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Teacher's Guides

The National Science Teachers Association and science educators at Miami University of Ohio brought stories of real kids doing real science to classrooms across America with Dragonfly magazine. Originally published by NSTA and now published by Scientific American Explorations, Dragonfly showed real kids dreaming, developing and doing their own inquiry-based investigations. The creators of Dragonfly magazine then shared this concept with Twin Cities Public Television, who brought the ideas to a whole new medium: introducing DragonflyTV!

DragonflyTV premieres on PBS stations nationwide in January 2002, and includes off-air recording rights for a full year! (Check with your local PBS station for exact broadcast date and time.)

These Teacher's Guides are based on DragonflyTV investigations. Please enjoy using, modifying, and sharing these guides, which will be featured in upcoming National Science Teachers Association publications.

To learn more about DFTV and Dragonfly magazine, visit our Web site at pbskids.org/dragonflytv.

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Issue 2

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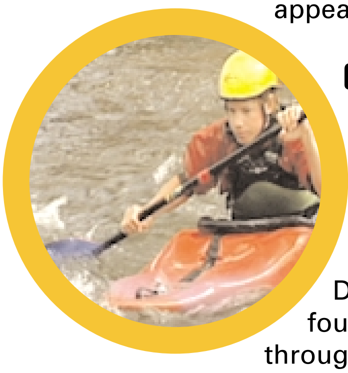
Rocks – Rock On!

Episode 105

Investigations To Explore

Kayaking

River Rats Jenny, Danny and Simi brave very rough waters in their kayaks. They noticed that large boulders appear in some rapids but not others.



Question

Why are all the boulders in the challenging rapids, and not in the calm waters?

Investigation

Danny, Jenny and Simi explored four different rapids, Class 1 (easy) through Class 4 (challenging). They measured the water speed at each rapid by measuring the time it took a floating orange to travel 10 meters. Then they classified the size of rocks they saw in each rapid.

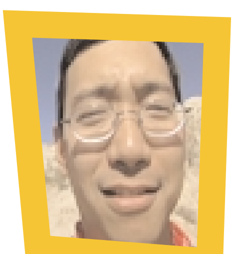
Results

Jenny, Danny and Simi found that the bigger boulders were usually found in faster waters. Here's what they found.

Rapids	Water Speed	Rock Size
Class 1	0.38 m/s	sand, gravel
Class 2	1.1 m/s	small rocks
Class 3	0.80 m/s	larger rocks
Class 4	1.7 m/s	boulders

Conclusion

They speculated that over centuries of time, fast water carried smaller rocks and sand further downstream, leaving the boulders behind. Sand and gravel are deposited in slower waters, leveling the river bed and slowing the flow even more. They were surprised that their Class 3 water speed measurement was slower than the Class 2 measurement.



Scientist: Gary Takeuchi

Gary is a paleontologist who searches for dinosaur bones in the La Brea tar pits. He loves the challenge of digging up fossils and searching for clues about ancient creatures.

Rock Climbing

Gordon and Jesse love to scale steep rock cliffs, and wondered if studying rocks would make them better climbers.

Question

How do different types of rock affect climbing?

Investigation

Gordon and Jesse climbed three different kinds of rock — igneous, metamorphic and sedimentary — and tested rock hardness, how much the rocks hurt their hands, and whether their feet slipped.

Conclusion

The boys found that rocks that provide good footholds also hurt their hands (granite and gneiss), while rocks that didn't hurt their hands also didn't provide good footholds (sandstone).

Find out more: pbskids.org/dragonflytv.

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Rocks – Rock On!

Episode 105

Classroom Inquiry

1) Getting Started

- Ask if your students go canoeing or kayaking. Do they go on rivers or lakes? Or, take a trip to a local river or stream. Maybe even arrange a canoe or kayaking trip!
- What kinds of rock do they see or remember? How does water affect rocks over time?
- Ask about erosion and weathering. How long does that take? (Students living near the coast may be very aware of erosion.)
- How old are rocks? Where do rocks come from? (Not the landscape store!) Are new rocks made in nature?

2) Going Deeper

- Sort a collection of different rocks, such as river rock, used by landscapers. How many ways can you classify them? Consider size, color, hardness or other features.
- Learn to identify rock types by comparing them to pictures in a geology book.

