX Classroom (k-2) **OR** GOBOX PRO (if doing LED Lighting)
- Build-a-Bot Accessory Set (if doing now monster bot activity)
- 3DuxDesign Machine Maker Accessory Kit
- 1 printed student worksheet and template per team
- Scissors
- Pencils, crayons, or markers
- Blank scrap paper

OR

- Cardboard
- Tape
- String
- Copper paper fasteners (or similar)
- Plastic straws
- 1" Pom poms
- 1 printed student worksheet and template per team
- Scissors
- Pencils, crayons, or markers
- Blank scrap paper

Optional: assorted crafts, scrap cardboard, extra batteries, tissue or shoe boxes, cardstock, masking tape, popsicle sticks, marbles, paper cups, wooden skewers, hole puncher, copper conductive tape, miniature LED bulbs, mini eccentric oscillating motor

Grades

k-6

Electrical lighting is recommended grade 3+

Snow monster bots are recommended for grades 3+

Time:

Expect 30 minutes of active build time per challenge plus extra if incorporating a read-aloud, suggested video resources below, and class discussion.

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Introduction:

For this project, it is important to discuss the first 3 challenges in advance as this will likely affect the ski school design process. Challenge 1 is the school design. Challenge 2 (see image below) is to build 3 different slopes (beginner, intermediate, and advanced skiers). The slopes will extend from the ski school structure so will need to be considered during the school design process. Challenge 3 will be to build a tow rope pulley system to bring skiers to the ski school rooftop. This will also need to be incorporated into the ski school design.

Challenge 1: Build a Ski School.

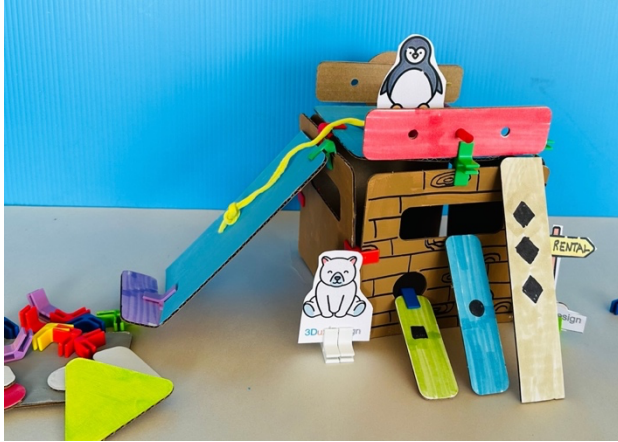
Learning goals: basic 3D modeling, engineering design.

1. Students should consider customer experience, navigating the facility, and being sure they have included key features needed (food, bathroom, rentals, shop).
2. Students will need to account for challenges 2 and 3 in the design, depending on how the project is broken up in class (in some cases, each student team may focus on a different feature).
3. Students should list essential structural elements and draft their designs before constructing.
4. Students will use an assortment of 5"x5"- 5"x10" cardboard pieces (plus a variety of other shapes) to construct a 3D building structure.
5. Students may also decorate and include interior components based on their design. Examples may include food, bathroom, warming station, first aid station, ski rentals, etc.
6. Students may also include structural features that will protect the school from extreme weather. (Optional extension: If you have access to a blow dryer or shake table, this would be a fun engineering and forces extension).

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Challenge 2: Slopes



Learning goals: slopes and inclines, frictional forces

1. Students will use cardboard and/or other craft materials to design and build 3 different pitched slopes. Each slope should begin at a different vertical height from the school structure but end at the same horizontal distance from the school. This way, each level has a different pitch. Advanced students may use the Pythagorean theorem ($a^2 + b^2 = c^2$) to calculate the length needed.
2. Students will use 1" round cardboard pieces (or other material of equal size) to test the differences in velocity of the "polar bear and penguin" traveling down the 3 slopes. Students should document their findings and be prepared to share. (Optional extension- use Google Sheets, excel or another app to create a table or graph).
3. For a student-friendly tutorial on slopes and friction:
<https://www.youtube.com/watch?v=N45lGUxAAC&t=141s>
4. Optional extension Students may also change the surface material (by adding smooth tape, sandpaper, etc.) and observe the effects of surface friction. For deeper exploration of slopes, friction, and the scientific method, refer to the Fun with Friction at the 3Dux Winter Park lesson plan.
<https://www.3duxdesign.com/pages/3duxuniversity-designchallenge-fun-with-friction>
5. Students should be prepared to share.

