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NDSU Technology Action Plan Request

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I. Action Plan Introduction and Authorizations

NDSU ORGANIZATION OR UNIT
Department of Geosciences Department of Architecture and Landscape Architecture

TITLE OF PROJECT: Augmented Reality Sand Table

Project Duration (3 years maximum)	**From:** March 1, 2016		**To:** December 30, 2016
Type of Project (Check one)	**New** x	**Previously Submitted**	**Renewal**
Total Technology Fee Request : $13,625			

Project Director **(Must be NDSU faculty or staff)** Stephanie S. Day Jessie Rock Ben Bernard Dominic Fischer	**Campus Address:** 1340 Bolley Drive **Phone:** 701-231-8837 **Fax:** **E-mail:** Stephanie.day@ndsu.edu

Name (Type or Print)	Signature	Date
Project Director Stephanie S. Day		1/14/16
Unit Head Peter Oduor		1/15/16
Project Director Jessie Rock		1/14/16
Unit Head Peter Oduor		1/15/16
Project Director Ben Bernard		1/15/16
Unit Head David Bertolini		1/15/16
Project Director Dominic Fischer		1/15/16
~~**Unit Head**~~ ~~David Bertolini~~		
~~**IT Division Consultant**~~ ~~Steve Sobiech~~		
IT Division Consultant Jim Ross		1/15/16

Executive Summary (maximum of 175 words)

Reading and understanding topographic maps helps students better understand landscapes and develops spatial reasoning and problem solving skills. While these skills are important to all fields, and in particular geosciences and landscape architecture, they remain difficult to teach. Students struggle to understand a two-dimensional representation of three-dimensional features. The Augmented Reality Sand Table is a tool that will help students develop the skill and better understand the surface of the Earth in an active learning environment. This system allows students to create a topographic model out of sand and then projects a color elevation map and contour lines. In addition the technology can be used to simulate where water would collect and move on the surface. We will be integrating this technology into at least 10 classes immediately as well as several outreach events planned for the coming year. This technology will help at least 550 students better understand topographic maps each year. Moreover we anticipate that thousands of community members will use the sand table each year fostering an interest in science.

We will only accept for consideration Technology Action Plan Request forms which are fully completed and signed according to the guidelines listed in the Instructions, pages 1 and 2.

Technology Action Plan Request forms will be opened and reviewed after the submission deadline.

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II. Project Overview

1. How does this project meet student needs?

In introductory geoscience and landscape architecture courses students learn to read and interpret topographic maps. This skill provides context for better understanding the surface of the Earth. In addition, map reading skills can help students in all disciplines improve in their spatial reasoning and problem solving skills. While we can demonstrate the value and importance of this skill, teaching it remains a challenge. Students struggle with a two-dimensional representation of the Earth's surface. This project will provide students an active, three-dimensional, real-time environment to develop their map reading skills.

2. What audience does this project directly serve? What audience is indirectly served? How many students are affected?

This technology will be used in several Geoscience and Landscape Architecture courses. The large introductory level laboratory courses include the Physical Geology Labs and The Earth through Time Labs. Each year, 320 students from across campus take these general education laboratory courses. Upper level courses served by this project include Geomorphology (25 students), Geography of North America (25 students), Glacial Geology (40 students), Hydrogeology (25 students), Structural Geology (25 students), Site Development and Detailing (60 students), Environmental Planning Studio (15 students), and Site Planning Studio (15 students). In addition, these sandboxes will be used as outreach tools serving the general community.

3. For projects that target a subset of NDSU's students, please describe the possibility for broader application in the future.

While the sand tables will be used primarily in classrooms, they will also be used in the outreach that our departments are active in. Examples of outreach we have been involved in and expect to continue in the future include: Expanding your Horizons, PBS Share-A-Story, Earth Science Week at the Fargo Public Library, Pop-up museums, Governor's Schools, and K-12 classroom visits all of these events are opportunities to use the augmented reality sand table to help community members become more engaged in science and develop a deeper understanding of the landscape.

