Forensic Science: Oxymoron?

Max M. Houck, Ph.D., FRSC
Managing Director, Forensic & Intelligence Services, LLC

1. Capital cases require extreme levels of assurance, given the stakes
   1.1. Science is complex and, moreover, unfamiliar to non-experts in the field (even other scientists)
   1.2. Scientists are not very good at communicating complex ideas to non-scientists (courts, lawyers, juries)
   1.3. Therefore, special attention by lawyers can help resolve whether the science offered is “fit for purpose” or lacking

2. Science is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe.
   2.1. Science has several hallmarks:
       2.1.1. It works in testable statements
       2.1.2. It documents work and progress
       2.1.3. It is repeatable (potentially, if not actually)
   2.2. In science you form an explanation for what is causing a phenomenon; a hypothesis.
       2.2.1. A hypothesis is tested through experimentation, these experiments are designed to try to disprove the hypothesis.
           2.2.1.1. Whenever it fails to be disproved, evidence is provided to support the hypothesis.
       2.2.2. But importantly, a hypothesis is never proven, it never becomes fact.

3. Forensic science is a historical science
   3.1. Forensic science is a historical science, like geology or archaeology, that reconstructs past events, in this case, criminal events.
   3.2. It does so using not the event itself, which is over, but the remnants of the event, or the proxy data.
   3.3. All evidence is transferred from one location to another, creating proxy data, or what forensic scientists call evidence.
       3.3.1. Therefore, all physical evidence is “circumstantial”.

4. Forensic science can be thought of using the Three C’s
   4.1. Collection: Populations and samples
   4.2. Classification: What is it?
   4.3. Comparison: Questioned and known
   4.4. Relationships and context matter almost as much as the evidence itself.

5. Science can provide only statistical statements, not absolutes
   5.1. Sufficient evidence, from a variety of sources with strong statistics, can assist the trier of fact
   5.2. Most forensic scientists do not deal with statistics; those that do typically only apply them, rather than study them (that is, they are not statisticians)
   5.3. Sampling, assumptions, and interpretations are all weak points for forensic science
5.4. The expert cannot rely solely on *ipse dixit* (see Kumho); experience is a close cousin to *ipse dixit*.

5.5. Any absolute statements (“...to the exclusion of all other [evidence type] in the world” are a red flag.

6. Critical thinking tools can help lawyers peel away the jargon and complexity of the offered science to reveal whether it is valid or not

6.1. Think RED
   6.1.1. RECOGNIZE assumptions
   6.1.2. EVALUATE arguments
   6.1.3. DRAW conclusions

6.2. Assess the FOG
   6.2.1. FACT: Definitive
   6.2.2. OPINION: Supportable
   6.2.3. GUESS: Speculative

6.3. Six approaches
   6.3.1. WHO
      6.3.1.1. Who said it?
      6.3.1.2. Some one known? Famous?
      6.3.1.3. Someone in authority?
      6.3.1.4. Should it matter who said it?
   6.3.2. WHAT
      6.3.2.1. What did they say?
      6.3.2.2. Did they give facts, opinions, or guess?
      6.3.2.3. Did they give ALL the facts?
      6.3.2.4. Did they leave something out?
   6.3.3. WHERE
      6.3.3.1. Where did they say it?
      6.3.3.2. Was it in public or private?
      6.3.3.3. Did other people have a chance to discuss it?
      6.3.3.4. WHEN
         6.3.3.4.1. When did they say it?
         6.3.3.4.2. Before, after, during an important events?
      6.3.3.5. WHY
         6.3.3.5.1. Why did they say it?
         6.3.3.5.2. Did they explain it? Support it? Define it?
         6.3.3.5.3. Were they trying to make someone look good or bad?
      6.3.3.6. HOW
         6.3.3.6.1. Were they happy, sad, or didn’t care?
         6.3.3.6.2. Was it written or spoken?
         6.3.3.6.3. Could you understand it?

7. Carl Sagan’s Baloney Detection Kit
   7.1. Wherever possible there must be independent confirmation of the “facts.”
   7.2. Encourage substantive debate on the evidence by knowledgeable proponents of all points of view.
7.3. Arguments from authority carry little weight — “authorities” have made mistakes in the past. They will do so again in the future. Perhaps a better way to say it is that in science there are no authorities; at most, there are experts.

7.4. Spin more than one hypothesis. If there’s something to be explained, think of all the different ways in which it could be explained. Then think of tests by which you might systematically disprove each of the alternatives. What survives, the hypothesis that resists disproof in this Darwinian selection among “multiple working hypotheses,” has a much better chance of being the right answer than if you had simply run with the first idea that caught your fancy.

7.5. Try not to get overly attached to a hypothesis just because it’s yours. It’s only a way station in the pursuit of knowledge. Ask yourself why you like the idea. Compare it fairly with the alternatives. See if you can find reasons for rejecting it. If you don’t, others will.

7.6. Quantify. If whatever it is you’re explaining has some measure, some numerical quantity attached to it, you’ll be much better able to discriminate among competing hypotheses. What is vague and qualitative is open to many explanations. Of course there are truths to be sought in the many qualitative issues we are obliged to confront, but finding them is more challenging.

7.7. If there’s a chain of argument, every link in the chain must work (including the premise) — not just most of them.

7.8. Occam’s Razor. This convenient rule-of-thumb urges us when faced with two hypotheses that explain the data equally well to choose the simpler.

7.9. Always ask whether the hypothesis can be, at least in principle, falsified. Propositions that are untestable, unfalsifiable are not worth much. Consider the grand idea that our Universe and everything in it is just an elementary particle — an electron, say — in a much bigger Cosmos. But if we can never acquire information from outside our Universe, is not the idea incapable of disproof? You must be able to check assertions out. Inveterate skeptics must be given the chance to follow your reasoning, to duplicate your experiments and see if they get the same result.

8. Suggested readings