3) Investigate with DragonflyTV

- Watch the video and see how Jenny, Danny and Simi explored the rapids of the Roaring Fork River in Colorado – OR – give your students data from the video (see opposite page) and have them draw their own conclusions.
- The three kayakers came up with a clever way to find the river speed. What did they do?
- Jenny, Danny and Simi measured the Class 3 rapids to be slower than the Class 2. What explanation did they have for that?
- They concluded that the fast water carries small rocks and gravel away. What other factors might affect the shape and speed of the river? What other experiments could you do?

4) Investigate On Your Own

- Using the Kayaking or Rock Climbing segments to start them thinking, ask your students to design their own rock investigation. Here are some challenge cards to give to student teams to get things rolling.

Challenge Cards

1) Rock Solid

How true is the saying, "Solid as a rock"? Collect different kinds of rocks and weigh them individually. Soak them in water and weigh them again. Did their weights change or stay the same? Why? Take a closer look at any rocks that gained weight. Make predictions about why they did. Test your ideas. What does your investigation tell you about how solid rocks are?

2) Invent Rock

Rocks in nature are formed in many ways. What keeps them together? Make at least three different rock recipes. Use ingredients such as clay, sand, mud, straw, Elmers glue, marbles, even cookie dough! Name your recipes and predict which one will be hardest or strongest. Why? Which ones will survive outside?

3) Watch Out for Rocks

Create a map that shows the major kinds of rock in your area. You may want to have friends bring back rocks from where they live. How many types of rock did you find? Try to relate the different kinds of rock to where they are found.

Next:

Hold a contest to see if your friends can tell the difference between natural rocks from your area and rocks that humans have made or imported. Include pieces of brick, cement or driveway gravel to test your friends.

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Weather – Wicked Winds!

Episode 107

Investigations To Explore

Forecasting

Mari and Lindsey wondered how people used to predict the weather before there were satellites, radar and computers. They knew of several folktales about the weather, and were curious if they were true.

Question

Can you use folklore to predict the weather?

Investigation

Mari and Lindsey explored several folktales about weather. They were: Clouds at night predict tomorrow's weather; hair won't hold its curl if rain is coming; bees stay near the hive when storms approach; cows lie down when it's going to rain; Grandma's toe hurts when bad weather is coming. They also built a homemade barometer to see if they could detect weather changes that way.

Results

The girls counted the number of times each predictor was correct about the next day's weather, out of nine days.

Clouds at night	7	**Bees**	6
Grandma's toe	3	**Hair**	4
Barometer	5	**Cows**	3

Conclusion

Mari and Lindsey found that over nine days, only two of their folktales were reliable more than half the time. They wondered if their results would come out differently if they observed the weather for several weeks.

Tornado Model

Fascinated by tornadoes, Sullivan and Alexa wanted to learn how tornadoes form in nature.

Question

Is a side wind or an updraft wind more important in forming a tornado?

Investigation

Sullivan and Alexa built their own tornado model from a large cardboard box, two household fans and a humidifier. They tried all combinations of settings to see how to make the strongest tornado vortex.

Conclusion

They found that a high side wind is important in making a destructive tornado, but it is not enough all by itself. The side wind becomes a destructive tornado only when there is also a strong updraft.

Find out more: pbskids.org/dragonflytv.

Scientist: Dr. Howie Bluestein

Howie is a stormchaser in Oklahoma who specializes in tornadoes. He has also studied other kinds of violent storms, and has flown into the eye of a hurricane six times!

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Weather – Wicked Winds!

Episode 107

Classroom Inquiry

1) Getting Started

- Ask your students to discuss extreme weather events they remember. Do bad storms keep them up at night? Do they worry about tornadoes or hurricanes?
- How do meteorologists predict the weather?
- Meteorologists talk a lot about barometric pressure. What is that?
- Do any students have devices in their homes that measure temperature, humidity, or pressure? Do any students use them? Could they be used for investigations?
- Show students a copy of The Old Farmer's Almanac. List different methods for weather prediction described in the book.

2) Going Deeper

- There are hundreds of weather myths, legends, and folktales. Name as many as you can. What would you need to find out if these legends are true?
- Create plans for a class weather station. What would you include? Ask teams to design a homemade anemometer to measure wind speed, a barometer to measure air pressure, a wind vane, a thermometer, or other instruments. Could you use these to predict the weather?

