AnimalScienceCraft
Using Educational Games to Teach Animal Science

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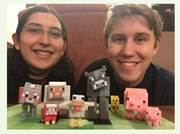


Problem and Motivation

- Animal Science is the science of "*Studying the biology of animals that are under the control of mankind.*" [13]
- Need to educate public of general issues in Animal Science [1]
- This education needs to start in classrooms at a young age [11]
- Though farm products are crucial to everyone, it is difficult to bring people to real farms.
- **Solution: An engaging virtual learning environment for Animal Science to promote public knowledge and to encourage people to learn about Animal Science.**

Animal Science Learning Objectives[5]

Objective	Standards	Summary	Status
Animal Origins	AS.01.01	Where animals come from	No plans to include
Animal Distribution	AS.01.01	How animals are distributed across the world	Built-in
Domestication	AS.01.01	How animals are tamed	Planned
Classification	AS.02.01	Logically organize animals by use and characteristics	Implemented
Anatomy	AS.02.02	Identify different parts of an animal's anatomy	No plans to include
Biology	AS.02.02	Explain the internals of animals	No plans to include
Inheritance	AS.02.03	Understanding how traits are inherited	Implemented
Healthcare	AS.03.01	Identify and treat sick animals	No plans to include
Biosecurity	AS.03.02	Ensure that contagions don't travel between farms	No plans to include
Feeding	AS.04.01	Determine optimal feeding patterns	No plans to include
Growth Hormones	AS.04.02	Understand the benefit and safety of Growth Hormones	Planned
Sexual Organs	AS.05.01	Understand how sexual organs in animals work	No plans to include
Reproduction	AS.05.02	Understand the process of animal reproduction	Implemented
Trait Breeding	AS.05.03	Choose which animals to breed	Implemented
Animal Handling	AS.06.01	Approach, move, and care for animals safely	Planned
Animal Product Safety	AS.06.02	Ensure that the products of animals are safe to consume/use	No plans to include
Housing Safety	AS.07.01	Design structures for the housing of animals	No plans to include
Housing Standards	AS.07.02	Comprehend government standards for animal housing	No plans to include
Environmental Impact	AS.08.01	Understand the impact that a farm has on the environment	No plans to include
Environmental Factors	AS.08.02	Understand how the location of a farm impacts the animals	Planned

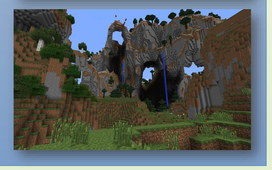
Educational Game Design

- Growing body of research on leveraging "serious games" for education
- Games offer many educational benefits, including automated assessment, just-in-time feedback, and rich motivating experiences.
- However, gracefully integrating the instructional material can be challenging, and the game world can become a source of distraction.

- Two kinds of educational games [9]:
  - In an endogenous game, understanding the material is key to succeeding in the situated game world at a very deep, integrated level.
  - In an exogenous game, the educational material has been grafted on - consider a game where you are randomly interrupted with a multiple choice quiz that you must pass before continuing the real game.

Minecraft

- A fully-interactive, infinitely-generating, block-based world [13]
- Best selling PC game of all time [3]
- One of the most sophisticated modding communities in the history of gaming, permissive licensing enables game extensions for new mechanics, blocks, etc [4]
- Already leveraged to teach mathematics, biology, digital logic, physics, computer science, and many other subjects [2] [6] [7] [8] [10]



Animals in Minecraft

- Genetic inheritance is faulty
- Reproduction is just plain wrong
- Gender is non-existent
- Age is binary

Mechanics and Pedagogy

Gender
Objectives: Reproduction, Classification
- All animals are gendered now
- Visible differences in the animal
- In order to breed two animals, they must be different genders.
- Gender affects the utility of the animal (e.g., male cows do not produce milk)

Reproduction
Objectives: Reproduction
- Adult females have an estrous cycle
- Periodically go into heat and seek out a male
- Varies by species:
  - Pigs have large litters
  - Cattle have single birth
  - Sheep are inclined to have twins
  - Chickens hatch from eggs

