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ALEXA WELCH EDLUND/TIMES-DISPATCH

Aerospace engineer Patty Howell holds a section of a space shuttle protective panel as Bill Winfree heats it with a quartz light for an infrared-camera demonstration at NASA's Langley Research Center.

Making shuttles safer

Camera can help an astronaut see cracks and impact damage

BY ABBY VOGEL
Times-Dispatch Staff Writer

HAMPTON

Scientists at NASA's Langley Research Center have developed a system to help spacewalking astronauts see if there is potentially critical damage to the shuttle wing's leading edge.

Researchers adapted an existing thermal camera — about the size of a tissue box — to see cracks and impact damage.

Damage to these panels from flying foam insulation from the external fuel tank caused the shuttle Columbia to break apart in 2003. NASA has been testing ways to find such damage and how astronauts could repair it in orbit.

"This is the only technique we have to look at such types of damage," said aerospace engineer Patty Howell. "They have a visible camera and a 3D laser, but they are not going to detect [invisible] damage, they will only detect surface damage."

Thermal imaging, also known as infrared imaging, is used in applications such as night-vision goggles, when someone wants to see objects invisible to the human eye. This technology captures light emitted as heat, with hotter objects emitting more infrared light than cooler ones.

Using this tool, scientists are able to slightly heat a panel, collect thermal images as it cools and process the images to detect the extent of damage within 20 minutes.

To heat the panels in space, astronauts will rely on positioning the shuttle to allow the sun to heat the panels.

Heat from a cup of coffee shows up on an infrared-camera screen at the research center.

"There were only astronaut eyeballs and a medium-resolution television camera previously," said Thomas Jones, a former astronaut who flew on four shuttle missions.

A commercially available thermal camera was altered to survive the atmosphere's temperature extremes, increased pressure, lack of gravity and exposure to radiation.

"The electronics won't like that environment so we repackaged them into something which is more rugged, more sturdy and it can take a kick by an astronaut," said Michael Gazarik, head of the passive-sensors branch at Langley.

"The astronauts are in cumbersome spacesuits, so the keypad has been redesigned so it's easy to push the buttons, operate the camera and easy to focus," said research scientist Elliott Cramer.

They also modified the system so an astronaut could mount the camera on his workstation and tool belt.

This technology is sensitive enough to find small cracks and know when the layers of the leading edge are breaking apart. "Having done space walks, I can tell you the lighting is very tricky out there. Sometimes, you're working at night, and you just have your helmet flood lamps, and it's hard to see very subtle detail. In the bright sunlight, things can be washed out by the glare of the sun. This technique seems to get around some of these lighting problems," Jones said.

One infrared camera will travel with the astronauts on Discovery's mission next week.

"There are no plans to take it out and use it unless other indications say that something might have happened," said Howell.

If the infrared camera is needed in an emergency, mission specialist Charlie Camarda, the former head of the thermal structures branch at NASA's Langley Research Center would do the space walk. Before Discovery's return to Earth, the camera will be transferred to the International Space Station.

Thermal images will be collected by astronauts on the space station and researchers will see if they can replicate the same results from the measurements collected on the ground.

On the Atlantis flight scheduled for September, a second infrared camera will go up with leading-edge panels that have been analyzed extensively on the ground.

On the flight following Atlantis, both cameras and test panels will return to Earth.

