

# Ski Jump STEM Activity- Corinne De Keukelaere

**Lesson Topic:** Physical Science

**Science Concepts:** Newton's Laws of Motion, Kinetic Energy, Potential Energy, Inertia, Friction, Distance

**Essential Questions:**

- What is the difference between potential and kinetic energy?
- What is meant by inertia and how would you change a ski jumper's inertia?  
How are Newton's 3 laws demonstrated by a ski jumper?  
How can you reduce friction to increase the distance a skier jumps?

**Objectives:**

- Students will research the country that they randomly pick to represent the country's colors and flag on their ski jumper
- Students will measure the distance traveled by the ski jumper after the ramp
- Students will design and build a ski jumper with skis that reflects their home country
- Students explain Newton's 3 law of motion and the difference between kinetic and potential energy

**Engage:** Ask students to initiate discussion such as:

- Can the design of skis affect how far a ski jumper can "jump" on a ramp?
- What are the colors and flags for different countries that compete in the Winter Olympics?
- What accessories/ enhancements can be used so the ski jumper can go the farthest distance and land standing up?

**Challenge Overview:**

The mission is to design a ski jumper to go down a ski jump and land on a ramp to travel the furthest distance. The ski jumper also will get style points for incorporating their countries colors and flag on their skis and uniform.

**Challenge Background:**

Ski jumping is an event at the Olympics and uses all of Newton's Laws to successfully go down the ramp and jump the furthest with the best style. Learn out the country and their colors for style points and design a ski jumper to go the distance. Get inspired by the [Olympic Theme Song](#) and watch a [ski jumper from GoPro](#).

## Standards:

- MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
- MS-PS3-2 Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
- MS-PS2-2 Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
- MS-PS2-4 Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

## Vocabulary:

<a href="#">Potential and Kinetic Energy</a>	Potential Energy: Stored Energy Kinetic Energy: Energy of Motion
<a href="#">Inertia</a>	Resistance of an object to change its velocities
<a href="#">Friction</a>	Resistance to motion between bodies in contact
<a href="#">Distance</a>	The space between two objects
<a href="#">Newton's Laws of Motion</a>	<b><i>Newton's First Law of Motion: An object at rest will stay at rest, and an object in motion will stay in motion unless a force acts on it.</i></b> <b><i>Newton's Second Law of Motion: Force equals mass times acceleration.</i></b> <b><i>Newton's Third Law of Motion: For every action, there is an opposite reaction and forces come in pairs.</i></b>

## Materials:

### Materials for student:

- 1 Straw
- 1 Pipe Cleaner
- Masking or scotch Tape/ rulers/markers/ scissors- 1 large piece cellophane tape
- Aluminum foil sheet
- 4 Popsicle Sticks
- Construction Paper
- Choice: Washers or pennies or paperclips (4)

### Teacher Preparation Materials

- Ramp with landing area as shown to right
- Metric meter stick
- Vegetable oil spray
- Data chart to keep track of distances and style points

Country	Jump 1	Jump 2	Jump 3	Style Points (-1, 0, 1, 2, 3)	Total: Best of 3 Style Points
Germany- Gavin, Ivan, Jackie	56	52	51	1	57 Gold
Norway- Kaitlyn, Jaxon	23	27	25	2.5	29.5
Sweden- David, Chase, Eddie	23	15	27	2	29
Canada- Sadie, Anthony	36.5	45	42	3	46 Silver
ROC- Halley, Sam, Abigail	41	35	41	2	43
Netherlands- Kayla, Brady, Emily	36	42	40	1	43 Ski off Bro



## Lesson Outline:

Day 1 Initiation 15-20 min)	Teacher Tasks	Student Tasks
	<p><b>Identify the Problem:</b></p> <p>Get inspired by the <a href="#">Olympic Theme Song</a> and watch a <a href="#">ski jumper from GoPro</a>.</p> <p>Ask students to initiate discussion such as:</p> <ul style="list-style-type: none"> <li>• Can the design of skis affect how far a ski jumper can "jump" on a ramp?</li> </ul>	<p>Individual:</p> <p>Write down ideas to questions in notebook</p> <p>Group:</p> <p>Share ideas in small groups and display on <a href="#">Jamboard</a> for class</p>

