Reach for the Sun: The Seeds of Strategy

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Game Description

Reach for the Sun is a game about the plant life cycle aimed at 6th – 8th graders. In *Reach for the Sun*, players take on the role of a plant, managing its resources over the growing season as it sprouts, grows, respires, photo-synthesizes, and produces flowers, pollen, and hopefully seeds. Beyond the first plant, which can act as a tutorial, players can grow several other types of plants, each of which have different growth and resource use profiles that players can learn to optimize.

In response to feedback from *Reach for the Sun's* release on Steam, we designed a turn-based strategy mode to accompany the time-based standard mode of play. *Reach for the Sun's* Strategy Mode allows players to spend time considering resource costs and benefits before they make each turn's decision about investing in growth, photosynthesis, or reproduction (see Figures 1 and 2). In strategy mode, resource costs are explicit, and the game shows what resources will be gained at the end of the turn based on the plant parts the player has grown so far (see Figure 3).

Figure 1: Timed growth season, standard mode.

Figure 2: Turn-based growth season, strategy mode.

Figure 3: Current resources, plant part costs, and additional resources that will be gained at the end of the turn are explicitly shown.

Gameplay

The primary goal in *Reach for the Sun* is to produce as many seeds as possible at the end of the growing season for each plant. Every plant part the player grows increases the plant's storage capacity for water, nutrients, and starches. Water and nutrients can be taken in periodically from the environment, while starches must be made by photosynthesis in the plant's leaves. Each plant part has a certain resource cost to produce, but then provides additional capacity for collecting and storing resources (see Figure 4). There are tradeoffs involved in deciding which plant parts to grow at different stages in the growing season. For example, roots allow the plant to replenish its store of water and nutrients from the soil. Stems increase storage capacity and provide more nodes for growing leaves and flowers later. Leaves allow the plant to make starch, which is important for growing plant parts, especially pollen and seeds. Flowers give the plant the ability to make pollen and seeds. Investing in pollen prepares flowers to seed, which allows players to invest in seed production for each flower they manage to fertilize with pollen.

Figure 4: Storage capacity grows as more plant parts are added.

Players can unlock up to five different types of plants, which vary in the ways they gather resources and use them to produce plant parts. The sunflower is the "easiest" plant, and most players will be able to produce seeds from at least one flower on their first play-through. The sunflower level provides an optional tutorial explaining the interface and actions the players can take. Each type of plant requires players to adapt their strategies to its strengths and weaknesses. Even though all plants are being grown in the same garden, the differences in plants abilities can be a good jumping-off point for discussing adaptation to different environments.

Curriculum for Game-Based Learning

Reach for the Sun is the game component of a game-based learning unit, *Plant Structure and Processes*, which is part of the PLEx Life Sciences Suite. The unit guide embeds *Reach for the Sun* in a series of lessons which support and build on the experiences students have during gameplay (see Figure 5). A brief video overview highlighting key game features accompanies the unit plan to help teachers prepare to facilitate the game in class.

Figure 5: The *Plant Structure and Processes* unit guide contains assessments, suggestions for implementation, lessons, and extension activities.

Research on learning games in classrooms broadly indicates that games can have a greater impact on learning when they are played over multiple sessions (Clark et al., 2014). This gives students time to reflect on their experiences in the game and to refine their strategies as their understanding develops. The *Plant Structure and Processes* unit includes a brief pre-assessment activity so that teachers can gauge students' incoming experience with key concepts. Then students play the game right away so that they can start the unit with a discussion of concrete experiences. Subsequent lessons focus on supporting and building out different components of the learning objectives. These lessons include gameplay but also involve activities that give students opportunities to work with alternative representations of the content.

Classroom Implementation

As with any classroom experience, it is not sufficient for the students to sit and play the game in a vacuum. Teachers are active facilitators before, during, and after gameplay. The curriculum materials provide a guide that teachers can follow for implementing the game and leading discussions and side activities, but they may choose to draw on it in part or not at all depending on the hardware and time available and the lessons they have prepared. While hardware availability sets some limits, *Reach for the Sun* can be played by the class on one computer, by small groups on multiple computers, or by students individually if enough computers are available.

Learning Objectives

Students will be able to use a model to explain plant structure, life cycles, photosynthesis, use of resources, and reproduction. They will understand the life cycle of temperate plants and how it relates to seasons. They will understand the resources plants need to survive and reproduce, the role of photosynthesis in plant growth, plant anatomy and the functions of plant parts, and the role of pollination in plant reproduction.

Target Population

Reach for the Sun targets 6th - 8th grade students in classroom environments.

Next Generation Science Standards (2013)

MS-LS1-6: Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms
MS-LS1.B:

- Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction (MS-LS1-4)

- Genetic factors as well as local conditions affect the growth of the adult plant (MSLS1-5)

MS-LS1.C: Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-8) (NGSS Lead States, 2013)

Common Core State Standards

CCSS.ELA-Literacy.RST.6-8.4: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

CCSS.ELA-Literacy.RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Reach for the Sun Demo Video and Launch Page

A video demo of *Reach for the Sun* is available on the Filament Games website:

https://www.youtube.com/embed/ezAH_WY6a8I?rel=0&wmode=transparent&width=640&height=390&iframe=true

Reach for the Sun can be played as part of the Plant Structure and Processes Unit in the PLEx Life Sciences Suite: https://www.filamentgames.com/plex-life-science#learning-games

References

Clark, D., Tanner-Smith, E., Killingsworth, S. (2014). Digital Games for Learning: A Systematic Review and Meta-Analysis (Executive Summary). Menlo Park, CA: SRI International. Retrieved from http://www.sri.com/sites/default/files/publications/digital-games-design-and-learning-executive_summary.pdf

National Governors Association Center for Best Practices, Council of Chief State School Officers (2010). *Common Core State Standards.* Washington, DC: National Governors Association Center for Best Practices, Council of Chief State School Officers

NGSS Lead States (2013). *Next Generation Science Standards: For States, By States.* Washington, DC: The National Academies Press.

Acknowledgments