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DATA Nugget

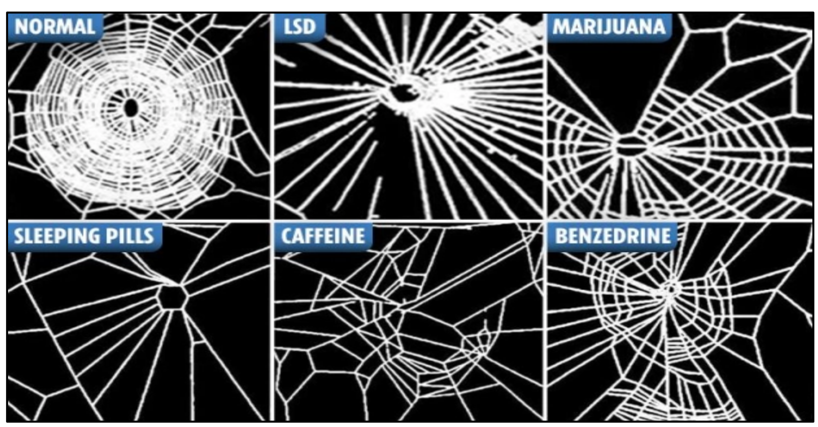
Spiders under the influence

Featured scientists: Chris Hawn from University of Maryland Baltimore County and Aaron Curry from Baltimore Ecosystem Study LTER

Research Background:

People use pharmaceutical drugs, personal care products, and other chemicals on a daily basis. For example, we take medicine when we are sick to feel better, and use perfumes and cologne to make ourselves smell good. After we use these chemicals, where do they go? Often, they get washed down our drains and end up in local waterways. Even our trash can contain these harmful chemicals. For example, when coffee grounds are thrown into the trash, caffeine gets washed into our waterways.

Animals in waterways, like insects, live with these chemicals every day. Many insects are born and grow in the water, absorbing the drugs over their lifetime. As predators eat the insects, the chemicals are passed on, working their way through the food web. For example, spiders living along riverbanks feed off aquatic insects and absorb the drugs from their prey.



Drugs significantly impaired spiders' ability to make webs. Retrieved from 1995 NASA report.

Just as chemicals change human behavior, they change spider behavior as well! Effects of drugs on spiders have been studied since the 1940s. Dr. Peter Witt first discovered that chemicals change spider web construction. Peter gave caffeine, and a few other drugs, to spiders to see if they would build their webs during the day instead of at night, which is when they usually work. After giving his test spiders some of the drugs, the spiders still created their webs at night. However, he noticed something unexpected – the web structure of spiders on drugs was completely different from normal webs. The webs were different sizes and had more spacing between each thread. Normal webs help spiders to easily catch prey. Irregularly shaped webs were not good at catching prey because insects could fly right through the large spaces. After his study, Peter knew that drugs were bad for spiders.

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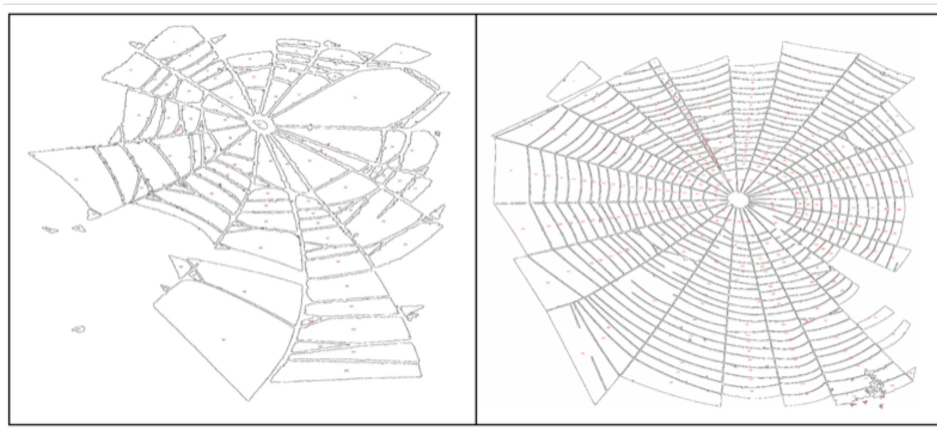
Chris (they/them), a current resident of Baltimore and a spider enthusiast, lives in a watershed that is affected by chemical pollution. They wanted to build on Peter's research by looking at spider webs in the wild instead of in the lab. Chris knew that many types of spiders live near streams and are exposed to toxins through the prey they eat. Chris wanted to compare effects of the chemicals on spiders in rural and urban environments. By comparing spider webs in these two habitats, they could see how changed the webs are and infer how many chemicals are in the waterways.

Field picture of an urban web using dark paper to make the web more visible for data collection.

Chris worked with Aaron, a local high school teacher, to do this research. They collected images of spiderwebs in areas around Baltimore. They chose two sites: Baisman Run, a rural site far from the city, and Gwynns Run, an urban site close to the city. Chris traveled to the sites and took pictures of eight spiderwebs at each location. Chris and Aaron expected that urban streams would have higher concentrations of chemicals than rural areas because more people live in cities.

When they got back to the lab, Aaron took the pictures and used a computer program to count the number of cells and calculate the total area of each web. These data offer a glimpse into whether spiders near Baltimore are exposed to harmful pharmaceutical chemicals and personal care products. If spiders are exposed to these chemicals, the webs will have fewer, but larger cells than a normal web. The cells will also have irregular shapes.



A computer program was used to measure web properties such as the number of cells, web area, and cell area. The web on the left is from Baisman Run. The web on the right is from Gwynns Run.

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Scientific Question: Does the habitat where a spider lives affect their exposure level to chemicals?

What is the hypothesis? Find the hypothesis in the Research Background and underline it. A hypothesis is a proposed explanation for an observation, which can then be tested with experimentation or other types of studies.

Scientific Data:

Use the data below to answer the scientific question:

Location	Habitat type	Area of web (mm^2)	Number of cells in web	Cell area (mm^2)
Baisman Run	rural	28939	153	69
Baisman Run	rural	14135	108	60
Baisman Run	rural	35807	76	153
Baisman Run	rural	55714	203	122
Baisman Run	rural	27450	191	47
Baisman Run	rural	35491	213	44
Baisman Run	rural	23174	145	73
Gwynns Run	urban	34933	342	66
Gwynns Run	urban	32898	893	11
Gwynns Run	urban	37128	471	54
Gwynns Run	urban	42826	489	58
Gwynns Run	urban	10821	41	75
Gwynns Run	urban	24728	319	17
Gwynns Run	urban	26453	829	21
Gwynns Run	urban	46892	544	30

Location	Habitat type	Average area of web (mm^2)	Average number of cells in web	Average cell area (mm^2)
Baisman Run	rural			
Gwynns Run	urban			

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Which data will you graph to answer the question?

Independent variable: ____________________________________

Dependent variables: ____

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Draw your graphs below: Identify any changes, trends, or differences you see in your graph. Draw arrows pointing out what you see and write one sentence describing what you see next to each arrow.

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Interpret the data:

Make a claim that answers the scientific question.

What evidence was used to write your claim? Reference specific parts of the tables or graphs.

Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about how spider web structures change when exposed to various drugs.

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Did the data support Chris' hypothesis? Use evidence to explain why or why not. If you feel the data are inconclusive, explain why.

Your next steps as a scientist: Science is an ongoing process. What new question(s) should be investigated to build on Chris' research? How do your questions build on the research that has already been done?