SEASON FOUR, ISSUE THREE

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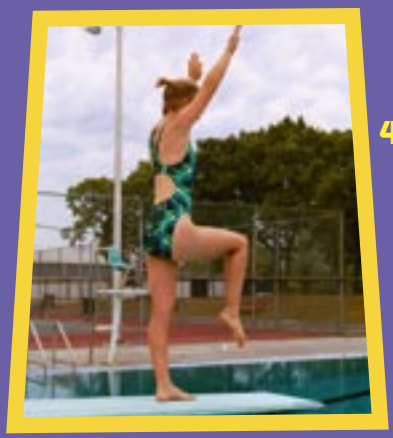
DragonflyTV Educator's Guide

Pull out this booklet and use it to ignite inquiry in your classroom or club!

410/Chemistry: Make-Up

412/Mammals: Cheetahs



411/Human Body: Diving

412/Simple Machines: Trebuchet

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HOW TO USE THIS GUIDE

1. Duplicate the DFTV student page of your choice (pp. 3–6) and distribute it to your students. Read the questions posed by the young scientists. Encourage your students to describe how they would investigate the questions. Guide them through the steps of developing an inquiry (see below).

2. If you have videotapes of the episodes featured in this guide, play the video segment to see how the DFTV kids investigated the questions and what their results were. The investigations are also described on page 7 of this guide and on the DragonflyTV Web site. Apply the ideas learned in the DFTV example to the classroom activity "Do It, Get To It," or encourage students to do the investigation described in "Take It Outside!"

3. If your students develop investigations of their own, encourage them to visit the DragonflyTV Web site, pbskids.org/dragonflytv, and click on DFTV Boards. Kids can describe their investigations and share their ideas with others.

OBSERVATIONAL

1. Write the question: How does A compare to B? Make a hypothesis.
2. Decide what to measure or observe for both A and B and how to do it.
3. Make multiple observations when possible. Record all results.
4. Organize the data in a table or chart, looking for differences or similarities.
5. Write an answer to the original question. Also write down any new questions that come up during this investigation.

EXPERIMENTAL

1. Write the question: If I change A, what happens to B? Make a hypothesis.
2. Choose the independent variable (the thing you change) and dependent variable (the thing that is affected) and how to measure them.
3. Do multiple trials when possible.
4. Organize the data into a table and prepare a graph. Look for patterns or trends.
5. Write an answer to the original question. Also write down any new questions that come up during this investigation.

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410 / Chemistry Make-Up

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Student Page

What's Up?

We're Jazi and Danielle, and we made up our minds to make some makeup! We took a cool chemistry class where we learned about what makes cosmetics look, smell, and feel good. We created a formula for lip gloss, and shared our beautiful results with our friends. But our curiosity didn't end when the class did; we want to make our products even better! Our DragonflyTV question: **How can we create an even better lip gloss formula?**

How Would You Answer This Question?

To create a makeup formula, research what ingredients are commonly used in cosmetics. Are they specialty ingredients, or stuff you can find at your house or a common drugstore? Once you've determined your ingredient list, find out how makeup is actually, well, *made*. How are the contents combined? Are they heated or cooled? Why? And how can you package them to make sure they are easy to use, and won't spoil? Write your ideas in your notebook and discuss them with your classmates and your teacher. Then watch the video segment, or go to www.pbskids.org/dragonflytv to check out Jazi and Danielle's fantastic formula.

Do It, Get To It

Investigate how liquids mix (or don't mix) with each other. Gather a number of household liquids, such as water, syrup, vegetable oil, vinegar, or liquid soap. Pour one of the liquids into a small glass, or into a test tube, about halfway up. Now pour a second one on top slowly. Do they mix, or do they form layers? Which one floats on top? What happens if you shake or stir? Try different combinations, and find the pairs of liquids that mix with each other.

Take It Outside!

Learn about suds and foam, and what kinds of substances increase or decrease the amount of suds you get from soap. Find a large 5 gallon pail, and a garden hose with a sprayer. Put just a drop of liquid soap in the bucket, then spray water into the bucket to make suds. Spray for 5 seconds. How much suds do you have? Now try again, this time starting with a drop of soap and a spoonful of vinegar. Do you get more or fewer suds when vinegar is present? Try other things like rubbing alcohol, vegetable oil, or corn syrup.

