

COVER SHEET FOR GRANT PROPOSALS

State Board of Education

SBOE PROPOSAL NUMBER:
(to be assigned by SBOE)

AMOUNT REQUESTED: \$67,600

TITLE OF PROPOSED PROJECT:

AN EVOLUTIONARY APPROACH FOR PROCEDURAL OPPONENT GENERATION IN VIDEO GAMES.

SPECIFIC PROJECT FOCUS:

Our long term goal is to "spin-out" the UI interdisciplinary game design studio, Polymorphic Games, into an independent and profitable game and software development company situated in Moscow, ID. Polymorphic Games would provide quality jobs to Idaho students in a booming, high tech, multibillion dollar industry. It would publish its own games, serve as a publishing vehicle for independent student games, and develop "asset packages" to license to other companies who seek to use evolutionary procedural content generation. The purpose of this incubation funding request is to support the development of a fully realized and modern evolutionary game that will produce revenue, provide a concrete example of success that attracts additional capital, and provides a stable base for a fledgling company. Ultimately, we would also seek to expand our business relationship to all three major Idaho Universities, providing summer internship and training opportunities for students in a wide variety of disciplines.

PROJECT START DATE: July 1 2017

PROJECT END DATE: July 1 2018

NAME OF INSTITUTION:
University of Idaho

DEPARTMENT:
Institute for Bioinformatics and Evolutionary Studies

ADDRESS: 875 Perimeter Dr., Moscow ID, 83844

E-MAIL ADDRESS:
brobison@uidaho.edu

PHONE NUMBER:
208 885 7137

NAME:

TITLE:

SIGNATURE:

PROJECT DIRECTOR/PRINCIPAL INVESTIGATOR

Barrie Robison

Professor



CO-PRINCIPAL INVESTIGATOR

Terence Soule

Professor



NAME OF PARTNERING COMPANY: NA

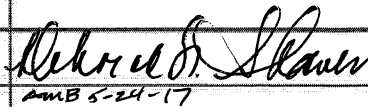
COMPANY REPRESENTATIVE NAME:

NAME:

SIGNATURE:

Authorized Organizational Representative

Deborah N. Shaver



AMB 5-24-17

Director, Office of Sponsored Programs

SUMMARY PROPOSAL BUDGET

Name of Institution: **University of Idaho**

Name of Project Director: **Barrie Robison**

A. PERSONNEL COST (Faculty, Staff, Visiting Professors, Post-Doctoral Associates, Graduate/Undergraduate Students, Other)

| Name/ Title | Salary/Rate of Pay | Fringe | Dollar Amount Requested |
|-------------------------------|--------------------|----------|-------------------------|
| Landon Wright / Lead Designer | \$39,520 | \$12,963 | \$52,483 |
| Samantha Heck / Programmer | \$9,880 | \$238 | \$10,117 |
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|---------------------------|-------|------------------|----------|
| % OF TOTAL BUDGET: | 92.6% | SUBTOTAL: | \$62,600 |
|---------------------------|-------|------------------|----------|

B. EQUIPMENT: (List each item with a cost in excess of \$1000.00.)


| Item/Description | Dollar Amount Requested |
|------------------|-------------------------|
| | |
| | |
| | |
| | |
| | |
| SUBTOTAL: | |
| | |

C. TRAVEL:

| Dates of Travel (from/to) | No. of Persons | Total Days | Transportation | Lodging | Per Diem | Dollar Amount Requested |
|------------------------------|-------------------|---------------|----------------|---------|----------|-------------------------|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| SUBTOTAL: | | | | | | |

D. Participant Support Costs:

| | Dollar Amount Requested |
|------------------|-------------------------|
| 1. Stipends | |
| 2. Other | |
| SUBTOTAL: | |

| E. Other Direct Costs: | | Dollar Amount Requested |
|--|----------------------------|-------------------------|
| 1. Materials and Supplies | | |
| 2. Publication Costs/Page Charges | | |
| 3. Consultant Services (Include Travel Expenses) | | |
| 4. Computer Services | | |
| 5. Subcontracts | | |
| 6. Other (specify nature & breakdown if over \$1000) Marketing (\$3000) Software Licenses (\$980) | | \$4980 |
| SUBTOTAL: | | \$5000 |
| F.. Total Costs: (Add subtotals, sections A through E) | | TOTAL: \$67,600 |
| G.. Amount Requested: | | TOTAL: \$67,600 |
| Project Director's Signature:  | Date: <i>May 24 / 2017</i> | |

