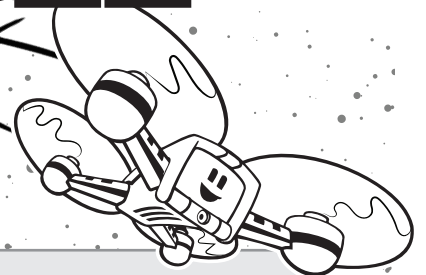
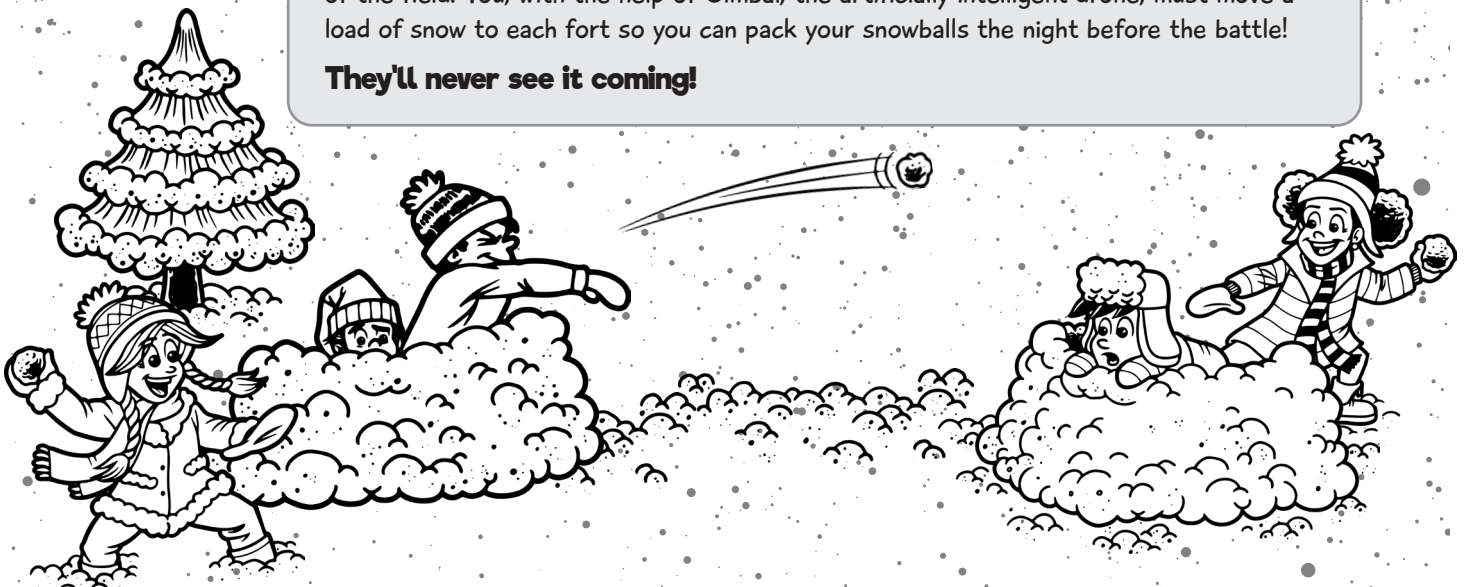


SNOWBALL FLIGHT

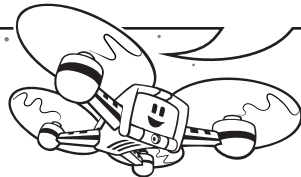


Fresh snow, perfect for packing into snowballs, has fallen over your town. You and your friends challenge a group of neighborhood kids to a snowball battle! Your team's strategy is to be more prepared than your opponents. You create four forts from where you'll lob your snowballs. The problem is that most of the snow is piled up in the middle of the field. You, with the help of Gimbal, the artificially intelligent drone, must move a load of snow to each fort so you can pack your snowballs the night before the battle!

They'll never see it coming!