• Contact Abby Vogel at (804) 649-6154 or avogel@timesdispatch.com

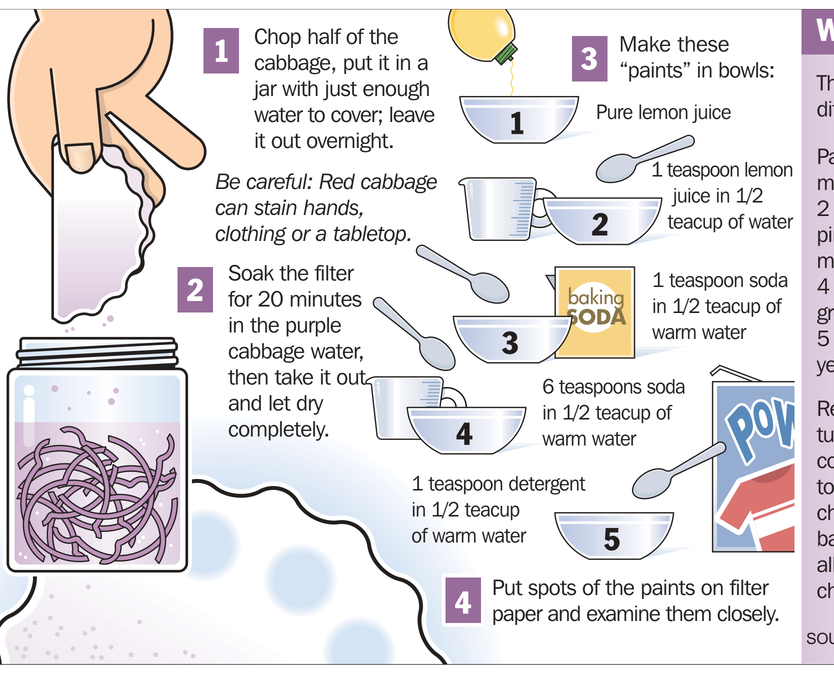
Try this

Chemical colors

Here's how to make colored patterns – and even color pictures – using chemical reactions:

You'll need:

- Small red cabbage
- Glass jar
- Knife
- White coffee filter
- Five small bowls
- Five spoons
- Lemon juice
- Baking soda
- Laundry detergent
- Adult helper



1. Chop half of the cabbage, put it in a jar with just enough water to cover; leave it out overnight.

Be careful: Red cabbage can stain hands, clothing or a tabletop.

2. Soak the filter for 20 minutes in the purple cabbage water, then take it out and let dry completely.

3. Make these "paints" in bowls:
   1. Pure lemon juice
   2. 1 teaspoon lemon juice in 1/2 teacup of water
   3. 1 teaspoon soda in 1/2 teacup of warm water
   4. 6 teaspoons soda in 1/2 teacup of warm water
   5. 1 teaspoon detergent in 1/2 teacup of warm water

4. Put spots of the paints on filter paper and examine them closely.

What happened?

The spots turn different colors.

Paint 1 makes red; 2 makes pink; 3 makes blue; 4 makes green; and 5 makes yellow.

Red cabbage turns different colors when it touches acid chemicals or basic, or alkaline, chemicals.

SOURCE: Industry Supports Education (U.K.)

KNIGHT RIDDER TRIBUNE

2003, SAMUEL HOFFMAN/THE ASSOCIATED PRESS

Coolah, a Tasmanian devil at the Fort Wayne Children's Zoo in Fort Wayne, Ind., was one of only two devils in North America in 2003. The other was at the San Diego Zoo.

Tasmanian devils facing their own hell with disease

A mysterious malady has killed nearly half of the world's devils

BY SANDRA BLAKESLEE
New York Times News Service

LAUNCESTON, Tasmania

Even by the brutish standards of Tasmanian devils, Rosie, Harry and Clyde have led a lamentable life.

A year ago, when the three were each the size of a sesame seed, they wriggled out of their mother's birth canal and undulated their way to her pouch. There, each locked onto a teat and grew like gangbusters.

But tragedy struck. Within months, their mother developed devil facial tumor disease — a mysterious malady that in the past three years has killed nearly half of the world's devils, marsupials that are found only in Tasmania. Shortly after she died, the baby devils, grown to the size of tiny puppies, were found dangling from their mother's pouch, starving to death.

Will orphans be infected?

Rescued and reared by hand, Rosie, Harry and Clyde recently joined six similarly orphaned devils at the Launceston Lakes and Wildlife Park, all in strict quarantine. The fate of their exotic species — Sarcophilus harrisii — may lie in what happens to these rambunctious youngsters in the next 12 to 18 months.

"If they contract the disease, devils may be headed for extinction in the wild," said Nick Mooney, a wildlife biologist with Tasmania's Department of Primary Industries, Water and Environment in Hobart. "If they're free of the disease, we may have reason for hope."