| INSTITUTIONAL AND OTHER SECTOR SUPPORT (add additional pages as necessary) | |
|--|----------|
| A. INSTITUTIONAL / OTHER SECTOR DOLLARS | |
| Source / Description | Amount |
| UI – Vandal Ideas Project / Our VIP grant supports development through the "alpha" stage by paying for this summer's development team (described in proposal) | \$65,000 |
| UI – Robison Salary Savings Account / Professor Robison uses the funds from his Salary Savings account (generated by his 25% appointment as IBEST Associate Director) to support the purchase of equipment, computers, supplies, and for student and faculty travel. | \$22,000 |
| B. FACULTY / STAFF POSITIONS | |
| Description | |
| | |
| C. CAPITAL EQUIPMENT | |
| Description | |
| | |
| D. FACILITIES & INSTRUMENTATION (Description) | |
| | |

AN EVOLUTIONARY APPROACH FOR PROCEDURAL OPPONENT GENERATION IN VIDEO GAMES.

- 1. INSTITUTION:** University of Idaho
- 2. PROJECT DIRECTORS:** Barrie D. Robison and Terence Soule
- 3. PRIOR INCUBATION FUNDING:** None

4. EXECUTIVE SUMMARY:

The video game market is expected to generate over 106.5 billion dollars in 2017 and is growing rapidly. Barriers to entry into this market are very high because of the large and expensive teams required to produce increasingly complex and compelling game content. Our solution is ***evolutionary procedural content generation*** - using evolutionary models to evolve novel game content as the game progresses rather than relying on pre-programmed content.

This approach has been developed by Polymorphic Games, an interdisciplinary video game design studio at the University of Idaho. Evolutionary procedural content generation provides a unique competitive advantage to Polymorphic Games that positions us to produce compelling, commercially successful games with significantly lower development costs. As a proof of concept, we developed and released Darwin's Demons on the Steam distribution platform. Our long-term goal is to "spin-out" Polymorphic Games into an independent and profitable game development company situated in Moscow, ID. We seek \$67,700 in incubation funds to bring a fully realized, modern, 3D, game to market, demonstrating the full potential of evolutionary approaches to content generation.

5. PROJECT OBJECTIVE AND BUDGET REQUEST:

Our long term goal is to “spin-out” Polymorphic Games into an independent, commercial game studio in Moscow, ID. The studio would provide jobs to Idaho students in a booming, high tech, multibillion dollar industry. It would publish its own games, serve as a publishing vehicle for independent student games, and develop “asset packages” to license to game companies seeking to use evolutionary procedural content generation.

To achieve our goal, we seek \$67,700 in incubation funds. ***Our objective is to bring a fully realized, modern, 3D, game to market that demonstrates the potential for evolutionary approaches to reduce game development costs.*** Achieving this objective would: 1) Increase the revenue potential of our game, 2) Provide a concrete example of success to help attract investment capital, and 3) Create a stable base for establishing an independent company with close ties to Idaho’s Universities.

Evidence of Prior Success: Polymorphic Games has developed one commercial game (Darwin’s Demons) that uses evolutionary procedural generation of enemies. We have shown empirically that the evolutionary component meets its intended objectives: the game gets more difficult over time and the opponents appearance, behavior, and traits adapt to the choices and strategy of the player.

This game was designed as a proof-of-concept project. The project was a critical test of our development strategy; hiring a development team of (primarily) undergraduate students full time to complete the majority of development over one summer. We released Darwin’s Demons commercially on the Steam platform February 13th, 2017 (the day after Darwin Day).

Having confirmed that evolution can fulfill its intended design function and that our summer development model works, the objective of our current project is to incorporate evolutionary opponent generation into a modern style of game - a 3D, tower defense game. In a tower defense game the player builds defensive emplacements to defend against waves of opponents. Normally the opponents in a tower defense game become increasingly difficult following a fixed, programmed schedule. This limits player interest and replayability. Our evolutionary procedural generation produces a uniquely compelling and highly replayable game experience even over multiple replays.

6. INSTITUTIONAL RESOURCES AND STRATEGIC ALIGNMENT:

Below, we highlight how our project aligns with the aims of the UI Strategic Plan.

***Aim 1:** Scholarly and creative productivity at the highest level, resulting in designation as a Carnegie Highest Research Activity (R1) Institution.*

Developing methods for procedural content generation in video games is a new and very active research area. Recently several journals and conferences devoted to Artificial Intelligence in games have been founded. However, our approach of using evolution to procedurally generate opponents is unique. Darwin's Demons is the only commercial game on the market using this approach, creating many research opportunities.