Hey! Look at this snowflake! No matter which way I turn it, it looks the same! Maybe my AI can explain why and help us learn more!



AI Prompt: Why are no two snowflakes the same and how do we know?

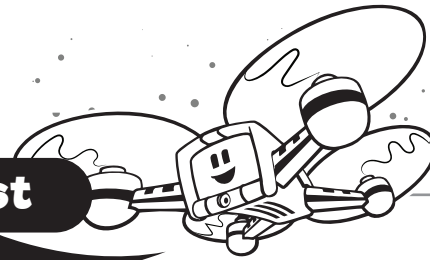
AI Response:

In the late 1800s, Vermont farmer Wilson "Snowflake" Bentley discovered that no two snowflakes are alike AND almost all of them are symmetrical! Symmetrical means an object has two matching halves that look exactly the same. Using **photomicrography**, Bentley looked very closely at over 5,000 individual snowflakes (snow crystals). Documenting each of these crystals, he made a discovery that led to advances in the science of meteorology.

photomicrography: a picture of a microscopic object



SNOWBALL FLIGHT



Materials List

Materials needed:

- Tello Drone*
- At least 2 fully charged batteries
- 4 boxes, bowls, or baskets
- Roll of tape
- Ruler or yardstick

Optional:

- A lightweight ball (like a ping pong ball) for flipping.**
- Saddle cup for Tello Drone.***

Download the following 2 apps onto each of the Android or iOS devices you will be using.

- **Tello flight app**
- **DroneBlocks coding app**

Note: As of 9-1-2023, the Android version of the Tello flight app is not available on the Google Play Store. It must be downloaded and installed on your Android device using the link on this page. If you are using school-issued devices, your IT department may need to approve the download. If you experience any issues, email support@dronelegends.com. We're here to assist you.



Tello flight app

<https://www.dji.com/downloads/djiapp/tello>



DroneBlocks coding app

iOS (Mac - iPad) – <https://shorturl.at/sIW26>

Google Play (Android) – <https://shorturl.at/axDM2>

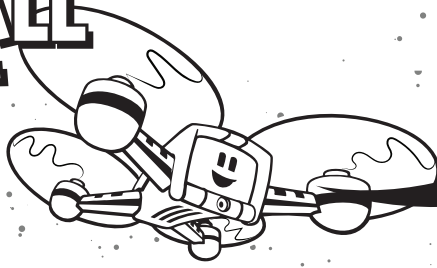


*This mission is specifically designed for use with a Tello Drone. If you do not own a Tello drone, you can purchase one here: <https://a.co/d/2zoTipJ>