	<ul style="list-style-type: none"> <li>• What are the colors and flags for different countries that compete in the Winter Olympics?</li> <li>• What accessories/ enhancements can be used so the ski jumper can go the farthest distance and land standing up?</li> </ul>	discussion
<p><b>Day 1</b> <b>Conceptual Model</b> <b>(20-30 min)</b></p>	<p><b>Brainstorm:</b> Prepare materials to show students: <b>Conceptual Model- plan your ski jumper with these materials:</b></p> <ul style="list-style-type: none"> <li>• 1 Straw</li> <li>• 1 Pipe Cleaner</li> <li>• Masking or scotch Tape/ rulers/markers/ scissors- 1 large piece cellophane tape</li> <li>• Aluminum foil sheet</li> <li>• 4 Popsicle Sticks</li> <li>• Construction Paper</li> <li>• Washers or pennies or paperclips (4)</li> </ul> <p><a href="#">Pick counties randomly for each group to research</a></p> <p><a href="#">Countries in Winter Olympics</a> <b>Introduce Vocabulary:</b> <a href="#">Potential and Kinetic Energy</a> <a href="#">Inertia</a> <a href="#">Friction</a> <a href="#">Distance</a> <a href="#">Newton's Laws of Motion</a></p>	<p>*You will get a country- the ski jumper has to show the colors/ flag of the country &amp; a person on either skis or snowboard. In Design notebook : As a group, discuss ideas &amp; then draw conceptual models. Research your country to add to the design.</p>
<p><b>Day 2: 20-30 minutes</b></p>	<p><b>Design:</b> Give the students the prepared materials once their conceptual model is finished. Visit groups to discuss designs and monitor progress.</p> <p><b>Test &amp; Evaluate:</b> Have the track set up with a meter stick at the end of the jump to see how far the skier travels. The skier must be upright when landing and the front of the skis is the measurement point.</p> <p>Monitor students and ask questions about the</p>	<p>Use materials given to design your skier and then test the distance traveled on the ski jump Constraints:</p> <ol style="list-style-type: none"> <li>1. Only materials in the bag can be used</li> <li>2. There must be a skier on the skis or snowboard</li> <li>3. Th counties colors/ flag get style points to be added to distance</li> <li>4. Record distances in a design notebook.</li> </ol>

	differences between potential and kinetic energy and what Newton's Laws are demonstrated.	
<b>Day 2</b> <b>15-20</b> <b>minutes</b>	<b>Redesign</b> Students can adjust design and add to their uniform for style points. Skier should be ready for competition the next day.	Using only the materials given and a practice spray of vegetable oil any adjustments can be made to jump the furthest distance. Color and flags can be added for style points. Skier needs to be ready for competition the next day. Record changes in design notebook.
<b>Day 3 (15-20 minutes depending on number of groups)</b>	<b>Share the Solution:</b> Competition Day: Students get one spray of vegetable oil. The students can start the skier from any point on the jump. Best of 3 distances measured by the student. Record the distances in a shared class document. Up to 5 points which adds to distance for style points based on the creativity using colors and flags to represent the country.  Share reflection questions	<b>Competition Day:</b>  1 spray of vegetable oil if desired. 3 trials with the furthest distance recorded 0- 5 style points for creativity using colors and flags to represent the country  Answer reflection questions in design notebook

### Reflection Questions:

1. Where did you have the most potential energy on the ski jump and how did increasing potential energy change the kinetic energy?
2. Pick one of Newton's Laws and explain how your skier demonstrated the law
3. What is inertia and how did you change the inertia of your skier?
4. What were some of the ways you reduced friction to increase the distance your skier jumped?

**Assessments:**

**Score for Group**

Country	Jump 1	Jump 2	Jump 3	Style Points (-1, ),0, 1, 2, 3,4, 5)	Total: Best Jump + Style Points
Germany-					Gold
Norway-					
Sweden-					
Canada-					Silver
ROC-					
Netherlands-					Ski off Bronze

**Individual Rubric for Activity:**

Task	Gold Medal	Silver Medal	Bronze Medal
Participation	Excellent- leader- encouraged all country mates.	Good- worked with country mates but ventured to other countries	Ok- worked a little but mostly was at the Olympics to socialize`
Design & Testing	Excellent- team really planned and practiced in order to redesign and go for the gold	Good- more time is needed to design and practice in order to redesign to get the gold	Ok- More effort is need to design and practice in order to redesign to create the best ski jumper
Reflection Questions	Excellent- answers the 4 reflection questions with great detail and examples from what they discovered from their ski jumper. Really trained hard and got the gold!	Good- answers the 4 reflection questions. More detail needed to get the gold and explain the science concepts.	Ok- More training is needed to successfully answer the reflection questions

