

African penguins like these are endangered in the wild.

Picky Penguins

Biologists engineer artificial nests to protect rare African birds

African penguins stand only 50 centimeters (20 inches) tall. But the little birds have big personalities. Waddling around their large colonies, they honk loudly at

each other. Like people, each penguin has a unique voice.

The penguins live along the southern coast of Africa (see *Coastal Living*, right). Like penguins that live in Antarctica, they hunt fish in the ocean and lay eggs on

land. But African penguins have a problem. Years of environmental change have left them no safe place to nest.

A global team of scientists wants to help. They're designing artificial nests to protect African penguins. But that's

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MARTIN HARVEY/GALLO IMAGES/GETTY IMAGES (GUANO BURROW); KEVIN GRAHAM, DALLAS ZOO (ARTIFICIAL NEST); JIM MCMAHON (MAP)

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Guano burrows once provided shade and shelter for penguin families.

Scientists hope artificial nests can protect penguins now that most of the guano is gone.

not easy. People have tried building nests before, but the penguins didn't use them. The nests often got too hot.

"We're going about it more scientifically this time," says Kevin Graham. He's a biologist at the Dallas Zoo in Texas. He and three other scientists are leading the project to develop the penguin homes. Over the past two years, they've tested 15 designs to find the perfect fit.

Underground Homes

African penguins used to nest by burrowing into a thick layer of **guano**, or bird poop. The guano came from the penguins and from seabirds overhead. Over hundreds of years, it had built up into a layer 3 meters (10 feet) deep.

The penguins used their feet and bills to dig small tunnels in the guano. Then they carved out burrows and laid their eggs

inside. These guano nests were perfect for penguin families. They shielded eggs, chicks, and their parents from the hot sun. The tunnels kept out

seagulls and other predators that eat penguin eggs.

But in the 1860s, people began collecting the guano to use as fertilizer for farms. By

Coastal Living

African penguins nest along the southern coast of Africa. They swim in the surrounding waters to hunt fish.



Think: What human activities might affect the environment where African penguins live?

Testing Nests

Scientists tested 15 artificial nest prototypes. They placed them in the sun near the coast of South Africa and monitored the temperature inside. Here's how four of the prototypes performed.

REJECTED



A dome covered in crushed rock became too hot inside for penguin eggs.

REJECTED



A dome with soil and plants on top stayed cooler but was still too warm.

FINALIST



This tube-shaped nest had holes on top for ventilation. It stayed cool.

FINALIST



A sloped design with vents on top and in back was another success.

Think: Why did the scientists first test the prototypes without penguins inside?

1900, almost none was left. “It’s like if I came and bulldozed your neighborhood,” says Trudi Malan. She works with penguins in South Africa and leads the nest project there.

Without guano to nest inside, the penguins now lay their eggs out in the open. But that means the penguins often get too hot. If the parents leave the eggs to cool off in the water, predators can easily snatch the eggs.

The lack of safe nesting spots is one reason African penguins are now **endangered**. Millions of them used to live in southern Africa. Now only about 25,000 pairs of nesting birds are left.

Field Tests

The artificial nest project kicked off in 2016. First the scientists came up with **criteria** for their design. The nest had

to protect penguin eggs from predators. It couldn’t flood in the rain. And it needed to keep penguin families cool.

The scientists built 15 nest **prototypes**. Each was a hutlike structure that a penguin could lay eggs inside. But the sizes, shapes, and materials were different.

Malan helped test these prototypes in South Africa. Scientists placed the nests in the sun and measured the temperatures inside.

