

# Dina the Monster Bee

## PART A: Making a Model of Sweeta the Honeybee

Working as a group, you will make a model of Sweeta the Honeybee. Use heavy construction paper (card stock, manila, cardboard, etc) to make the bee model. Sweeta is the approximate size of a natural honeybee. Her body is made of four rectangular strips 3 cm x 2 cm that are taped together to form a rectangular cylinder with openings at either end.

Cover one end with a 2 cm x 2 cm piece that represents her head (okay, she has a flat head, but you can draw on it to make it more realistic). Tape it to cover the opening

Cover the other end with a 2 cm x 2 cm piece that represents her tail (okay, she has a flat tail, but that's better than getting stung). Tape it to cover the opening.

Attach two wings made of paper each 2 cm by 3 cm.

Insects breathe through holes in the surface of their bodies. To do this, they need to have more surface area than volume (more places for air to come in than all the places in the body that need to get air). To make sure that Sweeta can live, we will need to calculate the ratio of the surface area of Sweeta's body to the volume of her body.

Measure the total surface area of the bee, not including the wings. Enter your measurements and calculations here:

Sweeta's total body surface area =

Calculate the volume of Sweeta's body. Enter your measurements and calculations here.

Sweeta's total body volume =

Divide the surface area by the volume:

If your answer is greater than 1, then Sweeta has enough surface area to bring in air for her body. If your answer is less than 1, Sweeta is in trouble.

Will Sweeta have enough air?

Sweeta also has to fly. The surface area of her wings has to be large enough to generate the lift to raise her body. Measure the total surface area of Sweeta's wings. Enter your measurements and calculations here:

Sweeta's total wing surface area =

To be able to fly, the ratio of the surface area of the wings to the volume should be at least 0.5.

Divide the wing surface area by the body volume:

If your answer is greater than 0.5, then Sweeta has enough surface area in her wings to lift her body and fly. If your answer is less than 0.5, Sweeta cannot fly.

Will Sweeta be able to fly?

## **PART B: Making Dina the Monster Bee**

Working as a group, you will make a model of Dina the Monster Bee. Use heavy construction paper (card stock, manila, cardboard, etc) to make the bee model. Dina is ten times size of a natural honeybee in every direction. Her body is made of four rectangular strips 30 cm x 20 cm that are taped together to form a rectangular cylinder with openings at either end.

Cover one end with a 20 cm x 20 cm piece that represents her head. Tape it to cover the opening

Cover the other end with a 20 cm x 20 cm piece that represents her tail. Tape it to cover the opening.

Attach two wings made of paper, each 20 cm by 30 cm.

Insects breathe through holes in the surface of their bodies. To do this, they need to have more surface area than volume (more places for air to come in than all the places in the body that need to get air). To see if Dina can live, we will need to calculate the ratio of the surface area of Dina's body to the volume of her body.

Measure Dina's total surface area, not including the wings. Enter your measurements and calculations here:

**Dina's total body surface area =**

Calculate the volume of Dina's body. Enter your measurements and calculations here.

**Dina's total body volume =**

Divide the surface area by the volume:

If your answer is greater than 1, then Dina has enough surface area to bring in air for her body, and she will have enough energy to attack us. If your answer is less than 1, we are safe from Dina the Monster Bee.

Will Dina have enough air?

Dina also has to fly. The surface area of her wings has to be large enough to generate the lift to raise her body. Measure the total surface area of Dina's wings. Enter your measurements and calculations here:

**Dina's total wing surface area =**

To be able to fly, the ratio of the surface area of the wings to the volume should be at least 0.5.

Divide Dina's wing surface area by the body volume:

If your answer is greater than 0.5, then Dina has enough surface area in her wings to lift her body and fly. If your answer is less than 0.5, we don't have to worry about the Dina the Monster Bee.

Will Dina be able to fly?

Do you think that scaling up in size just involves getting bigger and bigger, or do other things change when you scale up in size? Explain your answer.