**As a lightweight ball, mini rubber hedge balls work best. You can find them here on Amazon: <https://amzn.to/49TZxHQ>

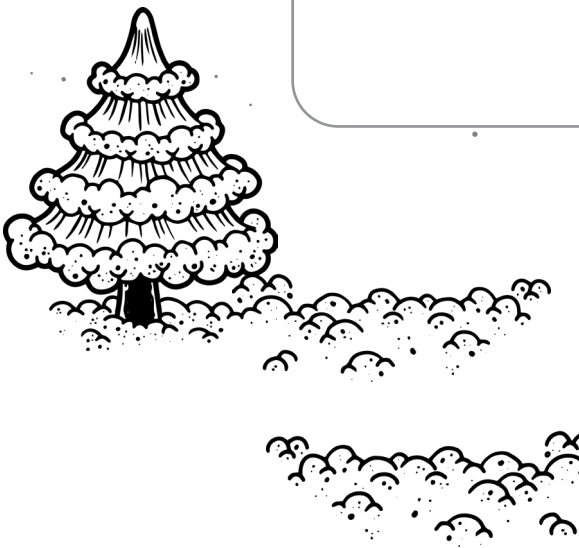
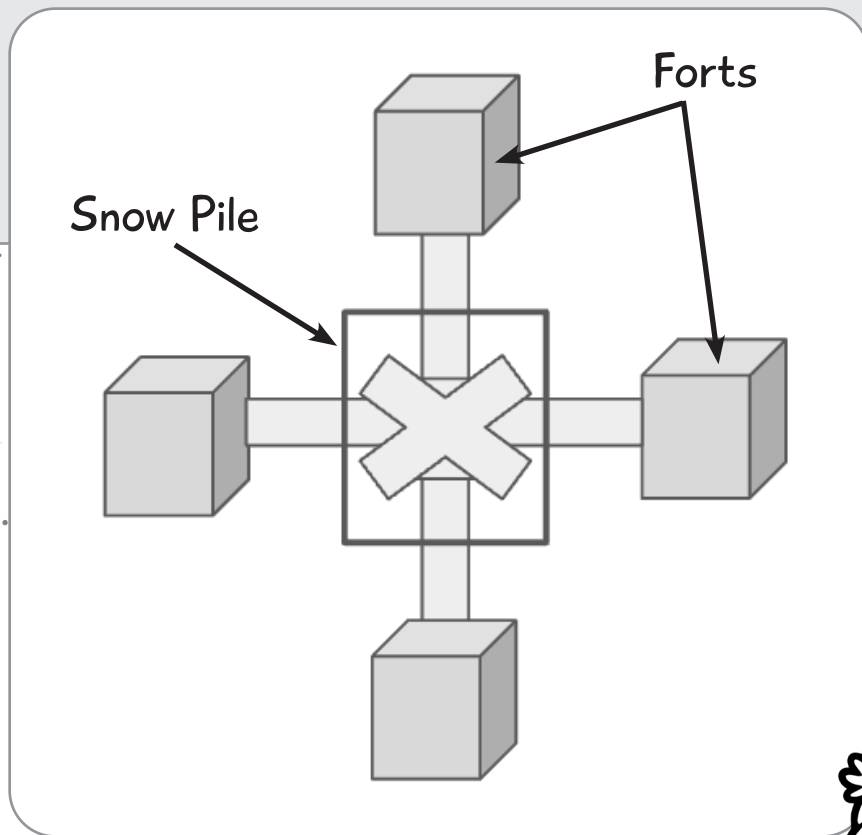
***If you have access to a 3D printer, you can print your own saddle cup that attaches to a Tello Drone: <https://bit.ly/3T26EYT>

SNOWBALL FLIGHT



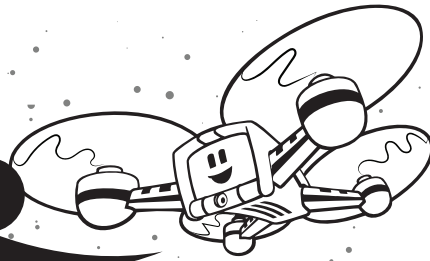
Time to Build

Luckily, no one else is at the field right now! You and your team need to build your forts and mark the snow pile before the others show up. Use tape to create a square to mark the snow pile in the middle. The snow pile will be both your launch pad and your landing pad. Mark an X in the center of it with tape. Use tape to create equally long paths from the snow pile out to each of the four forts as shown in the diagram. Your forts can be made out of any open containers like boxes, bowls, or baskets! Measure the distance from the landing pad to each fort, and make sure the distances are all the same.

