Science for All: Bringing Science to the People of Philadelphia

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What happens if you submerge candy in a mixture of water and baking soda? Depends on the candy. M&Ms do nothing, but Sour Patches fizzle like fireworks due to their acidity! From the acids in foods to the circuits in smartphones, the footprints of science are all around us. Yet widespread doubts regarding climate change and vaccine safety illustrate that many people do not fully understand science or its benefits to society. Maintaining a scientifically literate and engaged public is thus important, not
just to prevent the propagation of bad science, but also to ensure that taxpayer-funded research and the resulting rewards are understood and appreciated.

To support this cause, Dr. Zenobia Cofer, a postdoctoral researcher at the Children’s Hospital of Philadelphia (CHOP), created Science for All. Formed in 2015, this organization holds local science outreach events with the help of volunteer postdocs from CHOP, The University of Pennsylvania (UPenn), and the Monell Chemical Senses Center. As Dr. Cofer explained, through these events, this group aims to educate the public, generate excitement about science, and give lay people an opportunity to meet and interact with scientists. Additionally, these efforts give scientists a chance to learn how to explain their research, and science in general, to a lay audience. Science for All held three such events this past fall at the Free Library of Philadelphia’s Fumo Family Branch.

The first event brought science to children on Halloween with a trio of interactive demonstrations. Participants saw the effects of submerging dry ice in water in a demo led by Dr. Cofer. In another activity led by myself and inspired by demos at candyexperiments.com, participants learned about the acidic content of candies by dropping Halloween treats into a baking soda solution. A particularly notable activity led by Dr. Gautami Das demonstrated DNA extraction from blueberries using alcohol and detergent. As explained to participants, releasing DNA from the fruit via detergent followed by precipitating it with alcohol is the method used by scientists in a laboratory. Thus, although these demos appeared to be merely simple and fun activities, they gave audience members insights into laboratory procedures and showed that scientific phenomena are present all around us, even in everyday items found in our kitchens.

In November, Science for All held its next event, “Scientists Talk Science.” This was the group’s first event aimed at teens and adults and consisted of presentations by researchers outlining the significance of their work. Dr. Amanda Zacharias
highlighted the importance of intergenic DNA, the “dark matter” of the genome, and its role in regulating gene expression. Dr. Jessica Chacon outlined her strategy to improve melanoma therapy by culturing patient-derived T cells, to make them more aggressive, followed by reintroducing them to the patient. A talk concerning the circadian rhythm by research associate Dr. Sarah McLoughlin concluded the event.

Communicating research to a lay audience is no easy task. To accomplish this, the presenters focused on the underlying concepts motivating their studies rather than technical details. Importantly, they utilized real-world examples to emphasize their work’s significance to society. Dr. McLoughlin, for example, highlighted the importance of circadian rhythm research by noting that the Chernobyl accident occurred at night, when workers are least alert. The presentations were well received by the audience. As library branch manager and audience member Renee Pokorny mentioned, it “…was fascinating to hear what kind of research people are currently conducting…. What I loved about [the presentation[s] was they made it...really easy for me to grasp as a layman…. Science actually intimidates me, and [the presentations] made me really comfortable and interested in what the scientists are doing.”

Science for All’s most recent event, “The Science of Baking,” was held in mid-December. Directed towards children and families, it was the most hands-on event of the three and explained the chemistry behind converting butter, sugar, and flour into cookies and cakes. Participants baked a pound cake after calculating the required amounts of ingredients, a tomato soup cake after determining the needed amount of leavening agents, and cookies using a variety of sugars. Each baking session was preceded by an explanation of the underlying science by Drs. Cofer and Zacharias, Dr. Keeley Mui, and myself. The bakers gained much from these activities beyond just a hearty meal. They learned to see a recipe as scientists do, as a protocol where reagent types and amounts can be adjusted as needed to change the outcome of the procedure.

“The [Science for All presentations] made me really comfortable and interested in what the scientists are doing.”

-- Attendee at “Scientists Talk Science”

Given the hectic lives that scientists live, why did these researchers take the time to volunteer? As Dr. McLoughlin pointed out, being largely government-funded, scientists
have an obligation to communicate their endeavors to the public. “We don’t need to live separate from society, we’re part of society and we should tell people what we do, cause we’re dealing with taxpayers’ money....” Importantly, these outreach activities were also an opportunity to develop valuable communication skills. “A lot of people don’t realize how challenging it is to explain your research to a non-scientist,” explained Dr. Chacon. “[These skills are] really critical because not everybody you meet is going to be a scientist -- such as donors, your spouses, your children, your family...this kind of practice helps you to become a better scientist by allowing you to gain expertise in talking [with] non-scientific terms....”