***Aim 2:** Suggest and influence change that impacts societal needs, global issues, economic development and advancement of culture.*

We seek to develop a commercial product and, more importantly, a sustainable game design company that will continue to produce new products (games and licensed

software). Ideally, our project will provide positive evidence that successful video games can be developed in Idaho, rather than requiring relocation to a current hub of the video game industry.

Aim 3: Advance our educational impact.

This project will develop significant human capital in Idaho. The studio experience teaches students how to work in broadly interdisciplinary and collaborative teams – a key skill in industry. The game studio will also help attract and retain Idaho students in higher education. Our studio has interacted with hundreds of students, ranging from 3rd grade to incoming freshman. The response to the studio has been uniformly positive with many students expressing an increased interest in attending college and in attending the UI rather than going out of state.

7. SPECIFIC PROJECT PLAN AND BUDGET:

We currently have funding to develop the alpha version of our next game through the Vandal Ideas Program (the summer development team described below) and through Professor Robison's Salary Savings budget (computers and other supplies). Our purpose with this request is to ***bring the alpha version of this game through to commercial release***. Below, we describe the milestones in our development process, and **highlight those enabled by Incubation Funding**.

Development Milestones and the Path to Commercialization

1. Initial game design and rough mock-ups. Complete.
2. Hire summer development team. Complete
3. Initial game prototype. Complete
4. Sound design – creation of both the music and the sound effects. Summer 2017.

5. Build media “buzz” – use social media to build interest. Summer 2017.
6. Alpha version – complete rough versions of key game elements. Summer 2017.
7. **Beta version** – complete versions of all game elements. Release to the public through early access to build interest and obtain market feedback. Fall 2017.
8. **Pre-release version** – refined versions of all game elements. Winter 2017.
9. **Testing** - Quality Assurance testing prior to commercial release. Winter 2017.
10. **Advertising** - targeted, online advertising based on keywords in Google search, Facebook, and similar platforms. Winter - Summer 2017.
11. **Release** - Release on Steam, Mac OS, and Windows Live. Spring 2017.
12. **Support and Refinement** - Fix bugs, refine content, engage with user community. Spring 2017 - Summer 2017.

Development Team:

We have hired our summer development **team**, which will conduct primary development of the game through the alpha stage.

Project leads: Landon Wright (Virtual Technology and Design), and Samantha Heck (Computer Science). They are part of the game development team, but are also responsible for day-to-day development decisions.

Programmers: Computer Science majors Samantha Heck, Patrick Vanvorce, and Nick Viventi are responsible for the bulk of the programming tasks.

Artists/Modelers: Virtual Technology Design majors Landon Wright, Tristan Lassiter, and Cameron Perry are responsible for creating all of the “art” assets of the project. They work closely with the programmers to implement the evolutionary procedural generation of the game opponents.

Musician: Music major Sam Carlson is responsible for creating the soundtrack of the game and overall sound design.

Biologists: Biological Science majors Weston Durland and Spencer Gomez are responsible for testing the evolutionary aspects of the game.

Product “Evangelist”: Biology and Art major Courtney Bryant is responsible for web content and media outreach.

Writer: English major Marlan Smith is responsible for the background information, in-game story, and contributes to the media outreach and technical documents.

The Market Opportunity

Ultimately, commercially successful games provide two components to their customers:

Complex and compelling content, particularly in the appearance and behavior of the opponents, and ***replayability*** - which contributes to the perceived value to the player.

Developing these components is expensive, usually requiring a large development team to create content and to program many alternative paths for game play. An alternative, and equally expensive approach, is to develop online games that allow humans to compete against each other. This approach particularly appeals to hardcore gamers who want the challenge of adaptable opponents rather than opponents that follow a pre-programmed script.

Our Value Proposition: Unlike any other commercial studio, Polymorphic Games uses evolution to inexpensively create complex, compelling, and replayable content. The opponents in our games evolve in response to the player’s choice; the most successful opponents have the most opportunities to “reproduce,” populating later stages of the game. Thus, as the game proceeds the player encounters increasingly

complex and challenging opponents. When a player chooses to replay the game using a different strategy the opponents will adapt to that strategy, creating an entirely different and uniquely challenging game play experience.

Applications, Markets, and Demand

Market Segment 1: “Gamers” Almost 200 million people play video games in North America alone and the rate of engagement in this form of entertainment is increasing rapidly. The overall video game market is expected to generate over 106.5 billion dollars in 2017. Our technique can be applied to almost any game genre, providing a large potential user base.