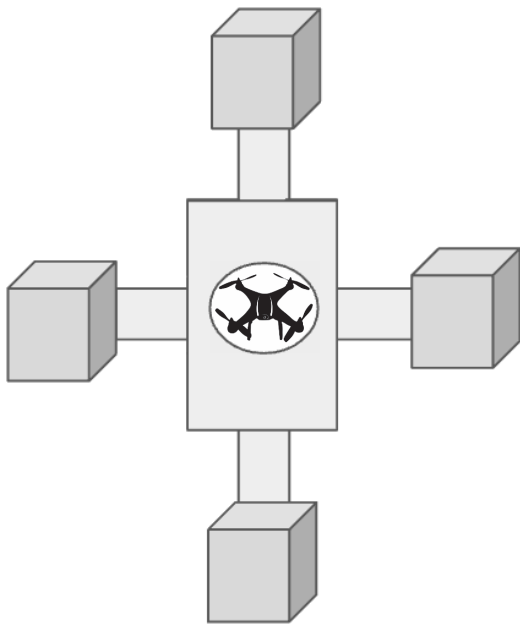


SNOWBALL FLIGHT

Time to Fly



Time to get the snow to the forts! If you have a clip-on saddle or cup, place it on the top of DJI Tello. Put a ball (we'll pretend it's snow!) in it before you place your Tello on the launch/landing pad. If you don't have a saddle cup attachment, you can create your own or just do the flips without launching anything into the forts.



STEPS:

1. Place the Tello on your launch pad facing any of the forts.
2. Review the safety tips.
3. Take off and fly forward until you reach a fort.
4. Flip your load of snow into the fort. (NOTE: The Tello will not flip if the battery is at or below 50%.)
5. Fly backward to return and land on the field to get your next load.
6. Take off, **yaw** 90 degrees right (or left), and fly to the next fort to deliver your load.
7. Repeat this process until snow has been delivered to all 4 forts.
8. Return and land on the landing pad when you are done.

Optional Challenge:

Leave plenty of extra room around your flight space to attempt this challenge!

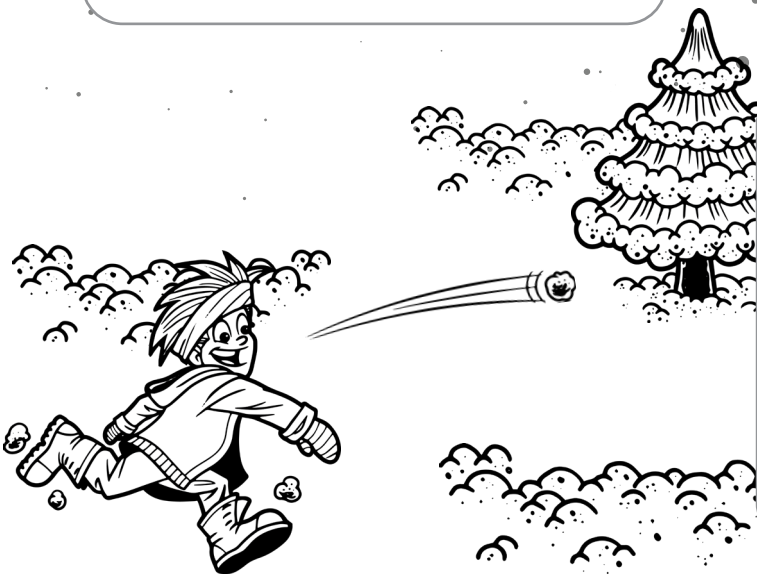
Use the circle flight mode in the Tello flight app to fly in a circle and record a short video of how much snow is left in the middle of the field.

Estimate the radius of the circle your drone flew.

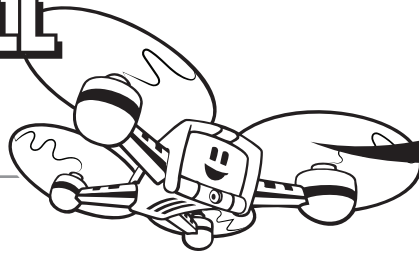
yaw: rotate aircraft left or right

Safety Tips:

- Pull back and secure long hair.
- Make sure the Tello's propellers are securely fastened and in good condition.
- If possible, have a visual observer walk with the drone as it's flown to warn the pilot of obstacles.
- Avoid collisions.
- Don't pick up the Tello until it has come to a complete stop.