Right now, wildlife experts are struggling to comprehend the nature of the fast-moving epidemic. Moving at a rate of 6 to 10 miles a year, it is 100 percent fatal. Nearly half of the estimated 150,000 devils in Tasmania are now dead.

Devil facial tumor disease is grotesque; the mother of Rosie and her brothers died when tumors ballooned out of her face and neck, choking off her ability to eat. It is also an extraordinary puzzle. Scientists do not understand its cause, mode of transmission, time from infection until the tumors appear, or potential to infect other species.

Breaking rules of biology

Their current best guess breaks all the rules of modern biology. Scientists suspect that the disease is caused by a cancer cell that itself moves from one animal to another when they bite one another.

Having declared an emergency, officials are trapping healthy devils for captive breeding in case the disease cannot be stopped. The real devil bears no resemblance to Taz, the Warner Bros. Looney Tunes cartoon character that roars and whirls like a dervish. A real devil is the size of a spaniel, with strong forelimbs, a huge head and a disappointing back end. Geoff King, who lures devils to his ranch in northwestern Tasmania for ecotourists to observe, said they lived solitary, nocturnal lives, coming together to devour carrion. Their bite is as strong as that of a dog four times its weight. "They are nature's cleanup crew," King said.

Females have lustrous black coats with a purple hue, white stripes on their rump or below the neck, exceptionally long luxurious whiskers and narrow pointy faces. When they get excited, their ears turn blood-red. "They are beautiful," King said.

Males have similar markings along with big boxy heads and heavily scarred faces and rumps. A devil can eat a quarter of its body weight in one feeding.

Devils got their name from early European settlers who heard spine-chilling screams in the night and thought that Satan was surely in the back yard.

Six-year limit on life

After six years of scavenging, screeching and seeking mates, devils abruptly die, said Dr. Menna Jones, a wildlife biologist who also works in the environment department. They are one of the few species in the world with so-called catastrophic mortality. How and why they die this way is not known, she said.

Tasmanians have always taken devils for granted, Mooney said. Few scientists ever bothered to study them. When the first animal with facial tumors was photographed in 1996, he said, "people thought, eeew, that looks horrible, but it did not ring alarm bells."

It took five more years for scientists to realize the disease was widespread, Mooney said. Later surveys show a devastating picture. Spread animal to animal, the disease is now endemic across two-thirds of the island, which is slightly smaller than West Virginia.

In Launceston, Dr. Stephen Pyecroft is spearheading the government's investigation into what is causing the disease. A virus seemed likely. But so far, Pyecroft said, every effort to identify a virus has come up empty-handed. A virus has not been ruled out, he added, but scientists are now entertaining other hypotheses.

Because Tasmania has widespread use of agricultural chemicals and pesticides, researchers are looking at 10 toxins to see if devil disease is associated with poisons that can cause tumors.

Is tumor transmissible?

But the leading theory is that devil facial tumor disease is caused by a transmissible tumor cell, Pyecroft said. It goes like this: About a decade ago, a random mutation occurred in a single animal in a type of cell involved in hormonal regulation. This devil developed tumors on or near its face. When another devil bit into the tumor, it was infected with tumor cells. With time, tumor cells were passed around in the bloody fray of devil social life, spreading the disease.

Meanwhile, Mooney's team is trapping devils islandwide to determine the extent of the epidemic. They are also in the process of trapping 25 young animals from apparently disease-free areas as an insurance policy. The juvenile devils are being placed in urban and offshore sites to keep them apart from older, wild devils. If after a year or so they show no signs of disease, they will be bred to ensure survival of their species.

Similarly, Rosie, Harry and Clyde are living with other orphans — Donny, Hansel, Gretel, Beatrice, Zilla and Scamp. "We usually don't see the disease until after the animals turn 2 years old," said Heather Hesterman, another biologist on the team. It is possible they might get the disease from their mother's milk or contact with her saliva, Hesterman said. On the other hand, they may have resistance to it.

Veterinarians will watch the orphans for the next year or so to see what happens.

"We have so many question marks, so little time," Hesterman said.