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411 / Human Body: Diving

Student Page

What's Up?

We're Jaq and Niki, and we always make a splash with our favorite sport: Diving! Actually, just the opposite is true; we try NOT to make waves. Since competitive divers are judged on form and entry into the water, less splash is better. We hit the water at a high speed, so we can't always tell why we make a lot of splash on some dives. So let's dive into our DragonflyTV question: **How can we figure out what's causing splash on our dives?**

How Would You Investigate This Question?

A lot of kids have tried a "cannonball" into a pool or lake, where the goal is to create the biggest possible splash. What makes a good cannonball? Is it how you place your legs or arms, how high you leap, what you do with your hands? Now that you've thought about splashing, how can you use these same methods to *not* splash? Write your ideas in your notebook and discuss them with your classmates and your teacher. Then watch the video segment, or go to www.pbskids.org/dragonflytv to watch Jaq and Niki solve their diving dilemma.

Do It, Get To It

Explore ways to observe things that happen slowly, such as the growth of a plant. Place a few bean seeds on a moist paper towel, and lay the towel in a plastic zipper bag. Line the inside of a clear cup with the bag, so you can see the seeds; a second cup placed inside the first helps hold the bag. Make drawings or take pictures of the seeds each day as they begin to sprout. How can you use the images to make a movie of the seeds sprouting and growing?

Take It Outside!

Use a home video camera to take an extraordinary look at ordinary events. Record the splash of a water balloon hitting the sidewalk, or of a baseball falling into a bucket of water. Play the video back one frame at a time to notice things about the event that you couldn't see in "real time." Use this technique to study other events, such as a model earthquake. Build a small village on a cardboard platform, then shake the platform back and forth to create an earthquake. Play back the video to look for details about how damage occurred.

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412 / Mammals: Cheetahs

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Student Page

What's Up?

DragonflyTV has gone global! We're Mickey and Caroline, and we're at the Cheetah Conservation Fund, located in Otjiwarongo, Namibia. We're working with Dr. Laurie Marker, who told us that the Fund protects cheetahs that were either orphaned when their mothers were killed or captured by farmers to protect their herds. We wanted to learn even more about these big cats and how they thrive in their natural habitat, so we asked the DragonflyTV question: **How do the numbers of prey animals change throughout the day?**

How Would You Investigate This Question?

What does life look like for an average African cheetah? What do these creatures eat, and how do they hunt or gather their food? When do they sleep, and how do they interact with one another? What kind of plant and animal life is featured in their natural habitat? Once you learn a little bit about a day in the life of a cheetah, think specifically about their dining habits and tackle the DragonflyTV question. Write your ideas in your notebook and discuss them with your classmates and your teacher. Then watch the video segment, or go to pbskids.org/dragonflytv to find out more about Mickey and Caroline's African adventure.

Do It, Get To It

Investigate your kitty's ability to smell different scents. Get three bowls. Rub the inside of the first bowl with something like jelly, leaving just a little smear. Put a small smear of peanut butter in the second, and ketchup in the third, or pick whatever flavors and smells you think your cat will like. Hide the bowls in a room, then bring your cat in. Which bowl does she find first? Does she ignore any of them?

Take It Outside!

You've probably played "Sharks and Whales" in gym class, right? Well, do a science experiment with the game. Get a bunch of kids, say 12 or more, and start with just one shark. Have someone start a watch, and time how long it takes for the shark to catch all the whales. Now play a new round, starting with two sharks right away. Continue this way, adding another shark with each round. Collect your data and look for a trend. Another variation is to change the size of the playing field, or "ocean," and see what effect that has on the time.

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412 / Simple Machines: Trebuchet

Student Page

What's Up?

We're Angus and Jonathon, and we're into really old-school stuff: medieval history! When we're not building castles, playing joust, or reading about knights, we're engineering stuff. Our most recent invention is called a trebuchet, a catapult-like device dating back to medieval days that is useful for transporting materials (translation: flinging stuff) long distances. We want to throw out this DragonflyTV question: **What trebuchet design will to throw things the farthest?**

How Would You Investigate This Question?