Market Segment 2: “Educators and Parents” Our games are built upon accurate models of biological evolution. Thus, our games have significant potential for teaching concepts in biology, evolution, and genetics. We can market our games to middle school and high school teachers (and college professors), and to parents desiring games with educational value.

Our Product: Our first game, Darwin’s Demons, is an update of classic arcade games and targets a generally older audience and casual players. Our second game, which these funds would move to market, is a strategic, tower defense game that targets a younger and more strategically-oriented audience.

Our Competition and our Competitive Advantage: We obviously do not seek to compete (yet) with AAA game studios with billion dollar budgets. Our competition is other “indie” game design companies, ranging in size from 1 to 10 employees. Polymorphic Games has three main competitive advantages over other indie studios:

1. Access to non-dilutive capital in the form of grants (e.g. the NSF program in Advancing Informal Stem Learning and the NIH SEPA program).
2. Access to highly talented student developers from a wide range of disciplines.
3. Low overhead costs while the start up company is incubated.

Reaching Our Customers: The largest outlet for PC games (games that run on personal computers) is the online store Steam, with over 125 million active users. Our first game is currently for sale on Steam (\$4.99). We are also working with the UI Office of Technology Transfer to distribute our games on the Mac store and Windows Live.

Barriers to Entry: The barriers to market entry for our next game include development through the beta stage, extensive testing and refinement, and support during the first few months of commercial release. These barriers would be overcome with the proposed incubation funding.

Path to Commercialization:

Our Technology: Evolutionary procedural content generation uses evolutionary algorithms to evolve game content as the game is being played. The opponents in our games are modeled as biological populations, and feature a digital genome that controls their appearance and behavior. The opponents that perform the best, survive the longest, do the most damage to the player, etc. pass those genes to their offspring in the next level/wave of the game.

Market Need and Intellectual Property Status: Evolution based procedural content generation creates game content that is much more compelling than randomly generated content at a much lower cost than scripted content generated by a large

development team. This approach provides a significant competitive advantage to Polymorphic Games. UI owns the Intellectual Property associated with Darwin's Demons, and the forthcoming game. The technology was developed at UI by Drs Robison and Soule with funding from NSF through the BEACON Science and Technology Center (of which UI is a partner) and the Vandal Ideas Project.

Commercialization Partners: Currently Polymorphic Games is entirely on-campus, UI based game studio and UI is the only commercialization partner.

Institutional Support

UI has been extremely supportive of this project. Our current funding is through the Vandal Ideas Program. We have space in the new Integrated Research and Innovation Center (IRIC). UI's media center has spearheaded a number of media events leading to articles in local, state, and national news outlets. The Office of Technology Transfer has worked closely with us to develop the necessary legal and royalty agreements.

Unique Infrastructure: The broad range of technical expertise available at UI is a unique strength of Polymorphic Games. We have access to all of the expertise necessary to create successful video games (programming, design, music, business, etc.), plus access to the experts in evolutionary biology necessary for successful evolutionary content generation. This access to experts in evolutionary biology is one of the studio's key competitive advantages over other game studios.

Our location in the IRIC building is ideal for Polymorphic Games because it supports the interdisciplinary nature of the studio. Additionally, we have access to UI's ITS department, space, power, etc.

Budget:

Total Budget Request: \$67,600 (*rounded to nearest \$100*)

Total Personnel Costs: \$62,600

Lead Designer: \$52,483 (one year, full time: \$39,520, plus \$12,963 in fringe benefits)

Landon Wright is a recent UI graduate in Virtual Technology and Design and has worked for Polymorphic Games for the past year. Landon will oversee the development, refinement, commercial release, and support of our game. He has been an integral part of the development of our 3D procedural opponent generation.

Programmer: \$10,117 (\$9,880 part time Irregular Help plus \$237 fringe benefits)

Samantha Heck is a junior in computer science employed by Polymorphic Games for the past year. She is a National Merit Scholar who carries a 4.0 GPA. Sam will work on the programming aspects of our game after the summer development cycle has ended.

Other Expenses: \$5,000

We request \$3000 to support the marketing and advertising of our game (including ads on google adwords, Facebook, and other social media outlets) and \$1,980 to support the software licenses for Unity, our game development engine (\$1,500), and Adobe Creative Cloud, our art and media software (\$480).

