Down with Food: An iPad Game About Digestion

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Introduction

Down With Food is an in-development iPad game that addresses upper elementary school children's misconceptions about what happens to food after they eat. Children typically have a simplified understanding of digestion: food enters your mouth, goes down your throat, enters your stomach, and digestion is completed in a linear fashion. We address the complexities of the digestive system through a storybook narrative integrated with a series of mini-games and simulations that are each based on attempts to apply popular game mechanics to an educational context.

Though much effort has been put toward integrating game elements in educational spaces to improve learning, results have been disappointing (Wouters, Nimwegen, Oostendorp, & van der Spek, 2013). One reason for this unsuccessful hybrid is that designers have taken a "chocolate-covered broccoli" approach, in which the gaming element is a reward for completing the educational component. Our game is developed with the mindset that educational games need to be designed in a way that allows for the learning material to be delivered through the parts of the game that are most engaging (Habgood, Ainsworth, & Benford, 2005).

Game mechanics

Down With Food requires the player to be an active agent in facilitating the ingestion, digestion, and absorption processes. The player flips through storybook pages to learn about the various organs of the digestive system, such as the mouth, esophagus, stomach, small intestine, and large intestine. Within these pages are interactive mini-games or simulations that model the organ's biological functionality. Below we discuss in more detail the esophagus and small intestine games.

Esophagus

The esophagus game mimics the design of the popular rhythm games genre. Rhythm games are typically set to music and require the player to correctly simulate dancing, singing or playing an instrument along to the beat. This simulation usually requires the player to press buttons with precise timing, and rewards the player incrementally using points and/or ratings systems based on how well they were synchronized with the beat. The popularity of rhythm games stem from their ability to combine simplicity with increasingly complicated gameplay mechanisms that are relatively easy to learn but extremely difficult to master. This property of rhythm games gives them a very high replay value as players typically strive to obtain as perfect of a score as possible for each available level.

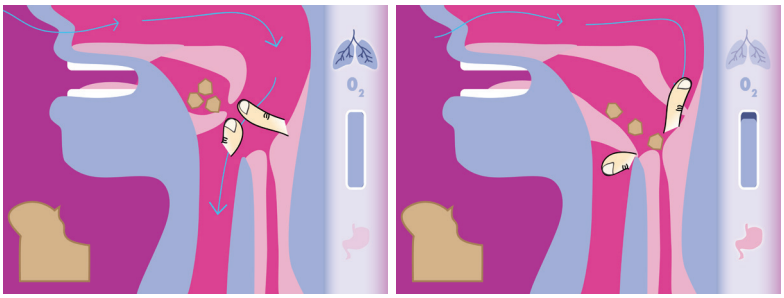

Figure 1: Opening the passageway to switch from breathing to swallowing.

In our esophagus game, the player must control the intake of food and air in a rhythmic fashion. The goal is to perfectly time actions to swallow food as it enters the body while also allowing the body to breathe in oxygen. The swallowing of food is controlled by using the thumb and forefinger to move apart the uvula and the epiglottis and

open the upper esophageal sphincter (see Figure 1). This motion also blocks the nasal passage and the trachea, briefly stopping the flow of oxygen to the lungs. The body switches from “breathe” to “swallow,” as indicated by the righthand column of the user interface (see Figure 2). The meter is an indicator of how much oxygen is in the body, and the player must pinch to close the passageway in time and switch back to breathing. When oxygen runs out, the body forcefully closes the opening and coughs out any food not in the esophagus.

Small Intestine

The small intestine game is presented in the style of the tower defense subgenre of real-time strategy games, in which a player typically places a variety of towers at several points on a game map. Computer-controlled enemy units, usually following a pre-determined path, attempt to infiltrate the player’s base by navigating past the defense system of towers. The goal is to successfully destroy all waves of enemy units before they are able to successfully infiltrate the player’s base. The tower defense subgenre has been popular for years, as these games combine intuitive simplicity with the opportunity for complex, multilevel strategy. Thus, they are easy to play but difficult to master, increasing replayability. Given the natural mapping of tower defense game mechanics to the processes that occur in the small intestine, we adapted the tower defense paradigm to illustrate the absorption processes in the small intestine.

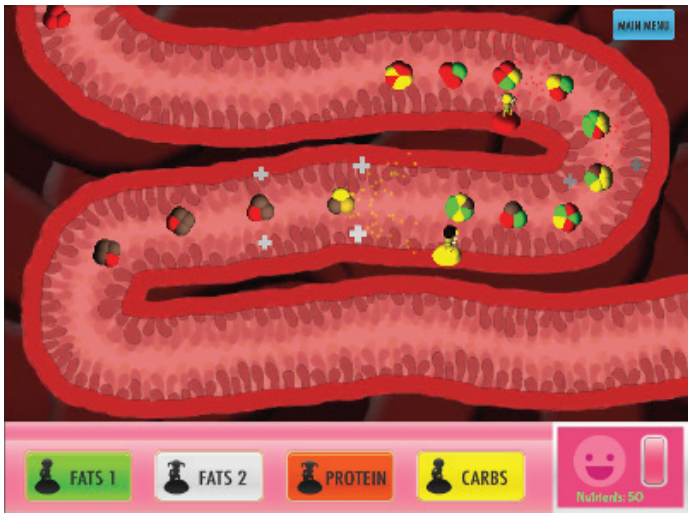

Figure 2: Towers release enzymes to bind to nutrients of incoming food.

In our small intestine game, players strategically place enzyme towers along the walls of the small intestine, to release enzymes at oncoming chyme, represented as multicolored food blobs (see Figure 2). The colors indicate the content of the food: carbohydrates (yellow), proteins (red), or fat (green and white). Fats in the body require two enzymes to be broken down. Each enzyme tower can release enzymes at food particles that contain their corresponding nutrient, indicated through color matching. For example, red enzyme towers can break down red food particles while yellow towers break down yellow food particles. The challenge is to place enzyme towers strategically so that as food blobs pass, the enzymes release to attach to the appropriate part of the food blob. If successful, the corresponding food particles will break down, releasing nutrients that are absorbed by the villi projections at the wall of the small intestine, to be released into the bloodstream.

Prototype in action

For the educational arcade, we present a prototype of a storybook integrated with games for the mouth, esophagus, and small intestine. This is available at http://www.downwithfood.com/prototypes.

References

Habgood, M. P. J., Ainsworth, S., & Benford, S. (2005). Endogenous fantasy and learning in digital games. *Simulation and Gaming, 36*(4).

Wouters, P., Van Nimwegen, C., Van Oostendorp, H., & Van der Spek, E.D. (2013). A meta-analysis of the cognitive and motivational effects of serious games. *Journal of Educational Psychology, 105*(2): 249-265.