Since its creation early last year, Science for All’s popularity has grown, with “The Science of Baking” having particularly strong turnout. The participants have benefited by meeting scientists and learning to see science in everyday life. Likewise, the volunteering postdocs have honed their communication skills and given back to the public that financially supports them. As Dr. Cofer noted, it is also particularly rewarding to see that more and more people are attending these events after hearing about them simply by word of mouth. Science for All will continue its mission of bringing science to the people of Philadelphia with additional events in the upcoming year. For more information, contact Dr. Cofer at zenobia.cofer@gmail.com.

A Hidden Medical Legacy: How Habits Influence Health Across Generations

By Amita Bansal, Ph.D., amitab@mail.med.upenn.edu, @amita_bansal

Every day we are exposed to a compound, Bisphenol A (BPA), a manmade chemical commonly used in many types of consumable goods, from the linings of canned and packaged foods to plastic bottles, and even baby pacifiers, paper receipts and eyeglasses. Our exposure to BPA is ubiquitous; we are exposed through what we eat, drink and touch. BPA can even be found on unwashed hands. Detectable amounts of BPA are found in urine of >90% of the United States population (1). Recently, BPA has captured even more attention because of its association with increased risk of diabetes and obesity in humans and animals. BPA is believed to disrupt the normal hormonal activity in the body, and is therefore scientifically categorized as an endocrine disrupting chemical.

In our laboratory, using a mouse model, we...
have demonstrated that offspring (first generation progeny, or the mouse’s “children,” and second generation progeny, or the mouse’s “grandchildren”) of mothers who were exposed to BPA (lower BPA group: 10 micrograms per kilogram of body weight per day, and upper BPA group: 10 milligrams per kilogram of body weight per day) in their food throughout pregnancy and the nursing period were significantly fatter and had reduced ability to metabolize glucose compared to first and second generation progeny of mothers who were not exposed to BPA (control group) (1). Male offspring were mostly affected and female offspring unaffected (1). Most frightening, the BPA doses used in this study were within the current safe human exposure levels. How the effects of BPA are transmitted from one generation to the next remains unknown. One possible effect of BPA is its effect on glucose metabolism.

We know that in order to metabolize glucose, beta cells of the pancreas produce a hormone called insulin. Insulin acts on target tissues such as liver, muscle, and fat, where glucose is processed. The body fails to metabolize glucose when either beta cells do not produce enough insulin (insulin secretory failure), or insulin fails to affect the target tissue (insulin resistance). To see which of these mechanisms might be at work, we performed physiological tests in our animals. We found that first and second generation progeny of mothers exposed to lower doses of BPA, especially males, had reduced insulin secretion, while those from mothers exposed to high doses of BPA were insulin resistant compared to mice that were never exposed to BPA. In BPA-exposed male animals we also observed defects in beta-cell mitochondrial function. Healthy mitochondria are essential to meet the energy demands for insulin secretion. We wanted to know what mechanisms caused these inter-generational changes.

To see if BPA was affecting how genes are turned on and off, we screened expression levels of genes that play an important role in insulin secretion in pancreas and insulin action in liver. Using a high throughput next-generation whole transcriptome sequencing technique, RNA Seq, we found that both lower and upper doses of BPA exposure in mothers alter expression of several pancreatic genes in male offspring. We have also used a real-time measure of gene expression levels, called qPCR, to measure gene expression changes in pancreas and liver. Our qPCR findings indicate that expression levels of several pancreatic and liver genes are altered in children and grandchildren of lower and upper dose BPA exposed mothers. Currently, we are investigating whether epigenetic alterations, i.e. changes where
expression of a gene is altered without changing the DNA sequence, are involved in the transmission of the observed gene expression changes from one generation to the next.

Our findings using a mouse model suggest that exposure to BPA in the womb and throughout nursing has deleterious effects on the metabolic health of the first and second generation progeny, especially in male mice. Although we don't know if BPA affects humans in the same way it affects mice, we suggest that, to be safe, people should make informed decisions while shopping for groceries, adapt a healthy lifestyle and choose fresh fruits and vegetables as opposed to canned and packaged foods. Importantly, policy makers overall use of BPA in manufacturing should also consider strictly regulating products, which might otherwise have severe public health consequences.

