Teen Biotech Blogging Challenge 2021

What is the Teen Biotech Blogging Challenge (TBBC)?
The TBBC is a blogging competition that builds on the success of the long-running website design competition, the Teen Biotech Challenge (2005-2020). Like the original contest, students will be asked to research a biotech topic and share fact-based information in an online format suitable for general audiences. The blog format and required media element will allow students to focus on developing creative writing and graphic design skills, along with building their knowledge of biotechnology. Winning first place blogs in the junior (Grades 6-8), intermediate (Grades 9-10) and senior (Grades 11-12) contest levels will be showcased on our Biotech Program website each year, as well as a list of all contest winner blog titles (2nd place, 3rd place and Honorable Mention).

Contest Instructions

• Students will write an original blog (500-750 words) on a biotech topic within one of the following categories*:
  o Agricultural Biotechnology & Food Science
  o Computational Biology & Genomics
  o Drug Discovery & Biomanufacturing
  o Environmental Biotechnology & Planetary Health
  o Molecular Tools: Nanobiotechnology, Synthetic Biology & Genetic Engineering
  o Regenerative Medicine & Biomedical Engineering

  (*Please see the end of this document for descriptions of these categories and the types of topics students may want to consider.)

• Blogs should be fact-based, supported by at least 3 scientific references, and suitable for reading by the general public (approximately 6th grade reading level and scientific understanding).

• Blogs should be saved as a .docx file, with the following sections in order from the top:
  1. Blog title
  2. Student author’s name, grade and school affiliation
  3. Blog text
  4. List of 3 references in a suitable format (e.g. APA, MLA, Chicago or CSE; see UC Davis Library citation guidelines for more information)
  5. Three keywords or phrases
  6. Image caption

  Keywords or phrases are those that a person searching for your blog online would enter into an internet browser search window (e.g. “stem cell”, “designer baby” or “bioenergy”). The image caption should briefly describe the content of your original image.

• Students will design/create and submit one original image (photo, infographic, table, graph or other) to illustrate their blog content (file type .jpg or .png only and limited to less than 3MB size).
Important Contest Dates

• October 1 – **TBBC application and instructions posted online.**
• April 1 – Contest Deadline. The following items will be due electronically by 11:59pm PDT:
  o Application form and blogger reflection (**Google doc to completed online**).
  o All blog materials (blog text, three key words, three references, original image <3MB, image caption) due via email attachment (.docx for blog text, references, key words and image caption, .jpg or .png no larger than 3MB for the image) to **biotechprogram@ucdavis.edu**. The email subject line should contain the student’s name, grade and school name. The email text should indicate the blog title and TBBC category.
  o TBBC contest agreement signed by the student applicant and a legal guardian.
• Early May (date TBA) – Contest winners will be announced across the six TBBC categories and contest levels (junior, intermediate and senior). The first-place winning blogs/images will be hosted on the Biotech Program website.

Eligibility

• Participants must be California* middle school or high school students:
  o Grades 6-8 (Junior Level)
  o Grades 9-10 (Intermediate Level)
  o Grades 11-12 (Senior Level)
• Participants may only submit one entry per contest year.
• Entries may only be submitted by individuals (no team entries).
• Each participant and one of their legal guardians will be asked to sign the TBBC Contest Agreement described below.

(*Note: If there are students from other states or global locales who would like to participate, please inquire. We are an all-volunteer group of academics and graduate students administering this contest, so capacity for applicants is limited by personnel availability. However, there may be extra capacity in some contest years.)

Application Information to Be Entered on the **Google Doc**

• Student name, email, and contact phone #
• Blog category and title
• Parent/guardian name, email and contact phone #
• Student school name and/or academic program (e.g. homeschool or independent study)
• Student grade level
• Sponsor teacher name and email (optional – please indicate if participating under the guidance of a sponsor teacher via an individual, class or academic program project)
• Blogger reflection (100-150 words) – in a few sentences, participants should outline why they chose their blog topic and the most surprising thing learned while writing the blog/creating the accompanying visual image.
TBBC Contest Agreement

Students and parents will be asked to sign an agreement that will be kept on file with their application and blog entry materials, verifying their understanding that:

- Submitted blogger reflections, blogs and accompanying visuals (infographics/images/figures) are original content created by the student participant alone (no plagiarism). For more information on how to avoid plagiarism, see the UC Davis University Library YouTube video on the topic.
- Biotech Program leadership reserves the right to re-categorize contest entries prior to judging, as needed, to ensure blogs on similar topics are reviewed as a group.
- Biotech Program leadership reserves the right to disqualify entries for plagiarism (in whole or part), inappropriate content or inaccurate information.
- Submitted blogs and accompanying content winning first place in a contest category will be publicly posted on the Biotech Program website for an indeterminate period of time, with the student publicly acknowledged as the blog author and the content subject to a CC BY-NC-ND Creative Commons license.
  - CC BY-NC-ND: This license allows reusers to copy and distribute the material in any medium or format in unadapted form only, for noncommercial purposes only, and only so long as attribution is given to the creator. https://creativecommons.org/about/cclicenses/
  - CC BY-NC-ND includes the following elements:
    ▪ BY – Credit must be given to the creator
    ▪ NC – Only noncommercial uses of the work are permitted
    ▪ ND – No derivatives or adaptations of the work are permitted
- Blogs that win 2nd place, 3rd place or Honorable Mention will be noted on a list of annual winners (blog title, student participant name, school name), but the full content of these blogs may or may not be posted on the Biotech Program website. Resources permitting, these winning blogs may be made accessible via a different format (e.g. pdf compilation linked to the TBBC website).
- Submitted blogger reflections, blogs and accompanying content may be used in part or whole by the Biotech Program in presentations, print materials or online media in order to promote the TBBC contest and educate non-specialist audiences (within CC BY-NC-ND guidelines).

Category Descriptions

The categories below are the same as the focus areas for the final Teen Biotech Challenge contest and will be familiar to students who have participated in past TBC competitions. If unsure of a blog topic’s suitability or the category it belongs to, please send a query to TBBC administrators at biotechprogram@ucdavis.edu.

I. Agricultural Biotechnology & Food Science

Understanding the interaction between genes and the environment will help us to optimize agricultural production systems and cope with climate change. As world population accelerates toward 8 billion, we need to find sustainable strategies to increase the quantity and quality of our food and feed supplies. Agriculture must also deliver more plant biomass, fibers, and seed oils for renewable products. Agricultural scientists are challenged to increase production yields while preserving natural resources, protecting biodiversity and dealing with the ever-shrinking availability of arable farmland and available water resources. The tools of biotechnology can be used to address challenges in agriculture by speeding up traditional methods of plant and animal
breeding, helping to identify the most sustainable farming and ranching practices, and in understanding the biology of important agricultural species and ecosystems.

Possible topics for research include, but are not limited to:

- **Aquaponics**
- **Cellular agriculture** – production of edible proteins, fibers and other nutrients within culture systems
  - Plant-based proteins and meat alternatives
  - Food allergen replacement products (e.g. Just Egg from mung bean protein)
  - Lab-grown meats
- **Crop and animal-associated microbes** for health and agricultural productivity
- **Post-harvest food safety** (monitoring microbes that may make people sick)
- **Vertical farming** (indoors)
- **Plant and Animal Breeding Methods**
  - Crop breeding by marker assisted selection (MAS), mutation breeding, transgenesis, gene-editing, etc.
    - Agronomic crop traits - Herbicide tolerance (HT), Insect resistance (IR), Disease resistance, Salt tolerance, Submergence/flood tolerance, Water use efficiency (WUE)/drought tolerance, Nitrogen use efficiency (NUE)
    - Nutritionally enhanced crops (BioCassava Plus, Golden Rice, celiac-safe wheat, GLA safflower, high oleic soybeans)
    - Crops that produce biomass or high value products (pharming, plant-made industrial products)
  - Animal breeding by marker assisted selection (MAS), mutation breeding, transgenesis, gene-editing, etc.
    - Disease-resistant pigs, chickens, and other agriculturally important animals
    - Fast growing salmon or other aquatic species (efficiency = more edible protein, fewer inputs!)
    - Technologies for large livestock breeding (gene-editing for polled dairy cattle, cloning valuable racehorses)

**II. Computational Biology & Genomics**

Computational biology or bioinformatics is the use of information technology to store, sort, analyze, share and understand biological data. Through data analysis and machine learning, scientists aim to build accurate computational models that can correctly predict biological phenomena. Similar informatics tools are used, whether one is analyzing events that occur within a single cell (e.g. protein folding of a particular polypeptide) or looking at interactions in multicellular systems (e.g. gut microbiome impacts on human health). Ultimately, the goal of computational biology is to help us understand how complex natural systems work. Thanks to computational biology tools and genomics research, information about an individual’s genome is now readily available to help tailor lifestyle choices and medical treatments. Understanding the relative contributions of
genes vs. the environment to human health and well-being is a complex task, but with the emerging tools of personal genomics, we are at the dawn of a new era in medicine.