What in the world is a trebuchet? What did medieval models look like and what were they made from? How and why were they used? What's the difference between a trebuchet and a catupult? Once you've gathered some background knowledge about trebuchets, think about how you throw or toss things, like a ball. What do you need to do to get the greatest distance out of your throw? Write your ideas in your notebook and discuss them with your classmates and your teacher. Then watch the video segment, or go to pbskids.org/dragonflytv to see Angus and Jonathon's excellent engineering.

Do It, Get To It

Do a quick investigation of how to fling things, using a meter stick. Hold the meterstick onto a table top, with 10 centimeters over the edge. Set a penny on the end, and try to give it a "twang." How far does the penny fly? Repeat this, with 15 cm of the stick hanging over the edge, then with 20 cm, 25 cm, etc. Do the pennies fly higher as you extend more of the stick off the edge of the table?
Do they fly farther?

Take It Outside!

Find a water balloon slingshot at a toy store, and do an investigation of things that fly! Make all the water balloons the same size (as much as possible), and try different investigations. How far do the balloons fly as you change the angle of launch? You can also use a stopwatch to record time of flight with different angles. Challenge yourself to come up with a launch strategy to make a balloon hit a certain target.

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About the DFTV Investigations

(for the educator)

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Educator Page

MAKE-UP

NATIONAL SCIENCE EDUCATION STANDARD

Physical Science Grades K–4:
Properties of objects and materials

Physical Science Grades 5–8:
Properties and changes of properties in matter

The girls took a basic lip gloss recipe (found on the Internet), and modified the percentages of two ingredients to see the effects on the final product. They increased or decreased the proportion of beeswax and castor oil in the formulation, then did "consumer testing" to see which formulation had the most desirable properties. They found that a change of just a few percent in the formulation had noticeable results in the opinions of the consumer. Further, they learned how the physical properties of a substance in a mixture contribute to the properties of the entire mixture.

Discuss with students the challenges of making a homogenous mixture out of heterogeneous components. For example, when combining the liquids and solids of the lip gloss recipe, it is necessary to melt the solids, so all the ingredients can be thoroughly mixed? Also discuss how the inability of some materials to mix limits one's choices in making a formulation.

DIVING

NATIONAL SCIENCE EDUCATION STANDARD

Physical Science Grades K–4:
Position and motion of objects

Science and Technology Grades 5–8:
Understandings about science and technology

The girls have been well coached in their diving technique, yet questions remained about why a dive that felt right still resulted in a large splash. They employed a high-speed video camera to examine their dive entries more carefully. A high-speed video camera shoots video at 500 or more frames per second. In the playback, one can see details in quick-moving events that one might miss using conventional video (30 frames per second). In this case, it was the little things like hand and toe position that caused the most splash, things they weren't able to notice with the unaided eye.

Discuss with students the difference between high shutter speed still photography and high-frame rate moving photography. Many home video cameras have high shutter speeds, but low frame rates, so they aren't as effective as a high-speed video camera. This investigation emphasizes how technology can enhance scientific investigation.

CHEETAHS

NATIONAL SCIENCE EDUCATION STANDARD

Life Science Grades K–4:
Organisms and their environments

Life Science Grades 5–8:
Populations and ecosystems

The Cheetah Conservation Fund in Namibia is a wonderful place to go on a safari to observe cheetahs and their fellow inhabitants in their natural environment. The girls went on a wildlife observation trek out on the Namibian savannah, counting the numbers of cheetah prey animals present at different times of day. The found greater numbers of prey animals in the cool of the early morning, compared to in the heat of the late morning. This led them to consider what time of day the cheetah might try hunting for prey with the most success.

Even without traveling to the African plains, one can still study animal behaviors in a local habitat. Sometimes the habitat is as confined as in an aquarium or terrarium, or as open as in a schoolyard or park. Discuss with students what variables they should keep in mind when designing an animal observation inquiry.