SNOWBALL FLIGHT



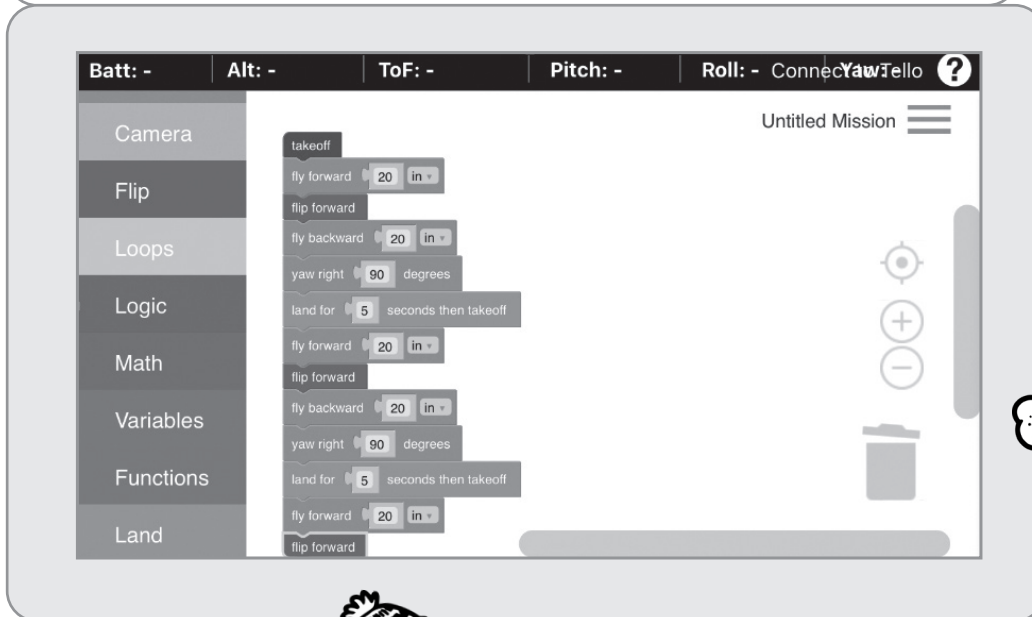
Time to Code

You did an amazing job flying the snow to the forts, but time is running out, and everyone else on your team is busy making the snowballs. Let's get even more snow to each fort by writing code for the drone to handle the job **autonomously**! Open the DroneBlocks app, follow the example code shown here, or make up your own!

See how to connect the Tello to DroneBlocks here: <https://bit.ly/3SYtIHX>

HINT: Measure the distance from the landing pad to a fort. Use your measurements to write a code to fly the mission autonomously.