3) Investigate With DragonflyTV

- Watch the video and see how Mari and Lindsey tested some weather folktales – OR – give your students data from the video (see opposite page) and have them draw their own conclusions.
- Mari and Lindsey found that some folktales described current weather, but not future weather. What's the difference between describing and predicting?
- The girls said the weather didn't change dramatically during the nine days they did their test. Should they have conducted their test during changing weather?
- Try making your own weather predictions for a week, using observations of natures clues. How successful can you be?

4) Investigate On Your Own

- Using the Forecasting or Tornado Model segments to get students thinking, ask your students to design their own investigations. Give these challenge cards to student teams to get things rolling.

Challenge Cards

1) Bowling in Tornado Alley

Has there ever been a tornado in your state? Are there places in the United States that get more tornadoes than other places? Where? Look at tornado maps. (Hint: try a tornado website, like the one at http://www.spc.noaa.gov/faq/tornado/f5torns.html) Do you see a pattern? Why do you think tornadoes occur in some places more than others? Do they occur near oceans? Near mountains? In deserts? Investigate your ideas. Based on what you've learned about U.S. tornadoes, predict other tornado-prone areas around the world.

2) Winds of Change

Winds often signal a new weather front moving in. See if you can tell what kind of weather is coming by the strength and direction of the wind. To measure the wind, you might try using a feather, or invent a wind flag. Keep a wind diary. Is it windy on a day when the weather map shows a new high or low pressure system approaching? Create an investigation to see whether cold weather actually comes from the north. Investigate where changing weather comes from where you live.

3) Weather City

Investigate three real cities from around the world that have very different types of weather. You might try a town in a desert, in a rainforest, even your own town. How does weather shape each place? Are the buildings different? How about the vehicles, food, drink, clothes, or holidays? Sketch six key differences.

Based on what you discovered, imagine building a city on Mars. Investigate the local weather and draw an imaginary town designed to match it.

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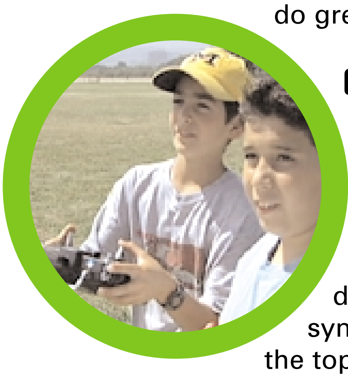
Flight – Take Wing!

Episode 106

Investigations To Explore

Model Airplanes

Ryan and Alex fly model stunt planes. There are many models to choose from, but they wanted one that could do great stunts.



Question

How does wing shape affect the performance of the plane?

Investigation

Ryan and Alex tested two wing designs, a flat-bottomed wing, and a symmetrical wing (curved equally on the top and the bottom). Using a scale of 0 to 3, they rated both types of plane on their ability to perform three stunts: an aileron roll, a snap roll, and an inverted loop.

Results

	Aileron	Snap Roll	Inverted Loop	Total
Flat-bottomed	2	1	0	3
Symmetrical	3	3	3	9

Conclusion

The symmetrical wing beat the flat-bottomed wing on all three stunts. Ryan and Alex concluded that air flowed over the symmetrical wing more evenly and provided lift, even when it was flying upside down.

Scientist: David Urie

David is an aeronautical engineer, whose latest invention is the SkyTrac, a kind of body surfboard for skydivers.

Paragliding

David, Alex and Abby are learning to paraglide. They want to find the best thermal updrafts to lengthen their flight.

Question

Where are the strongest thermals?

Investigation

Using a thermal camera, they measured the temperature of four different kinds of terrain: grassy, wooded, rocky and watery. David paraglided over each type of terrain, and checked how his altitude changed using a variometer.

Conclusion

David flew higher over the warmer terrain, and realized that the best thermals are found where the sun heats up rocky and grassy terrain.

Find out more: pbskids.org/dragonflytv.

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Flight – Take Wing!

Episode 106

Classroom Inquiry

1) Getting Started

- Ask if your students have ever flown in a plane or taken a helicopter ride. Invite a pilot to talk to the class, or to host a visit to the airport.
- How heavy is a plane? How does it get off the ground? Solicit ideas about how air lifts planes.
- Birds flap their wings, of course, but many glide for minutes on end without flapping. Why don't they fall to the ground?
- What is flight? Compare kites, planes, paragliders, parachutes, even "flying squirrels." How are they different? How are they similar?