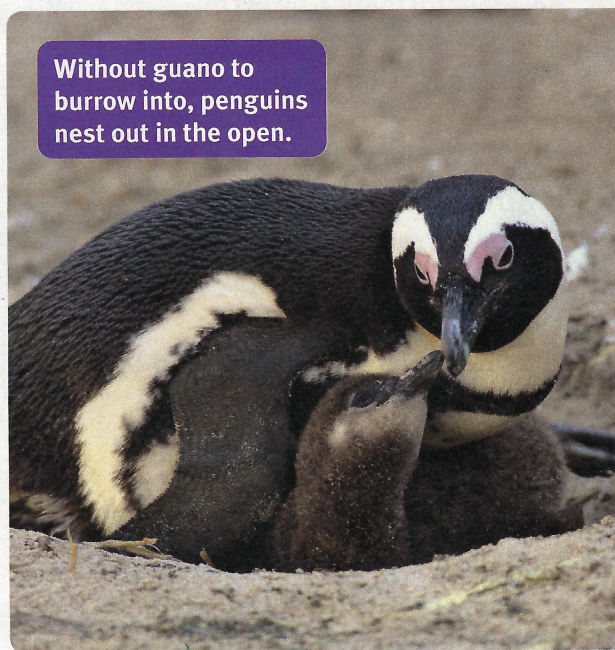
Some nests did better than others (see *Testing Nests, above*). Several got far too hot. But two prototypes really stood out. One was a simple tube shape. The other had

a sloped ceiling, like a guano burrow. Both had vents to let air flow through. It was time to see what the penguins thought.

Ready for Action

This past summer, the scientists tested the two best

Without guano to burrow into, penguins nest out in the open.



nests on African penguins at U.S. zoos. Now they're placing the nests in four colonies in South Africa to let wild penguins try them out. "Our **hypothesis** is that penguins will prefer the sloped design that mimics a guano nest," says Graham.

For several weeks, the scientists will watch to see where the penguins lay their eggs. The birds may even like both designs. "Penguins are individuals," says Graham. "Some of them like a little variety in their life."

The scientists plan to build more than 2,500 of whichever nests the penguins prefer. They'll set them up in penguin colonies all around South Africa. Malan hopes the new nests will help the endangered birds bounce back. "I think we've got a good shot," she says.

—Katie Peek

words to know

colony—a group of the same organisms living together

guano—seabird or bat droppings that have accumulated over time

endangered—at risk of becoming extinct, or dying out

criteria—the standards that a design must meet to be considered successful

prototype—an early version of an invention that is tested and improved

hypothesis—a prediction of results based on previous knowledge and evidence

Egg Defender

Can you design a safe penguin nest?



OBSERVE: African penguins used to nest in guano. Without it, they have no safe place to lay eggs. Scientists are trying to help by building artificial nests.

DEFINE THE PROBLEM: Can you design an artificial nest that meets the following criteria?

① It fits two eggs. ② It has an opening between 45 cm and 50 cm tall—big enough for a penguin to duck into but not a seagull. ③ The temperature inside rises no more than 5°C after 30 minutes in the sun.

MATERIALS: two plastic eggs • building materials such as cardboard, poster paper, foil, and cotton balls • 60-by-60-cm square of cardboard • scissors • tape or glue • thermometer • ruler • timer • paper and pencil

DESIGN A SOLUTION:

1. Examine the eggs and your building materials. Review the criteria above. Think about which materials would best keep the eggs cool and safe.

2. Draw a plan for your nest design. Label the materials you plan to use and what the dimensions of the nest will be.

3. Build your design. Use the cardboard square as a base.

When you're done, have your teacher cut a small slit in the top of the nest.

4. Move your nest into direct sunlight. Place the eggs in the nest. Slide the thermometer through the slit so that the bulb is inside the nest but you can read the temperature from the outside. Record this temperature.

5. Wait 5 minutes, then record the temperature again. Repeat every 5 minutes until 30 minutes total have passed.

6. After 30 minutes, analyze your results. Did your nest meet all the criteria?

CONCLUSIONS:

1. How did the materials you chose help your nest meet the criteria? If it didn't meet them, what do you think went wrong?

2. If you were building a real penguin nest, what other criteria would you need to consider? Use evidence from the article in your answer.

→ **TAKE IT FURTHER:** Compare your design with those of your classmates. Did you get ideas to improve your nest? Change your nest, then test it again.

STEP 4

