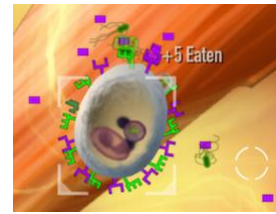


## **Melanie A. Stegman, Ph.D.**

*Between science and game*

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### **Summary**

As a science game creator, I have learned that iterative design, based on solid data collected from meaningful playtesting experiments, is the best way to choose a design path forward. Leading a team through a creative, yet data driven process requires a personality that makes all team members feel welcome and involved. I always try to make sure my team is enjoying their work and meeting their own personal goals. My science game design principles are to create game mechanics that let the player manipulate the fundamentals. I can play many roles, and sincerely enjoy working with a team that includes curriculum experts, because they complement my wide-open approach to teaching science fundamentals. I am a collaborator, problem solver, self-starter, faithful colleague and stalwart proponent of teaching everyone the fundamentals of natural science.

### **Education**

- 2004      **Ph.D.** Molecular Genetics, Biochemistry and Microbiology,  
The University of Cincinnati College of Medicine, Cincinnati, OH.
- 1992      **A.B.** Political Science,  
The University of Chicago, Chicago, IL.

### **Experience**

#### 2016 – **Lead Scientist and Jr. Game Developer**

Dig-It Games, LLC, Bethesda, MD.

- Designing game mechanics that integrate learning objectives.
- Leading game design of commercial mobile game, writing game design document, collecting input from whole team, training others on level design, observing playtesting and accumulating feedback.
- Designing evaluation methods and tools to determine effectiveness of learning games.
- Writing SBIR proposals, research methods, logic models and commercialization plans.
- Programming commercial, mobile games in Unity3d/C#.

#### 2017      **Game Designer, Contractor**

Planet3, LLC, Washington, DC.

- Worked with curriculum specialist Joseph Isaac and producer F.J. Lennon to create a game design that introduced infectious diseases to high school level students.
- Iteratively designed a game in which players diagnose a tiger with a bacterial infection inside its muscle cells. Player pilots a nanobot inside the infected cells and shoots the bacteria.
- Outrageously novel game design was feasible and under budget because we collaboratively designed within the constraints of curriculum and technical feasibility.

#### 2016      **Unity 3D Developer**

Right Eye, Inc., Bethesda, MD.

- Developed mini games to pixel perfect detail. Used data from eye tracking device to allow player to control game play and to collect precise data about player gaze position.
- Programmed in C#, Unity 3D, interfacing with eye tracker software. Participated in an 8-month agile development process on a 7-person team, as the only Unity developer.
- Collaborated closely with the lead scientist to read optometry testing protocols and translate into onscreen interactives, with the web developers to make sure that the player data my games collected was compatible with their reporting requirements.

## 2014 – Owner/Founder

Molecular Jig Games, LLC. Washington, DC. [www.MolecularJig.com](http://www.MolecularJig.com)  
Game designer, developer, evaluator.

- Manage team of 3 creating cell biology games for grades 5 through 12.
- Write Games and Biochemistry blog, I discuss practical aspects of designing game mechanics that let players learn science by manipulating fundamental concepts (see below).
- Manage, maintain the [ScienceGameCenter.org](http://ScienceGameCenter.org) (see below).
  - Host Science Game Discussion and Show during GDC to foster communication and collaboration among game developers interested in creating science games.
- For release this Spring: Suite of three 15-minute games for laptop/mobile that teach fundamental concepts of diffusion, cytokinesis, cellular behavior, protein function and infection diseases. Games designed for 7<sup>th</sup> – 12<sup>th</sup> grades.
  - *Microbot C85*: a strategy game in which players help white blood cells eat pathogens most effectively.
  - *Speedy Cell*: an endless runner, in which players turn the white blood cell's surface molecular in and off to change how it interacts with its environment.
  - *NanoCrasher*, a VR game in which players are not on the surface of the white blood cell, dodging the surface molecules and hunting down bacteria one at a time.

## 2010 – 2014 Director

Learning Technologies Program,  
Federation of American Scientists, Washington, DC.