Scalability: Our budget contains a certain amount of scalability, should a reduced amount of funding be available. The most critical part of the budget is the Lead Designer (\$52,483), followed by the Programmer (\$10,117), and then marketing and software expenses. Of course, a reduced budget would lower the potential revenue of the project, but any amount above \$50,000 would greatly increase our ability to bring a competitive game to market.

Appendix 1: Facilities and Equipment:

Polymorphic Games is housed in room 107 of the new, state of the art, Integrated Research and Innovation Center at the University of Idaho. IRIC provides cutting edge collaboration space with high speed internet, a customizable layout, and access to video conferencing and other utilities. The studio can house up to 14 staff full time.

The game studio itself has all the necessary equipment for game development, including two high end PC workstations, two Macbook Pro laptops, video cameras, still cameras, microphones, and other gear necessary for art and production. We also have licenses for all necessary software for art (Adobe Creative Cloud), modelling (Zbrush and Autodesk), and game development (Unity).

Terence Soule
Professor of Computer Science
University of Idaho, JEB 229, Moscow, ID, 83844
(208)-885-7789; tsoule@cs.uidaho.edu

Professional Preparation

| | | |
|-----------------------------|------------------|-------------|
| Reed College | Physics | B.A., 1991 |
| Washington State University | Physics | M.S., 1994 |
| University of Idaho | Computer Science | Ph.D., 1998 |

Appointments

Professor, Computer Science, University of Idaho, 2013- Present
Associate Professor, Computer Science, University of Idaho, 2006 – 2013
Director, Neuroscience Program, University of Idaho, 2009 – 2012
Adjunct Professor, Bioinformatics and Computational Biology, University of Idaho, 2004 - present
Assistant Professor, Computer Science, University of Idaho, 2000 - 2006
Assistant Professor, Computer Science, St. Cloud State University, 1998 – 2000

Products Related to this Proposal

1. Darwin's Demons (2017) a commercial video game released on Steam.
2. Soule, T. and Heck, S. and Haynes, T.E. and Wood, N. and Robison, B.D., (2017) Darwin's Demons: Does Evolution Improve the Game?, European Conference on the Applications of Evolutionary Computation, 435-451.
3. Soule, T. "A Project Based Introduction to C++", ISBN 978-1-4652-1328-0, KendallHunt, 2013.
4. Amador, Julie and Soule, Terence, "Girls Build Excitement for Math from Scratch", Mathematics Teaching in the Middle School, 20:7, 2015.
5. Robison, B.D., T Soule, N Wood, D Streett, and C Mirabzadeh. "Implementing models of evolution in video games", Proceedings of the Games Learning Society, 2016.

Synergistic Activities

1. Director of the Neuroscience Program, University of Idaho, August 2009 - August 2012
2. Member of the Education and Human Resource Development steering committee and Education and Human Resource Development lead for the University of Idaho for the BEACON NSF Science and Technology Center for the study of *Evolution in Action*.
3. Member, SIGEVO Executive Board (ACM Special Interest Group for Genetic and Evolutionary Computation), 2013 - present
4. Editor in Chief, Genetic and Evolutionary Computation Conference (GECCO) 2012.
5. Taught multiple programming camps for middle and high school students in Coeur d'Alene, Moscow, and Boise, 2013 - present.

Current Support

- Robison, Barrie and Soule, Terence (PIs), "Polymorphic Games – An Interdisciplinary Game Design Studio for Vandals", 08/14/16-08/14/17 \$65,000
- Edwards, Dean, "Configurable UUV Sensor Network II", 01/01/17-12/31/17

BIOGRAPHICAL SKETCH
Barrie D. Robison

Dept of Biological Sciences
PO Box 443051, University of Idaho
885-7905
Moscow, ID 83844-3051

Telephone: (208) 885-7137
Fax: (208)
email: brobison@uidaho.edu

A. Professional Preparation

| <i>Institution</i> | <i>Major or Area</i> | <i>Degree & Year</i> |
|---------------------------|-----------------------------|---------------------------------|
| Univ. Victoria | Biology | B.S., 1993 |
| Univ. Idaho | Fisheries | M.S. 1995 |
| Washington State Univ. | Zoology | PhD. 2000 |
| University of Oregon | Evolutionary genetics | Postdoctoral work; 2000-2001 |
| Indiana University | Evolutionary genetics | Postdoctoral work; 2001-2003 |

B. Appointments

| | |
|----------------|---|
| 2003 - 2009 | Assistant Professor, Dept of Biological Sciences, University of Idaho. |
| 2009 – current | Associate Professor, Dept of Biological Sciences, University of Idaho. |
| 2014 – current | Associate Director, Institute for Bioinformatics and Evolutionary Studies |
| 2016 – current | Professor, Department of Biological Sciences, University of Idaho. |