4. Describe both the immediate and long term impact of this project.

Students will develop spatial reasoning and problem solving skills that can be used in the classroom and throughout their lives. This project can also serve as a demonstration to other departments who might find the technology relevant and beneficial to their students. Moreover, because this project captivates people's interests, it is likely to become a favorite attraction at outreach events. As it generates community interests it will elevate the profile of the university.

5. Who will pay for ongoing expenses following the technology fee funded portion of this project (e.g., who will replace hardware or software after it has reached its end of life)?

Course fees from the Department of Geosciences and the Department of Architecture and Landscape Architecture will cover ongoing expenses.

6. **Describe how this project will follow NDSU's best practices in information technology. (Please make sure the NDSU IT Division staff you consulted signs in Part I of this form.)**

Computers will follow NDUS and NDSU policies for use.

Design and installation will follow documentation available from UC Davis W.M. Keck Center for Active Visualization in Earth Sciences where the system was designed (http://idav.ucdavis.edu/~okreylos/ResDev/SARndbox/). These procedures have been used by several other institutions with a successful outcome.

7. **What service on campus is most similar to the one proposed here? How does this project differ?**

There is no service on campus similar to this project. This project will help students develop a skill set that is broadly applicable to many fields of study, but primarily taught in geoscience and landscape architecture classes.

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III. Project Description (5 pages maximum)

Include information on the background of this project: how did it come to fruition?

Topographic maps are essential tools for geoscientists because they show the configuration of the Earth's surface. These maps are used to help students understand the formation and destruction of landscapes, show the distribution and density of geologic and geographic features, and they help keep students safe when doing field work. Topographic maps are also essential tools for landscape architects who must understand landforms in order to ensure stable and appealing design. Outside of these fields, map reading skills remain critical even in a digital age. An ability to read and understand maps translates to a variety of skills including spatial reasoning and problem solving. Moreover topographic maps remain the most commonly used maps for navigating remote areas and being able to read these maps is essential to people who engage in outdoor activities including hunting, fishing, hiking, or exploring state and national parks. While we can demonstrate the value and importance of this skill, teaching it remains a challenge. Topographic maps, which are two-dimensional representations of three-dimensional features remain the most challenging types of maps to read and comprehend. There are new readily available technologies that can help facilitate improving students' ability to understand topographic maps, and facilitate discussion about processes that shape the Earth.

The Augmented Reality Sand Table is one such tool that students can use to better understand topographic maps. This project was developed by researchers at the University of California Davis and is being widely used by universities throughout the world to help students develop map reading skills and develop a deeper understanding of how topography impacts other processes such as the movement of water and even lava flows. While these sand tables may look like toys to some, the data they project rely on highly sophisticated data collection techniques and processing, and use complicated formulas to ensure that the fluid flow is as realistic as possible. This system solves the problems students face when trying to understand how three-dimensional landscapes are represented on two-dimensional surfaces because it provides an active environment for students to develop and practice their skills. There is no other technology available on campus that enables students to practice these skills particularly in a hands on way.

The system is composed of a large (30" x 40") sand table, a computer, a laser scanner, and a mounted projector. The students manipulate the sand to represent various landscapes while the projector overhead draws topographic contours on their features. The possibilities are endless as the topographic lines refresh in a nearly real-time environment. In addition to projecting topographic lines, programs have been developed to enable students to use their hand to initiate localized precipitation events to observe the behavior of water on various landscapes. This technology allows students to recognize how water moves through different drainage patterns. This additional function of the augmented reality sand table environment helps students understand how landscapes impact other natural systems, and could allow students to develop and test hypotheses about hydrologic routing. Because of the many applications of this tool, it will be used in at minimum 10 NDSU courses including *Physical Geology Lab* (GEOL105L), *The Earth through Time Lab* (GEOL106L), *Geography of North America* (GEOG262), *Geomorphology* (GEOL312), *Glacial Geology* (GEOL413), *Hydrogeology* (GEOL414), and *Structural Geology* (GEOL457*), Site Development and Detailing* (LA341), *Environmental Planning Studio* (LA472), *and Site Planning Studio* (LA371) reaching over 550 students each year.