REFERENCES


Even before completing his Ph.D. in neuroscience, Mark Bell, a third-year patent agent at the law firm Pepper Hamilton LLC, knew he would not take the typical academic track. Though he loves science, he has a mind for business. Therefore, he began a venture capital internship to learn how applications from labs spin off into companies and real-world products. After receiving his Ph.D., Bell moved straight to working with biotechnology start-ups, and in the process, met several IP lawyers, as IP is crucial for the development of these small companies. Soon Bell realized that IP might be the field for him. In his words, IP/patent law “is where science meets law meets business, and that’s a great place to be. I’m always learning something new. Most people appreciate the speed [with which] science and technology change, but business and law change too, more than you might expect.”

So what does a patent agent do? Patent agents create patent applications and defend those applications to the United States Patent and Trademark Office (USPTO) in a process called patent prosecution. Not all applications are successfully issued as patents. Unlike patent attorneys, patent agents focus solely on patents, and cannot deal with other forms of IP, such as trademarks or copyrights, or litigate the use of patents. Bell says his typical day involves speaking with clients (especially inventors), writing new patent applications, and assisting attorneys with patents and other analysis and diligence projects such as mergers and acquisitions involving biotech companies. Although Bell works at a law firm, patent agents can also find jobs in technology transfer offices at universities or directly working for companies. Regardless of the setting, they have the same primary function: writing and prosecuting patents and assisting with the process of moving scientific and technological ideas into the business sphere. Bell particularly loves working with inventors and new ideas in a broad range of applications, as patent law by its nature deals with cutting edge technology in many fields. One downside, for those who continue on to become patent attorneys, as Bell plans to do, is that they will likely work long hours, but in return they are better compensated and can perform a wider variety of tasks.

A normal career arc in patent law is to get a science Ph.D., do a postdoctoral fellowship, and then become a technical specialist. One can also get to this point with a masters degree in something such as engineering. The next steps are passing the USPTO registration exam, commonly known as the “patent bar” to become a patent agent, and then if one so chooses, to attend law school and become a patent attorney. Not all patent attorneys take this track. For example, if you know you want to go into patent law, you can take the patent bar on your own before getting a job. Bell explains that while passing the patent bar exam prior to your job search will make getting a job easier, “what I learned while working made passing the patent bar exam much easier. Either way, take a training course before you take the test!” Also consider that if you take the patent bar while working as a technical specialist, your employer may cover many of the associated costs.

How do you know if you would be a good fit for patent law? Bell described three main characteristics needed to succeed in the field. First, you need an analytical mind with a love of fine details, especially technical details. “Most postdocs already know that
accurate details matter, and have honed their critical thinking skills,” Bell says. Second, because of the strong financial component – patents cost money to make and enforce – if you don’t inherently like business, patent law will not be the best fit for you. Finally, communication skills are key to understanding and translating ideas between the diverse vernaculars of technology, law, and business. Bell explains, “Most postdocs have written grants and papers. In a career dealing with patents, you are similarly writing to communicate … not for a general audience, but for the audience of the patent. For example, a biochemistry patent describes something in a manner that will allow it to be replicated by another biochemist, but not necessarily by a mechanical engineer.”

If this sounds like you, start learning more. The USPTO website and sciencecareers.com are good places to start, with articles such as this: http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2011_10_14/caredit.a1100113.

Bell also recommends “look up patents in your scientific area of specialization using Google Patents and see if you have any interest. They read like science papers but with law in them. If you read it and … think it’s an interesting way to describe a new product or invention, that’s a good indicator that you might enjoy a career in patent law.”

So how do you get started on your path to patent law? We have an amazing network as part of the UPenn community. Take advantage of it! Do alumni searches on LinkedIn or contact the career office to help you locate alumni who are in patent law. Bell says, “Write to them nicely to ask for an informational interview. Face time is really important. That person can point you in the right direction, and provide you with contacts or information. Get to know people.” You can also join business events involving startup companies, as patent attorneys often attend. Bell emphasizes that “once you move past being someone just looking for a job to someone who has taken the time to learn and meet with people, your chances go up dramatically.”
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Outreach bags for the homeless

can give money, items, food, or time!

- Individually wrapped snacks
  - Trail mix, breakfast bars
  - Peanut butter crackers, pretzels
  - Homemade cookies
  - Jerky (beef, turkey, etc), foil pack of chicken/tuna salad
- Gift cards for food (McDonald’s, etc)

- SOCKS! Especially wool!
- Gloves
- Handwarmers
- Baby wipes
- Ziplock bags (large)
- Toothbrush/paste

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