C. Selected Publications: *Most Recent 5 years*

- Published Products: 53
Total Citations: 1665
H Index (Google Scholar): 21
- Terence Soule, Samantha Heck, Thomas E Haynes, Nicholas Wood, Barrie D Robison. 2017. Darwin's Demons: Does evolution improve the game? European Conference on the Applications of Evolutionary Computation. 435-451
- Joshua M Sukeena, Carlos A Galicia, Jacob D Wilson, Tim McGinn, Janette W Boughman, Barrie D Robison, John H Postlethwait, Ingo Braasch, Deborah L Stenkamp, Peter G Fuerst. 2016. Characterization and evolution of the spotted gar retina. *Journal of Experimental Zoology Part B: Molecular and Developmental Evolution* 326. Pages 403 - 421
- Terence Soule, Barrie D Robison, Robert B Heckendorn. 2016. Co-evolution of Sensor Morphology and Behavior. *Proceedings of the 2016 on Genetic and Evolutionary Computation Conference Companion*. Pages 135-136.
- BD Robison*, T Soule, N Wood, D Streett, and C Mirabzadeh. 2016. Implementing models of evolution in video games. *Proceedings of the Games Learning Society*.
- Alida T Gerritsen, Daniel D New, Barrie D Robison, Arash Rashed, Paul Hohenlohe, Larry Forney, Mahnaz Rashidi, Cathy M Wilson, Matthew L Settles. 2016. Full mitochondrial genome sequence of the sugar beet wireworm *Limonius californicus* (Coleoptera: Elateridae), a common agricultural pest. *Genome announcements* 4(1): e01628-15
- Matthew L Singer, Kris Oreschak, Zachariah Rhinehart, Barrie D Robison. 2016. Anxiolytic effects of fluoxetine and nicotine exposure on exploratory behavior in zebrafish. *PeerJ*.
- KC Chapalamadugu, BM Murdoch, BD Robison, RA Hill, GK Murdoch. 2015. *Oncorhynchus mykiss pax7* sequence variations with comparative analyses against other teleost species *SpringerPlus*. 4 (1): 1-11.
- Tshering Sherpa, Tyler Lankford, Tim E McGinn, Samuel S Hunter, Ruth A Frey, Chi Sun, Mariel Ryan, Barrie D Robison, Deborah L Stenkamp. 2014. Retinal regeneration is facilitated by the presence of surviving neurons. *Developmental neurobiology*. 74: 851-876.

- Kalyan C Chapalamadugu, Catherine A VandeVoort, Matthew L Settles, Barrie D Robison, Gordon K Murdoch. 2014. Maternal bisphenol a exposure impacts the fetal heart transcriptome. PLoSOne.
- Benner, M.J., M.L. Settles, G.K. Murdoch, R.L. Hardy, and B.D. Robison. 2013. Sex-specific transcriptional responses of the zebrafish (*Danio rerio*) brain selenoproteome to acute sodium selenite supplementation. Physiological Genomics. 45. 653-666.
- Oswald, M.E., M.L. Singer, and B.D. Robison. 2013. The quantitative genetic architecture of the bold shy continuum in zebrafish. PLoS ONE 8(7): e68828.
- Drew, R.E., Settles, M.L, Churchill, E.J., Williams, S., Balli, S., and Robison, B.D. 2012. Brain transcriptome variation among behaviorally distinct strains of zebrafish. BMC Genomics 13(1) 323.
- Settles, M.L., Coram, T. Soule, T. and Robison B.D. 2012. An improved algorithm for the detection of genomic variation using short oligonucleotide arrays. Mol. Ecol. Res.
- Oswald, M.E., Drew, R.E., Racine, M., Murdoch, G., and Robison B.D. 2012. Is variation along the bold shy continuum associated with variation in the stress axis in zebrafish? Physiological and Biochemical Zoology, 85(6) 718 – 728.

Honors and Awards:

- University of Idaho Naval ROTC Mentorship Award, May 2017
- University of Idaho Excellence in Teaching, April 2017.
- University of Idaho College of Science Early Career Faculty Award, May 2009.
- University of Idaho Alumni Award for Excellence (with Mary Oswald), Nov 2006.

Current Support:

- Robison, Barrie and Soule, Terence (PIs), “Polymorphic Games – An Interdisciplinary Game Design Studio for Vandals”, 08/14/16-08/14/17, \$65,000