Challenge 3: Tow rope: wheel and axle / pulley system

Learning goals: wheel and axle, pulleys

1. For an introduction, students may watch the student-friendly video on pulleys (or lead discussion) https://youtu.be/W_vtKNPIrfg

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2. Watch the video on wheel/axles <https://youtu.be/6oFRxU4yaVo?t=1m0s>
3. Students will create their animal characters.

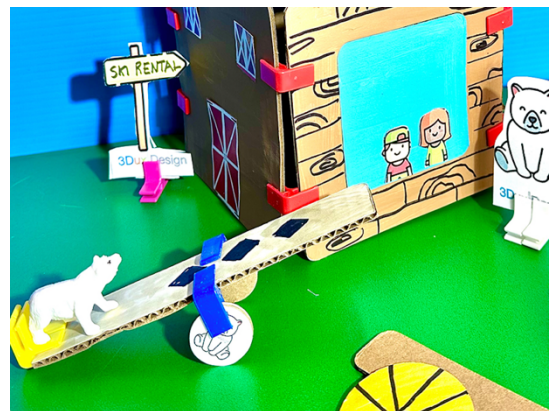


4. Students will design and draft plans for a pulley system that will attach to the penguin and polar bear characters and pull them up to the rooftop of the ski school.
5. Students will construct the tow rope, test it, and refine it until satisfied with the results. Ideally, the design will allow the characters to reach the top of the ski school in an upright position to avoid visits to the first aid tent!
6. Students should be prepared to share.

Challenge 4: Snowball Launcher

Learning goals: levers

1. Watch this student-friendly video on levers <https://youtu.be/9DtXBYtTPH8?t=1m19s>
2. Students will create snow monsters.
3. Students will design a catapult that will launch a pompom (or other soft object) to consistently hit the snow monster.
4. Students should explore and document how different lever lengths; fulcrum heights and positions affect the snowball behavior.
5. Students should be prepared to describe their project and findings.



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Challenge 5: Night Skiing and LED light circuits (grades 3+)

Learning goals: electricity and simple circuits, open and closed circuits

1. Review circuits for discussion: [bot facilitator guide p 9-12](#)
2. Students may use GOBOX PRO parts including LED bulbs, copper, alligator clips, and AA battery holder to draft an open circuit and with a conductive copper flap to close the circuit. For details on the design: https://www.3duxdesign.com/pages/designchallenge_led_lighting
Please note that an accidental short circuit (crossing the red and black leads without the bulb) can get very hot and cause burns.
3. **** If using lithium batteries, please note the warning of toxicity and risk of severe injury/death if accidentally ingested.
4. Students will build and test their design and on/off mechanism.

Challenge 6: Build a motorized snow monster-bot (grades 3+). This can also be done with a reindeer (or any character) theme.

Build-a-bot (facilitator's guide) – circuits, unequal forces, friction, and mass

<https://youtu.be/Vf7aKNqaznk?t=5m30s>

Reindeer-themed: <https://www.youtube.com/watch?v=kn-2TfPACR4>

Build-a-bot guide for kids

<https://www.youtube.com/watch?v=izyPLodqujl&t=21s>

https://www.tiktok.com/@3duxdesigneducation/video/7117794207850351915?is_copy_url=1&is_from_webapp=v1

Student teams will draft a design for their circuit including the motor.

Student teams will build and decorate their bots.

Optional extensions:

- a. Student teams may use a variety of craft materials to “train” their bot to travel in a straight line.
- b. Make ramps.
- c. Set up a racecourse.
- d. Using the snowball launcher, students may test their skills at hitting a moving target

More fun stuff:

Literacy-based Extensions:

1. Students may research and report on penguin and polar bear habitats: Sample student-friendly blog post <https://cimi.org/blog/polar-bears-penguins-are-polar-opposites/>
2. Explore and discuss the sustainability of ski resorts and sustainability:



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Ski slopes and sustainability:

<https://www.treehugger.com/ski-resorts-and-the-environment-1203969>

Efforts in the USA:

<https://rootsrated.com/stories/10-eco-friendly-ski-resorts-that-are-leading-the-way-for-sustainability-in-the-u-s>

Global efforts:

<https://www.nationalgeographic.co.uk/travel/2022/02/can-skiing-be-eco-friendly-heres-how-ski-resorts-are-upping-their-sustainability-game>

Video posing the problems:

<https://www.youtube.com/watch?v=dYU2QLNUexc>

video with options:

https://www.youtube.com/watch?v=fJqf4nGMy_A