Possible topics for research include, but are not limited to:

- **Computer simulations of complex biological processes and systems**
  - Spread of infectious disease in a population (e.g. SARS-CoV-2 evolution / COVID-19 pandemic)
  - Predator-prey interactions
  - Nutrient and energy flows
  - Predictive modeling of intracellular biological processes (gene expression, RNA processing, protein production and folding, metabolic path)

- **Personalized medicine – tailoring medical treatments to genotypes and understanding genetic contributions to disease susceptibilities**

- **Direct-to-consumer genome testing** (deCODE, 23andme)

- **Human genetics and reproduction**
  - Human cloning and “designer babies”
  - Understanding genome mutations and inheritance of genetic diseases
  - Epigenetics (environmental influence on gene expression/inheritance of traits)

- **Ancestry/human DNA profiling**
  - Human ID and paternity/relationship testing/mitochondrial DNA and Y-chromosome analysis
  - Fetal-maternal microchimerism/"vanishing twins"/chimeric organs and tissues
  - Genetic relationships between ancient populations of people (modern humans, Neanderthals, Denisovans and other ancient lineages)

- **Genomics and evolution**
  - Hologenomics – organisms evolving together
  - Metagenomics and microbiomes (plant-soil microbiome studies, Human Microbiome Project, breast milk influence on infant gut flora)
  - Tree of Life Project
  - Comparative genomics (e.g. What makes us human, compared to other primates?)

- **Life science informatics** (genome sequencing projects, online tools and resources [e.g. NCBI’s GenBank, MapViewer, Entrez Gene, OMIM, PubMed])

### III. Drug Discovery & Biomanufacturing

Many types of cells, including mammalian cells, plant cells, fungi, yeast and bacteria may be genetically engineered to produce useful proteins, therapeutic drugs, vaccines, industrial enzymes and other industrial precursors through biomanufacturing. Research and development in this field generally includes the use of recombinant DNA technologies, screening of candidate organisms or molecules for appropriate activities and monitoring small scale cell culture systems. Downstream processes require an understanding of large-scale fermentation systems & methods for isolating and purifying proteins and other molecules of interest. An important aspect of pharmaceutical biomanufacturing is compliance with Good Manufacturing Practices (GMPs)
and cooperation with the US Food and Drug Administration (FDA) to conduct clinical trials and gain drug approvals.

Possible topics for research include, but are not limited to:
- Development of biologic drugs (vaccines, monoclonal antibodies, hormones) to treat autoimmune disorders, cancer, diabetes and other chronic diseases, and infectious diseases
  - SARS-Cov-2/COVID-19
  - HIV/AIDS
  - Orphan drug development for rare genetic diseases
  - CAR-T cell engineering / immunotherapy to target cancer
- Antibiotics and new technologies to treat infectious disease
- Vaccines and therapeutics for “Neglected Tropical Diseases” (parasitic worms, leishmaniasis, Chagas Disease, river blindness, African sleeping sickness, leprosy, elephantiasis, snail fever, dengue fever)
- Industrial enzymes

IV. Environmental Biotechnology & Planetary Health
Environmental biotechnology uses living cells and systems to address natural resource limitations, the need for renewable energy technologies, pollution and climate change. As technological advances in information, transportation, medicine and many other areas of human achievement require ever more electricity and liquid fuel supplies; we need to find clean, “green” sources to keep us moving! Harnessing the metabolic and photosynthetic talents of microalgae, microbes and feedstock plants, scientists are developing new liquid biofuels, such as cellulosic ethanol and biodiesel. Biofuels decrease reliance on petroleum, which is beneficial for the environment and the economy. Scientists are also looking for ways to convert the energy stored in biomass into heat and electricity, including the development of anaerobic digestion systems and microbial fuel cells.

“Green chemistry” is a field of research that aims to eliminate the use or production of hazardous substances during industrial processes. One option that green chemists pursue is the use of genetically engineered cells (algal, microbial, fungal, insect, plant, etc.) to produce bioplastics, industrial precursors and useful chemicals. Cells and organisms have been genetically engineered (or characterized for naturally occurring abilities) and used in bioremediation (clean-up of hazardous substances in soils and waterways).

Possible topics for research include, but are not limited to:
- Biofuels and Biomass conversion
  - Algal biofuels
    - Macroalgae (seaweed!) for biomass
    - Microalgae for oils and transportation fuels
  - Anaerobic digestion of biomass or “biogassification” (municipal trash, human and animal waste, agricultural waste)
  - Biodiesel
  - Cellulosic ethanol, other liquid alcohols
Feedstock development (specific crops for maximum biomass)
Microbe or enzyme engineering (to breakdown and ferment biomass)

- Bioremediation
  - Metal-accumulating bacteria and plants (arsenic, lead, palladium)
  - Microbial biodegradation of petroleum products, chlorinated organic solvents, and other contaminants
  - Phytoremediation (plants remove or degrade contaminants)

- Green Chemistry
  - Bioplastics

- Microbial fuel cells
  - Water desalinization
  - Electricity generation from biomass

V. Molecular Tools: Nanobiotechnology, Synthetic Biology & Genetic Engineering

The Molecular Tools focus area captures all technologies for manipulating, changing or synthesizing cellular structures or useful molecules in biotechnology. Nanobiotechnology is the use of nanoscale (10⁻⁹) molecular systems to develop medical diagnostic devices, biomaterials, therapeutics and industrial processes. Research in nanobiotechnology often leads to the development of new tools that may be important “platform technologies” that are useful across many different fields of biotechnology. Synthetic biology uses information gained through computational biology and informatics (which allows understanding/modeling of biological systems) to design and/or reverse engineer biological devices and systems for useful purposes. Genetic engineering via “molecular tools”, such as the CRISPR-Cas9 system, allows scientists to redesign cellular systems by specifically changing the genetic code.