- Created a reliable, validated test of molecular cell biology for grades 7 – 12. Created a novel test of confidence with molecular cell biology.
- Used assessment tools to conduct a controlled study of 500 students, in 25 schools across the US.
  - Published controlled study of learning and confidence gains in players of the third person shooter *Immune Attack*. (Stegman, MA, 2014.)
- Managed a game development team of programmers, medical illustrators, game designers and scientists to prototype and iterate on completely novel game mechanics.
- Published the prototype of *Immune Defense*, which won spots in several independent video game expos. Published at [Kongregate.com](http://Kongregate.com).
  - *Immune Defense* is a real-time strategy (RTS) game in which players must use white blood cells to defeat real human pathogens. High school students who play *Immune Defense* for 20 minutes recall the names of the two different white blood cells, and describe the functions of two different proteins. The game is also highly engaging, as 75% of the 4000 anonymous, web based players on the non-educational gaming site [Kongregate.com](http://Kongregate.com) played through the 3<sup>rd</sup> level.
- Design and manage **ScienceGameCenter.org**.
  - The *ScienceGameCenter.org* is a site where teachers, game developers and scientists are invited to register as experts and review science games and game players aged 10 and older can review games as well. The *ScienceGameCenter* is designed to allow teachers to find out which games kids enjoy (the “hard” games are often more popular) and for developers of science games to have a place to reach a bigger audience. The *ScienceGameCenter* receives 10,000 visitors a month and sends 100's of visitors out to science game developers' websites. Recently described in *Nature*: [nature.com/naturejobs/2017/170720/pdf/nj7663-369a.pdf](http://nature.com/naturejobs/2017/170720/pdf/nj7663-369a.pdf)

2008– 2010 **Project Manager**, *Immune Attack* project,  
Learning Technologies Program,  
Federation of American Scientists (FAS), Washington, DC.

- Won new competitive grant from NIH/NIAID, R25, (\$750,000). Served as the P.I. Received \$100,000 additional funds at program officer's discretion. *Immune Attack*, created by FAS from 2004 – 2008 is a third person shooter in which players navigate through the blood stream and activate proteins to help white blood cells fight bacteria. My research grant was for the evaluation of this game and to use design based research to design the next game.
- Managed my own budget and personnel. Won additional funding from the ESA Foundation (\$160,000) and Amgen Foundation (\$50,000).
- Wrote FAQ that made *Immune Attack* more accessible, and switched distribution from CDs through the mail to downloads from Amazon Web Services. Created the ImmuneAttack.org website for distribution of the game, created teacher curriculum materials and began the biochemistry and game design blog.
  - The Biochemistry and Game Design blog, begun in 2009 at FAS, is now at [MolecularJig.com/blog](http://MolecularJig.com/blog).
- Investigated best practices for porting *Immune Attack*, a PC game to Mac, researched game engines for future development. Determined that Unity3d game engine should be our tool for future development.
- Worked with University of Southern Maine and Bette Manchester to create new learning and confidence evaluation methods. Iterated on assessment tools, optimizing reliability and significance.
- Used research on *Immune Attack* to begin to design *Immune Defense*. Students remembered names and functions objects they are required to use to win each level. Therefore, initial design goals were to require player to use more objects, for example, a strategy game instead of a flying game.
- Managed four different teams of video game development contractors, in addition to collaborating with medical illustrators to develop novel ways to show cells and make them interactive for our players in a technically feasible manner.
- Managed 1 - 3 interns each summer, high school students from DCPS and college students through Volunteer Fairfax. Created the prototype of a game that would be *Immune Attack 2*, a third person shooter that requires players to scan for malfunctioning proteins and repair them.
  - *Immune Attack 2 prototype*. A Flash game developed in 8 weeks with three high school interns under my direction. I molded together a game design that took advantage of my small, young team's skills and personal learning goals.

### **Skills**

**Agile development/Pre-production team leadership.** Pre-production is an experimental process: I design play testing sessions like experiments, to be sure the data needed to make the decision is collected with the methods used. I prepare clear data to share with the whole team about player feedback to allow for group discussion of our best path to our goal.

**Project management/Production team leadership.** I make sure everything gets done, first by planning, budgeting, accounting, writing contracts and scoping the project. Then, I lead the team through development with enthusiasm and encouragement, leading stand up/Skype meetings, listening, recording decisions in a game design document and task tracking systems like Jira.

