

PCBs in the Last Frontier: A Case Study on the Scientific Method

by

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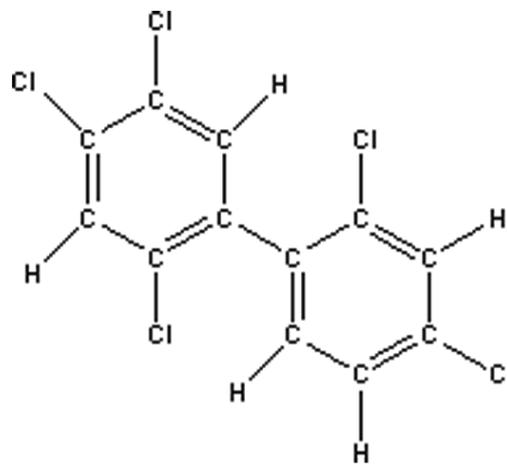
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Part I—PCBs

Polychlorinated biphenyls (PCBs) are compounds that were once used as insulators in electrical transmission lines and in the production of polymers. Each PCB differs by the quantity and location of the chlorine atoms. An example of one of the many different PCBs is shown to the right.

PCB production was halted in 1977 due to their potential toxicity, but the chemicals are still found in the environment due to their stability. Studies in remote areas of Alaska have shown that PCBs can even be found in lakes untouched by humans. There is no known natural process that produces PCBs, so all of the PCBs in existence are presumed to have been produced by humans.



2,2',4,4',5-Pentachlorobiphenyl

Questions

1. What scientific observation about PCB distribution is described above?
2. Propose a hypothesis or “explanatory story” to explain the global movement of pollutants such as PCBs. Specifically, how could they end up in the most remote Alaskan lakes?
3. Propose a method, either through observations or direct experimentation, which would test your hypothesis from Question 2. (Note: Your approach may be on a local scale despite examining a global phenomenon.)



Part II—Global Transport

Later studies showed that the global circulation of PCBs was at least in part due to atmospheric transport. PCBs enter the atmosphere by several mechanisms including the burning of organic material and evaporation in warmer climates followed by condensation at higher latitudes. This explained how chemicals made by humans could be found in areas untouched by humans.

Questions

1. Come up with a hypothesis or “explanatory story” to answer the following question: Should PCB levels differ significantly in Alaskan lakes that are near each other and at the same altitude? (Keep in mind that a hypothesis is an educated guess, so it requires a reason why you think your answer is correct.)
2. Propose a method, either through observations or direct experimentation, which would test your hypothesis from Question 1.



Part III—Significant Difference?

Recent observations of PCB levels in arctic lakes have shown that the levels of PCBs are not the same in all lakes that are near each other and at the same altitude. In fact, lakes at the terminus (i.e., the start) of river systems had higher PCB levels than completely isolated lakes that were close by.

Questions

1. What possible “explanatory story” might explain the observation described above?
(Hint: Think of species that leave a lake but return later in life.)
2. How would you test your hypothesis made above?



Part IV—Riddle Solved

Recent scientific studies have shown that sockeye salmon returning from the ocean to spawn in Alaskan lakes contain elevated levels of PCBs. After spawning the salmon die and their contents become part of the lake sediment and/or enter the food chain. The salmon are responsible for adding approximately six times as many PCBs to remote lakes as atmospheric circulation. The types of PCBs in the salmon also match those found in the ocean.

Question

1. Imagine yourself as a scientist working on this issue. What would you want to look at next?

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