TREBUCHETS

NATIONAL SCIENCE EDUCATION STANDARD

Physical Science Grades K–4:
Position and motion of objects

Science in Personal and Social Perpectives Grades 5–8:
Science and technology in society

The boys built a model trebuchet that they could easily modify. They looked at the effect of shorter and longer slings, and heavier and lighter counterweights. They found that heavier counterweights would throw an item farther than lighter counterweights, provided the entire trebuchet could withstand the strain of the additional weight. Longer slings didn't always result in farther throws, as a sling that is too long would dangle rather than fling something over the top.

Trebuchets have an interesting social history as well as an interesting technical history. They are ideally suited for discussions of how technologies advance in their societal context, and how they ultimately decline.

For more details on these investigations, visit pbskids.org/dragonflytv.
Use the search option to quickly find the specific segment.

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REAL SCIENTIST ROUND-UP!

Check out how these real scientists, featured in DragonflyTV's fourth season, turned their love of investigation into a vocation!

Joel Boyd: Jock Doc

Dr. Boyd is an orthopedic surgeon and head team physician for the WNBA's Minnesota Lynx and the NHL's Minnesota Wild. He is also an Olympic team physician, and has represented the United States' hockey teams in Sweden, Germany, and Japan! In his free time, Joel is a jock himself, enjoying golf and other sports with his three kids.

Ian Gilby: Chimpanzee Researcher

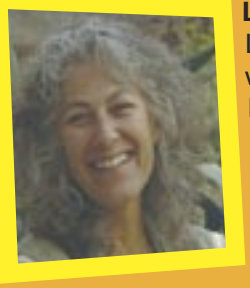
Ian likes monkeying around: He is a researcher for the Jane Goodall Institute's Center for Primate Studies at the University of Minnesota. He studies the hunting and meat sharing behaviors among chimpanzees in Gombe, Africa. Ian believes that the more we know about animal behavior, the better we'll be able to conserve their natural habitats! He always wanted to be a vet as a young child because he enjoyed being around animals.

Travis Lee: Solar Vehicle Engineers

This mechanical engineer is one very "bright" guy: He designs and races cars that run on sun! As a leading engineer at the University of Minnesota, Travis is in charge of designing and modifying the Borealis 2, a solar vehicle noted for its superior reliability and efficiency. The Borealis 2 is featured at national competitions, including the Formula Sun Grand Prix.

Corliss Outley: Urban Play Researcher

Having fun is her work: Corliss is an urban play researcher. In this role, Corliss hangs out at inner-city parks and recruits kid assistants to help her with her data gathering. These kids help Corliss determine what kinds of activities city kids like best, and what things they'd like to change about their neighborhoods. Corliss shares this information with educators and community leaders who can help adults and children improve and create new urban play environments.



Laurie Marker: Cheetah Conservationist

Laurie moved permanently to Namibia in 1989 to protect and sustain the wild cheetah and its wilderness habitat. Known in her African village as "the Cheetah Lady," Laurie founded the Cheetah Conservation Fund so she and other scientists can research, breed, protect, live with, and lecture about this sensitive and highly endangered cat.

John Fetrow: Cow Vet

Who does a cow call when she's sick? Large animal vet John Fetrow, otherwise known as Dr. Moo! John works at Wisconsin's Cow Transition Management Facility, where he researches the birth cycle of cows. He is an expert on common cow diseases, what kinds of food and care cows need to remain healthy (including "cow pedicures!"), and even the best kind of bedding for sleepy cattle!

Tammy Bush: Bioengineer

Tammy never gets all bent out of shape! She's an bioengineer who specializes in seat ergonomics, which help people sit in healthier postures. Tammy developed the LEAP seat, which is an office chair that uses motion measurement devices to determine the most comfortable and supportive seating for each individual. This same premise is being used in automobiles and wheelchairs, and Tammy's goal is to have "healthy" seats at schools, on planes, and everywhere! As a child she wanted to be a professional cheerleader, but decided to follow her love of math and science to an engineering career.

For more DFTV Real Scientists, visit pbskids.org/dragonflytv and click on Real Scientists!

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