In addition to being used in classrooms, the augmented reality sand table is portable and can therefore be used for outreach. This tool appeals to a wide variety of audiences and can be used for anything from fostering a sense of excitement in STEM fields to explaining local hydrologic processes and concerns. Unlike a stream table the sand table doesn't require a water source and therefore can be used in a wider variety of settings. The directors of this project participate in several outreach events reaching upwards of two thousand community members every year, and with the sand table available we will certainly receive more requests in the future.

We are requesting a total of five augmented reality sand tables. Four sand tables will be used in the Department of Geosciences and one will be used in the Department of Architecture and Landscape Architecture. Four sand tables are being requested in the Department of Geosciences because of the size of the courses they will be used in. Four tables

will ensure that students are able to have an opportunity to interact with the sand table and receive the full learning benefit it provides.

We would encourage the review committee to watch a video of an Augmented Reality Sandbox in action. There are several videos available online including this one: https://www.youtube.com/watch?v=d_ZHsgKjNNk showing a virtual dam failure.

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IV. Milestones

List the date for each project milestone. These milestones should represent the ***significant*** accomplishments that will be associated with the action plan. For each milestone, please indicate its expected outcome and the means for assessing that outcome. (The table may be extended as needed.)

	Date	Milestone	Expected Outcomes	Means of Assessment
1.	March 1, 2016	Initiation of Project	Materials and Equipment Ordered	Project beginning, and materials purchased
2.	June 1, 2016	Construction of sand table and stand begins	Carpentry starts	Carpentry begins
3.	June 15, 2016	Construction completed	Sand Table constructed	Construction completed and installation of additional equipment can begin
4.	June 24, 2016	Sand table available for outreach	Sand Table in working order	Sand Table in complete working order.
5.	August 22, 2016	Sand table available for use in classes	Sand table used in classes at the end of the spring semester	Students have access to sand table.
6.	December 1, 2016	Sand table used in several classes and as outreach tool	By this time students in several classes will have used the sand table to better understand topographic maps	Number of students who have utilized the sand table. This number is expected to equal at least 350. Also the number of community members who have been able to access the sand table. This number is expected to be in the thousands.

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V. Supporting Documentation

NDSU NORTH DAKOTA STATE UNIVERSITY

Dr. Peter G. Oduor, PhD.

To

Vice President Marc Wallman and the TFAC Review Panel.

Dear Vice President Wallman & TFAC Panel,

REF: Letter of Support for Technology Fee Advisory Committee (TFAC) Proposal

It is indeed a great honor to introduce to you Dr. Stephanie Day's proposal submitted as part of the TFAC request for proposals. I have read the proposal and concur indeed that it will improve the quality of education through information technology. Visual Acuity has been widely recognized as a critical component of Human-Computer Interaction. Dr. Day is proposing to utilize the proposal funds in purchasing 3D-optimized Augmented Reality Sand Table. The Augmented Reality Sand Table is interfaced with a laser scanner and a mounted projector. The technological components enable students to visually interpret simulated landforms in real-time. Currently, NDSU does not have an institution-wide available comparable system. With this integrated system, 7 courses (GEOL105L, GEOL106L, GEOG262, GEOL312, GEOL413, GEO414, and GEOL457) and more than 400 students will be impacted. This system will also be utilized by Landscape Architecture especially in courses that incorporate landscape design e.g. Low Impact Development (LID) in LA 341 Site Development I and other affiliated courses. The projected impact number of students is 90.