**UI/User experience design skills.** Discuss goals with developers and scientists to iteratively optimize engagement and understanding of game mechanics. Wireframe solutions in Photoshop and or basic HTML, to conduct online tests using Google analytics. Build UI in Unity3d, creating assets in Adobe Photoshop and Illustrator.

**Software.** Unity3d, WordPress, HTML, Jira, Perforce, GitHub, Excel, Adobe Photoshop.

**Computer language.** C#.

### **Publications**

#### **Education Related**

Stegman, M.A. (*in prep*) “Using strategy game mechanics in *Immune Defense* to engage non-scientists with molecular cell biology.” In: *An Architectural Approach to Level Design*, vol 2. C.W. Totten (Ed.).

Stegman, M. Immune Attack players perform better on a test of cellular immunology and self confidence than their classmates who play a control video game. 2014. *Faraday Discuss.*, 169:403-423

Khalili N, Sheridan K, Williams A, Clark K & Stegman M. 2011. Students Designing Video Games about Immunology: Insights for Science Learning. *Computers in the Schools*. 2011. 28:228-240.

#### **Biochemistry Related**

Mazloun, N., Stegman, M.A., Croteau, D.L., Van Houten, B., Kwon, N.S., Ling Y., Dickinson C., Venugopal, A., Towheed, M.A., Nathan, C. 2011. Identification of a chemical that inhibits the mycobacterial UvrABC complex in nucleotide excision repair. *Biochemistry*. 2011. 50:1329-35.

Mazloun, N., Nathan, C. Gold, B., Lin, G., Stegman, M., Sorio de Carvalho, L.P., Vandal, O., Venugopal, A., and Bryk, R. A Philosophy of Anti-Infectives as a Guide in the Search for New Drugs for Tuberculosis. 2008. *Tuberculosis*, Special publication by the Global Alliance for Tuberculosis Drug Development. 88 Suppl 1:S25-33.

Stegman, M.A. and Robbins, D. J. Biochemical Fractionation of Drosophila Cells, in *Hedgehog Signaling Protocols*. Edited by: Horabin, J. Humana Press Inc., Totowa, NJ. 2007.

Stegman, M.A., Goetz, J.A., Ascano Jr., M., Ogden, S.K., Nybakken, K., and Robbins, D.J. The Kinesin-related protein Costal2 associates with membranes in a Hedgehog-sensitive, Smoothened-independent manner. 2004. *J. Biol. Chem.* **279**:7064-71.

Stegman, M.A., Vallance, J.E., Elangovan, G., Sosinski, J., Cheng, Y. and Robbins, D.J. Identification of a Tetrameric Hedgehog Signaling Complex. 2000. *J. Biol. Chem.* **275**:21809-12.

### **Teaching experience**

2009 – 2012 **Collaboration with Dr. Kevin Clark, George Mason University,**  
Instructional Technology Program,  
Director of the Center for Digital Media Innovation & Diversity.

- Served as a Subject Matter Expert for high school programmers in who were tasked with creating a biology game like Immune Attack. Guided high school students through biology game development process, 6 week summer classes. As part of ITEST, an NSF funded research program led by Dr. Clark.
- Served as Ph.D. student Neda Khalili’s graduate committee member, and collaborated with her on her dissertation research into how students engaged with molecular cell biology when they are developing a video game in collaboration with a scientist (Khalili, et al., 2011).

2012 – 2013 **DCPS Professional Development.**

- Led workshops for DCPS high school teachers on integrating video games into science curriculum.

2006 – 2008 Teacher at **The American Museum of Natural History**, New York, NY.

- Taught high school level after-school classes in genetics and biochemistry.

- Presented and discussed genetic concepts with museum patrons in the Hall of Human Origins Education Lab.
- 2006 – 2006 Volunteer with **Cornell Science Challenge**, East Side Middle School, New York, NY.
- Over 6-week course, helped my group of 5 students design, execute, evaluate and present their science fair project. Judged presentations at the science fair.
- 2000 – 2001 Volunteer instructor with **Yeast as an Educational Tool**, Cincinnati, OH, an NIH SEPA funded program.
- Co-taught public middle school and high school science classes with their teachers, once a week for 6 weeks at each at 2 different schools.
  - Prepared lab materials and lectures to let the students replace a mutant yeast gene and assay for the new phenotype.
  - Assisted with the end of the year science fair.
- 1995 – 1997 **Academic Advisor**, University of Cincinnati, College of Arts and Sciences.
- Served as freshman and transfer student advisor, helped students with diverse educational histories prepare for a four-year degree.
- 1994 – 1995 **Tutor of English as a Second Language**, and academic tutor for ESL students. Norwood High School, Norwood, OH.
- 1994 – 1995 **Teacher of English as a Second language**, Traveler's Aid, Cincinnati, OH.

