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Research Experiences for Teachers (RET)

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Gold nanoparticles, Mutations, and Cancer Research

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High School Science Teacher

2017-2018

**Description:**

Students learned the process of synthesizing gold nanoparticles on table top in order to compare and contrast their samples to those made in a microfluidic device. Students also learned about mutations and cancer and how gold nanoparticles are being used in current cancer research.

**Learning objectives:**

Synthesize gold nanoparticles.

Compare table top made particles to those made in a microfluidic device.

Understand and explain mutations.

Understand and explain gold nanoparticles and their use in cancer research.

**Prerequisite knowledge/skills:**

Students need to have an understanding of cells, transcription, translation, protein synthesis, and mutations.

**Duration:**

Classroom instruction was designed for a five day lesson.

Best fit for a 90 minute class period for the actual lab.

**Target grade level(s):**

Best fit for 10th – 12th.

**Target subject(s):**

Best fit for a Biology class and maybe a Biochemistry class.

**Alignment with Next Generation Science Standards:**

HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

**Background:**

In the previous unit, students covered cells, their organelles, and the process of transcription, translation, and protein synthesis. This then led into the unit regarding mutations, cancer, HeLa cells, and gold nanoparticles.

**Preparation time:**

Lab prep took approximately ten minutes to set up. Worksheets, lessons, and planning took about an hour.

**Preparation notes for materials and chemicals:**

Best advice would be to purchase the gold nanoparticle kit from Flinn Scientific. Comes with all needed chemicals and droppers. Teacher will only have to supply flasks, stirring rods, beakers, hot plates, and distilled water.

**Safety:**

Students and teacher wore appropriate lab coats or aprons, safety goggles, and gloves. Students were also reminded to be careful with the hot plates.

**Waste disposal:**

I completed this lab and unit at a very small, rural school that did not have the proper disposal site. Therefore, I mailed my waste to a local university that was able to properly dispose of the gold nanoparticle waste.

**Materials/supplies/equipment needed with example source listed/pricing/CAS # and contact information**

Materials include: lesson plans, worksheets, beakers, stirring rods, hot plates, distilled water, gold nanoparticle kit. I had all of the supplies in my science lab except for the gold nanoparticle kit. It can be purchased at <https://www.flinnsci.com/ruby-red-colloidal-gold-nanotechnology---chemical-demonstration-kit/ap7117/>. Item #: AP7117

The kit was 37.50 but ran 7 experiments per one kit.

**Procedure/activity:**

Day One: Students learn about mutations through direct instruction and then practice identifying mutations.

Day Two: Students learn about HeLa cells, cancer, and mutations.

Day Three: Students will learn about different methods to synthesize gold nanoparticles and the pros and cons of each.

Day Four: Students synthesize their own gold nanoparticles.

Day Five: Students are assessed over the material from the week

**Presentation talking points:**

**Slide 1:** Introduction of the Beckman Institute where the original research took place.

**Slide 2:** Introduction of the research and the synthesizing of the gold nanoparticles.

**Slide 3:** Description of the project and variables that were changed. This helped researchers to see how different changes affected the gold nanoparticles.

**Slide 4:** Shows a diagram of the microfluidic device and a table of the results.

**Slide 5:** Description of the research the original facility had completed and their plans for the future.

**Slide 6:** An actual picture of the microfluidic device.

**Slide 7 - 11:** Pictures of the different conclusions at the various temperature levels.

**Slide 12:** A table showing the different conclusions at the various temperature levels.

**Slide 13:** The description of the module and what the unit for students would include.

**Slide 14:** Acknowledgments.

**Slide 15-17:** References.

**Links to the research articles and other resources:**

Expert advice of RET mentors

**Images:**

http://www.sigmaaldrich.com/materials-science/nanomaterials/gold-nanoparticles.html

By Aleksandar Kondinski - kondinski.webs.com, GFDL, <https://commons.wikimedia.org/w/index.php?curid=8890972>

**Articles:**

http://www.nano.gov/nanotech-101/what/definition

http://beckman.illinois.edu/research/themes/intim/bioimaging-science-and-technology

http://beckman.illinois.edu/content/uploads/files/research-topics/cancer-research.pdf

https://en.wikipedia.org/wiki/Microfluidics

http://www.sigmaaldrich.com/materials-science/nanomaterials/gold-nanoparticles.html

https://en.wikipedia.org/wiki/Colloidal\_gold#Nanotech\_applications

https://en.wikipedia.org/wiki/Transmission\_electron\_microscopy

Norman, Rachel. “Controlled Seeding and Growth of Gold Nanoparticles on Polymer-Wrapped Gold Nanorods.” First Year Doctoral Thesis. University of Strathclyde, Glasgow. (2012).

Tang, Hong-Wu, Xuebin B. Yang, Jennifer Kirkham, and D. Alastair Smith. "Chemical Probing of Single Cancer Cells with Gold Nanoaggregates by Surface-Enhanced Raman Scattering." Applied Spectroscopy Appl Spectrosc 62.10 (2008): 1060-069. Web

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The *nano@illinois* Research Experience for Teachers (RET) at the University of Illinois at Urbana-Champaign (from 2014-2017) exposes a diverse set of in-service and pre-service science, technology, engineering, and mathematics (STEM) teachers and community college faculty from across the nation to cutting-edge research in nanotechnology. The RET focuses on recruiting underrepresented minority populations (focused on ethnicity, geography, disability, and veteran status) including women and will target teachers from high-need areas, including inner city, rural, low-income, and those with significant URM students. Participants conduct research over 6 weeks in world-class labs with 4 follow-up sessions during the school year.

Teacher professional development opportunities includes teacher-focused lectures, mentoring, networking, poster sessions, ethics seminars, hands-on modules, STEM education issues, career choices, and resources for implementing a nano lab and curriculum. Teachers will develop modules to be disseminated widely and present their results. High-quality follow-up sessions and evaluation will be infused.

The nano@illinois Research Experiences for Teachers (RET) is managed by the University of Illinois Center for Nanoscale Science Technology.

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