Incest
Objectives: Reproduction, Inheritance
- Breeding related animals leads to genetic problems
- Lineage is tracked for each animal
- Animals cannot breed if they share a common ancestor in the past two generations

Genetic Traits
Objectives: Classification, Inheritance, Trait Breeding
- Genetic traits are passed on to children
  - Potential for Production
  - Meat Quantity
  - Domestication
  - Feed Efficiency
- Breed for traits by culling underperformers

Hunger
Objectives: Animal Handling
- Animals must eat to survive
- When their hunger drops to zero, they die
- The amount recovered by eating their food source is determined by their Feed Efficiency

Domestication
Objectives: Domestication
- Wild animals are skittish and hard to interact with
- Once bred for domestication, you can breed for production traits

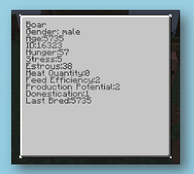
Growth Hormone
Objectives: Growth Hormone
- Offers a boost in production for the animal
- Available cheaply from villagers

Animal Products
Objectives: None (Gameplay)
- Animals products dropped on death have better return on investment
- The quantity of death drops are determined by the Meat Quantity stat
  - Pigs: Pork at low levels, bacon at high levels
  - Cattle: Steak at low levels, filet at high levels, leather at all levels
  - Sheep: Mutton at all levels
  - Chicken: Chicken meat at all levels

Animal Byproducts
Objectives: None (Gameplay)
- Some animals have by-products that do not require killing the animal.
- These drops are determined by the Production Potential stat.
  - Milk: Stacks and don't require buckets, has a health healing enchantment
  - Feathers: Dropped passively by chickens
  - Eggs, Wool: Unchanged from vanilla

Stress
Objectives: Reproduction, Handling
- Stressed animals will not reproduce and become antsy
- Complex calculation based on domestication, hunger, proximity to other animals

Classification
Objectives: Classification
- Animals are based on their species and reproductive capabilities
- In-game system uses this taxonomy
  - Cattle: Calf, Cow, Steer, Bull, Heifer
  - Pigs: Sow, Gilt, Barrow, Boar, Hog, Piglet
  - Sheep: Lamb, Ewe, Ram, Wether, Yearling
  - Chicken: Cockerel, Rooster, Capon, Hen, Pullet, Chick



Size and Age
Objectives: None (Gameplay)
- Animals age and eventually die
- Invincible to mob damage
- Size is determined by age and health
- Baby animals don't have oversized heads

Technical Details

Technical System
- Mod created using Forge for Minecraft 1.7.10
- Forge provides a skeleton and nice event system

Challenges
- Minecraft modding can be difficult - tutorials and guides are rapidly out of date
- Documentation and identifiers are crowd-sourced, but coverage is not 100%
- Community support is good, but not immediate

```
public GuiButton(int p_i1021_1_, int p_i1021_2_,
                 int p_i1021_3_, int p_i1021_4_,
                 int p_i1021_5_, String p_i1021_6_)
{
    this.field_146120_f = 200;
    this.field_146121_g = 20;
    this.enabled = true;
    this.field_146125_m = true;
    this.id = p_i1021_1_;
    this.field_146128_h = p_i1021_2_;
    this.field_146129_i = p_i1021_3_;
    this.field_146120_f = p_i1021_4_;
    this.field_146121_g = p_i1021_5_;
    this.displayString = p_i1021_6_;
}
```

Architecture
- Extended *EntityAnimal* with a new abstract *EntityScientific* class - making our animals compatible with existing animal features but incompatible with other mods
- Using *DataWatcher* in order to synchronize client and server state

Future Work

- Still at pre-alpha level
  - So far, only pigs and cows supported
  - Still have many learning objectives to cover!

- **LearnCraft:** Tutorial system as part of larger effort
  - Tied to in-game events
  - Web server architecture
  - Teach other subjects

- Future research is required to determine its effectiveness in terms of usability and instruction.

- Need to find funding for the project in order to advance development, research, and publicity

Source Code: github.com/LearnCraft/
Detailed Blog: tinyurl.com/animal-science-craft

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