2) Going Deeper

- Everyone has folded a paper airplane; what's your favorite wing design? Why does it work so well?
- Compare the flight of different paper plane designs, and decide what to measure and observe. What counts as a good flight?
- How could you keep a paper plane in the air longer?

3) Investigate with DragonflyTV

- Watch the video and see how Ryan and Alex investigate model airplane wings – OR – give your students data from the video (see opposite page), and have them draw their own conclusions.
- Ryan and Alex chose to study wing shapes. What other features of the airplanes might they have studied?
- Most planes actually have flat-bottomed wings. What's the advantage to those? Why did Ryan and Alex prefer the symmetrical wing?

4) Investigate On Your Own

- Using the Model Airplanes or Paragliding segments to start them thinking, ask your students what other questions they might explore. Here are some challenge cards to give to student teams to get things flying.

Challenge Cards

1) Flight Paths

Hawks soar. Chickadees flit. Why does each bird fly in its own way? Find a spot outside where birds gather and sketch the scene. Then, for 15 minutes, draw the paths of whatever birds fly through your scene. Can you relate the type of flight to the size of the bird, the shape of the wings, or even where it lives or what it eats? Make predictions and test your ideas.

Pretend the flight paths are drawings of music. Try to hum different flight paths, or use a musical instrument to play the sounds the flight patterns suggest.

2) Everything That Flies

Quick — think of 30 things you can find in the air. Don't forget things like dust, clouds, insects, and even germs! Now take a look at your list. How many different ways can you classify your flying objects? How do they become airborne? What keeps them going?

3) Flight Dreams

Almost everyone has dreams about flying. Are all the dreams similar? Do kids dream about flying more than adults? Who dreams about flying more: boys or girls? Are most flight dreams fun or frightening? Make predictions and then create surveys to gather data to answer your favorite flying dream question.

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Inquiry Tips

The Art and Science of Investigation: On Questioning

It is true that there is no such thing as a bad question, but experienced investigators develop a knack for sifting through many questions to find just the right ones to suit their purpose. This process, which is both an art and a science, is a fundamental part of an investigation. Discuss the questions below with your students to start them thinking about the nature of inquiry and to help track down questions that will most likely lead to great discoveries.

Why should I care about this question?

If your class worked together to generate the question, chances are you have already solved the problem of relevance. Students know what they find interesting, but they may still benefit by discussing reasons why a question is significant. Such a discussion becomes more important if the students did not generate the question themselves.

Is the question too easy or too hard?

Often questions that seem easy at first lead to other questions worth investigating. Ask your students to keep probing. When faced with a question that seems too hard, ask your students to break the question into interesting pieces.

What's my best approach?

Challenge students to devise alternative strategies for addressing a question. A question about lions may best be answered by library research. Other questions may require interviews, computer research, thought experiments, direct observation, or field experiments. The best questions often challenge students to adopt multiple approaches. You might try giving students a list of questions and then have them determine the best ways to address each one.

Will this question lead anywhere?

Point out the difference between a descriptive question and a comparative question. Imagine a student who asks the descriptive question, "How many animals are under that rock?" Let's imagine she picks up the rock and finds three pillbugs and a spider. So what? It seems a dead end. But, if she asks the alternative, comparative question, "Are there more animals under big rocks than small rocks?" she opens up other questions. Does she think more animals live under big rocks just because of their size? Or is there more moisture under big rocks? Is there more protection? Do spiders fall into the same pattern as pillbugs? How could she find out? Review the questions in the DragonflyTV investigations. Are they comparative questions?

A wonderful unit could be born with just one simple comparative question. To help your students with comparative questions, have them practice moving from description to comparison.

Do we have the resources?

Some excellent questions may require more resources than students have available. Yet, constraints in time and equipment can be used to inspire students to create ingenious solutions. Often, the best investigations are completed with rulers, string, paper plates, and other simple tools. While recognizing that not everything is possible, help your students realize that more is possible than they might first think.

It would be convenient, but not very interesting, if inquiry could be defined in a simple way. It cannot because the process of investigation relates to your life inside and outside the classroom.

If your students have great investigations, visit our Web site at pbskids.org/dragonflytv and tell us about them. Your students could be on DFTV!

For graduate-credit teacher workshops, visit www.DragonflyWorkshops.org

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