### Awards and Presentations

2014 – 2015 *Immune Defense* won places in these competitive video game expos:

Seattle, WA: **Power of Play**, *iFest*, and the **Seattle Indies Expo at PAX**.

Baltimore, MD: **Gamescape** at Artscape

Washington, DC: *MAGFest Indie Video Game Showcase*.

2015 Presented *Immune Defense* and my education research at the **Koshland Museum of Science**. Video available at [MolecularJig.com/research](http://MolecularJig.com/research).

**PAX Dev**, organized a panel on science game design and development. Title: "Why does everyone know how to kill zombies but not measles?"

2014 Invited speaker, **International Game Developers Association (IGDA) Seattle**.

Topic: "How to evaluate Intuitive Learning that occurs in a video game: using intuitive learning as a marker for success in iterative science learning game development."

Video available at [MolecularJig.com](http://MolecularJig.com).

2013 Mentor in Leadership Program, **Center for Research and Interdisciplinarity (CRI)** Paris France. Mentored early stage science professors who were interested in adding games and other innovative teaching methods to their classrooms. Presented two talks, one on how games can be designed to give an intuitive understanding of complex abstract and another on how to design assessment tools for such games.

Invited speaker, **National Institutes of Health (NIH)**, **Got Game?** Presented my work on Learning and Confidence gains games in biomedical science with games. Washington, DC.

Invited participant/presenter, **Molecular Simulations and Visualizations, Faraday Discussion 169**, Royal Society of Chemistry, Nottingham, England. Presented my peer reviewed paper on high school students who played *Immune Attack*. Invited by Arthur Olson, Molecular Graphics Laboratory, Scripps Research Institute.

2012 Rock Star of Science, **National Science Teacher Association (NSTA)** annual meeting.

Invited speaker at the **Association of Medical Illustrators (AMI)** annual meeting. Title: "Teaching the Unimaginable: Games make invisible things visible and abstract ideas touchable."

2010 Presenter, **Games, Learning and Society**, Madison, WI. Title: "Immune Attack 2.0 Building an Adventure in the Molecular World."

2009 Research Abstract chosen for Press Release Book for the **American Society for Cell Biology (ASCB)** Annual Meeting. First education abstract ever to be in press book. Presented preliminary findings of *Immune Attack* learning and attitude change research.

2007 Travel Award to attend and present at the **Gordon Research Conference on Oxidation and Disease**, Ventura Beach, CA. Presented post doctoral research on *Mycobacterium tuberculosis* DNA repair.

2005 Best Paper of 2004, **Cancer Mechanisms Program, Dartmouth College of Medicine**.

### **Related Activities**

2009 – **International Game Developers Association (IGDA) DC Chapter Co-Founder**.

Created [www.igdaDC.org](http://www.igdaDC.org).

Organized the first District Arcade, 2015.

2015 – 2016 **Patriots Technology Training Center**, video game industry liaison.

- Worked with Thurman Jones, Jr., the President of the Patriots Technology Training Center, in Seat Pleasant, MD. We organize video game related events for the Patriots, I recruit game developers to attend, show their games and give classes geared toward the students.

2013 – 2014 Served as a member of **STEM4all**, an NSF funded initiative lead by Dr. Kimberly Scott and Dr. Kevin Clark.

- This project convened a diverse group of researchers, practitioners, funding organizations, and policy analysts with interest, expertise, and knowledge in culturally relevant practices and its potential for positively affecting underprivileged students' digital creativity; racial and ethnic identity and its role in technological self-concept; and STEM workforce development for students from high needs areas.

2010 – 2013 **National STEM Video Game Challenge**, Youth Prize Judge.

2009 – 2013 **NSF and NIH peer review committee member** for research grants and SBIR awards.