Possible topics for research include, but are not limited to:

- Genome editing (CRISPR-Cas9, TALENS, ZFNs)
- DNA computing
- Synthetic biology
  - Designing biological devices and systems (molecular circuits, diagnostic tools, biosensors)
  - Designing whole viruses, microbes and other organisms
- Nanobiopharmaceutics
  - Drug delivery via nanocarriers (liposomes, nanoparticles)
  - Nanoparticles acting as drugs and therapeutics (biodegradable nanoparticle for immunotherapeutic MS treatment, nanoparticles as antimicrobial agents)
- Biomimetics or “biologically inspired design”
- Current and developing DNA sequencing technologies
  - Nanopore DNA sequencing (single molecule)
  - “next generation” DNA sequencing (short reads – 454 pyrosequencing, SOLiD, Ion Torrent, DNA nanoball, Illumina)
- “Lab-on-a-chip” systems and sensors
Molecular and medical imaging systems

VI. Regenerative Medicine & Biomedical Engineering
Biomedical engineers, immunologists, physicians and medical researchers from many fields are looking to stem cells and advanced biomaterials for new ways to repair damaged and diseased human tissues and organs. Work in regenerative medicine began many years ago, with the first bone marrow transplants, organ transplants and skin grafts. However, patients receiving donated body tissues have had to deal with immune responses to donated tissues, taking immunosuppressive anti-rejection medications that negatively impact length and quality of life. A revolution in regenerative medicine is now occurring, with new discoveries in stem cell technologies and biomaterials derived from engineered materials and patients own stem cells, preventing immune rejection and repairing the body. For aging populations in developed countries, such as U.S. Baby Boomers, regenerative medicine will play an especially important role in maintaining quality of life and allowing these people to contribute to our society well into their 70’s and 80’s. Regenerative medicine is also a vital field for treating and rehabiliting military veterans that have sustained severe injuries in the line of duty.

Possible topics for research include, but are not limited to:
- Artificial limbs and biocompatible prostheses
- Stem cell types & potential uses
  - Cord blood stem cells
  - induced pluripotent stem cells
  - embryonic stem cells vs adult stem cells
- Synthetic organs
- Non-immunogenic tissue scaffolds & biomaterials

Helpful Resources for Blogging and Science Communication
Below, we have listed a selection of researchers, journalists, bloggers, companies and professional organizations involved in blogging and science communication. Caveat - this is sampling of a large body of publicly available work, tools and “how to” advice, so feel free to explore other resources.

General Guidelines for Social Media and Science Communication Best Practices
- UC Davis Social Media Guidelines https://www.ucdavis.edu/social-media/guidelines
- AAAS Communication Toolkit https://www.aaas.org/resources/communication-toolkit

Creating Infographics and Images
- American Chemical Society https://www.acs.org/content/acs/en/pressroom/reactions/infographics.html
- Biofortified https://biofortified.org/info/
- Biorender https://biorender.com/
- Chemix https://chemix.org/
- LABIOTECH https://www.labiotec.eu/infographics/
UC Davis Bloggers

- Jonathon Eisen, The Tree of Life Blog [https://phylogenomics.blogspot.com/](https://phylogenomics.blogspot.com/)
- Paul Knopfler, The Niche Blog [https://ipscell.com/](https://ipscell.com/)
- EggHead Blog (curated by Andy Fell) [https://egghead.ucdavis.edu/](https://egghead.ucdavis.edu/)
- ScienceSays [https://davissciencesays.ucdavis.edu/](https://davissciencesays.ucdavis.edu/)
- UC Davis News [https://www.ucdavis.edu/news](https://www.ucdavis.edu/news)

Professional Science Communicators - Writers and YouTubers

- Maryn McKenna [https://marynmckenna.com/](https://marynmckenna.com/)
- Ed Yong [https://edyong.me/](https://edyong.me/)
- Carl Zimmer (advice to new science writers) [https://carlzimmer.com/to-beginning-writers/](https://carlzimmer.com/to-beginning-writers/)

Science Organizations – News Stories and Blogs

- AAAS Science Magazine [https://www.sciencemag.org/news](https://www.sciencemag.org/news)
- PLOS Blogs [https://blogs.plos.org/](https://blogs.plos.org/)