As NDSU also uniquely combines commitment to students, citizens and research as a land-grant research university. The system will also be utilized in departmental outreach activities including Expanding your Horizons, KidFest, Dino Day at the library, Pop-up museums, Governor's Schools, and K-12 classroom visits to engage the community scientific concepts. About 2,000 students and learners from the Fargo-Moorhead area attend our outreach activities. This integrated system will be the feature piece if funded for this year's outreach activities.

The educational component of this project will greatly enhance awareness of landscape and landforms' studies. Dr. Day's expertise lies in stream channel characterization and restoration. Dr. Day also conducts field-based studies and has engaged underrepresented groups in her research. I applaud Dr. Day's proposal in its aim for classroom and outreach activities and hope it will be funded.

Yours sincerely,

Peter G. Oduor, Chair and Associate Professor of Geology.

DEPARTMENT OF GEOSCIENCES
NDSU Dept 2745 | PO Box 6050 | Fargo ND 58108-6050 | 701.231.8455 | Fax 701.231.7149 | www.ndsu.edu/geosci

NDSU Technology Fee Action Plan Request
VI. Budget

(double-click on the form to begin entering data)

1.	**NDSU ORGANIZATION OR UNIT**	
	Geosciences	
2.	**PROJECT DIRECTOR(S)**	
	Stephanie S. Day	
	Jessie Rock	
	Ben Bernard	

3.				
	SALARIES AND WAGES			**Funds Requested**
	Personnel description	**Number employed**	**Number of months**	
	A. Staff			
	B. Graduate students			
4.	C. Undergraduate students			
5.	**TOTAL SALARIES AND WAGES**			$0.00
6.	**FRINGE BENEFITS**			
7.	**TOTAL SALARY, WAGES AND BENEFITS**			$0.00

	EQUIPMENT	
	A. BenQ MX631ST short-throw XGA DLP projector with 13000:1 contrast ratio and 3200 ANSI lumens	2,750.00
	B. Kinect Sensor with power adapter	625.00
	C. PC	6,750.00
	D.	
	E.	
	F.	
8.	**TOTAL EQUIPMENT**	$10,125.00

9.	**MATERIALS AND SUPPLIES**	
	A. 200 lbs Sand	$1,000.00
	B. Wood and Hardware	$1,250.00
	C. Polyurethane	$500.00
	D. aluminum slats	$375.00
	E. steel pipe	$375.00
	F.	
10.	**TOTAL MATERIALS AND SUPPLIES**	$3,500.00

11.	**TOTAL TECHNOLOGY FEE REQUEST**	$13,625.00
12.	**MATCH (Describe in Match Section)**	
13.	**TOTAL PROJECT EXPENDITURE**	$13,625.00

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VII. Budget Justification

Equipment:

Projector: The requested projector comes recommended for this project because it is a short throw projector and matches the Kinect's field of view when at maximum zoom.

Kinect: The Kinect sensor is one of the least expensive and most responsive laser scanners available.

PC: A dedicated PC must be connected to the set up.

Material and Supplies:

Sand: Approximately 200lbs of sand is required to fill the sandbox.
Wood and Hardware: The sandbox will be constructed of wood and will include casters.
Polyurethane: The box will be coated with polyurethane to ensure it is water tight as small amounts of water can be used to make the sand moldable.
Aluminum Slats: The projector and Kinect mounts will be constructed of aluminum slats.
Steel Pipe: The projector and Kinect mounts will be positioned above the sandbox with a steel pipe.

Cost Per Unit:

The cost for each system is: $ 2,725.00
For the five sand tables requested the total cost is: $13,625.00

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VIII. Budget Match

1. Attempted Budget Matches:

Construction of Sand Table from ALA woodshop and staff

2. Actual Budget Matches:

Construction of Sand Table $320 per table totaling $1600

3. Additional Budget Match information:

Sand tables will be constructed by ALA woodshop. Match is the use of woodshop space and staff time.