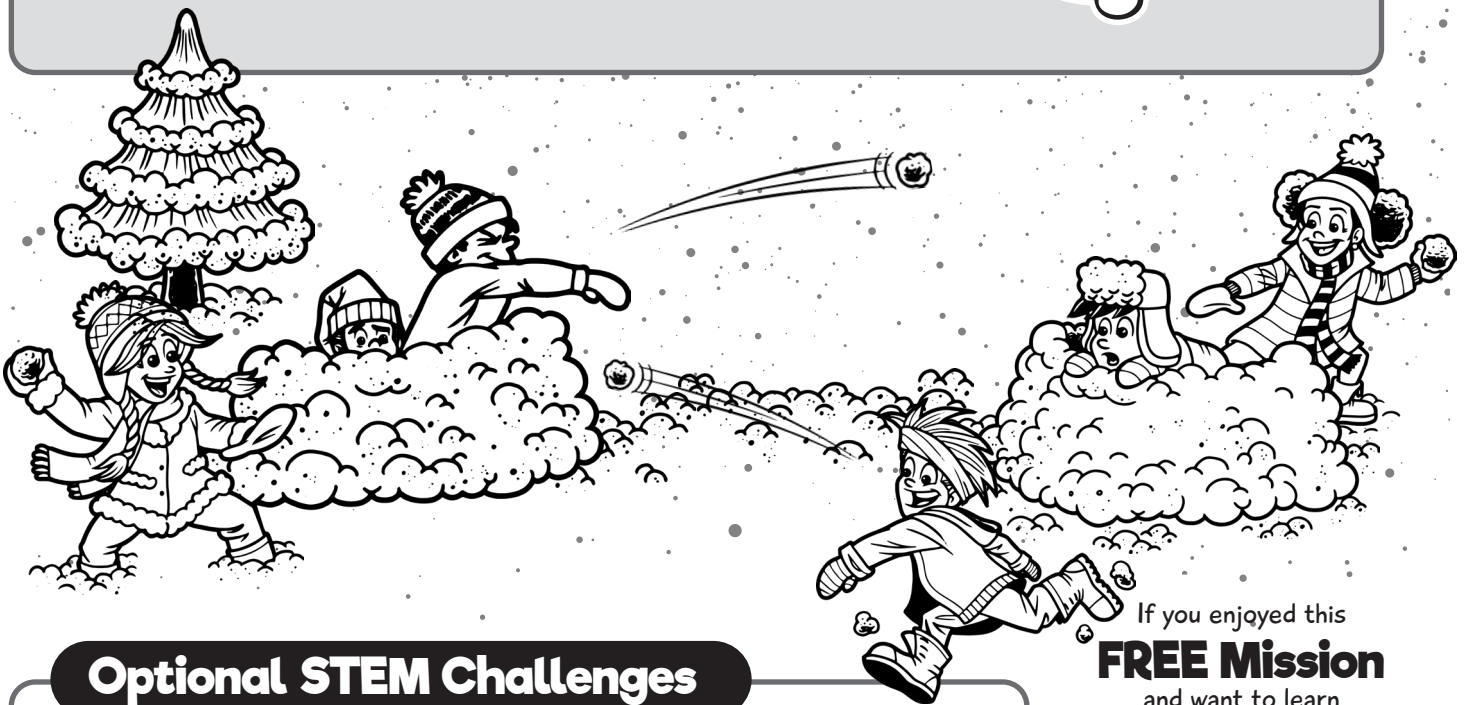
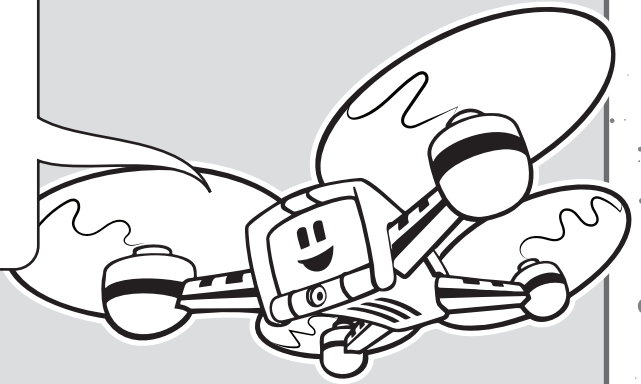
autonomously: able to fly by itself without human piloting



SNOWBALL FLIGHT

Wrap Up

Snowflake Bentley said, "Every crystal was a masterpiece of design, and no one design was ever repeated." The same is true for us. Each one of us has a special design with our own unique qualities and ideas. Just like snowflakes, no two people are exactly alike. Everyone has different strengths and talents. We can celebrate our uniqueness and remember that we are all legendary in our own special way!



Optional STEM Challenges

Science Challenge:

Investigate the symmetry of snowflakes.

Technology Challenge:

Refactor your code using loops to take 5 loads of snow to each fort.

Engineering Challenge:

Find something else that you can use to represent snowballs and try filling your saddle with them. What properties of "snowballs" work well to flip? What doesn't work well? How can you redesign your snowballs to work better?

Math Challenge:

Make a symmetrical snowflake with 6 sides and one with 8 sides. How many times can you rotate each one before you get back to the original orientation?

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FREE Mission
and want to learn
how to bring the
**Drone Legends
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or your classrooms,
email us at
[info@dronelegends.com!](mailto:info@dronelegends.com)

