**APES- Sustainable Island**



**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Objective:** *You are to create an island environment that is sustainable for a minimum of 8 generations. If you exceed the number of beans (for any category) than what you are allotted you have NOT create an environment that was sustained for that time period.*

**Materials:** Count out the following beans for your group and place them in each of 4 plastic cups. ***Remember to also record the appropriate numbers in the correct columns on your data table:***

* **70 NAVY BEANS-** to represent the water supply drawn from the lake on the island
* **40 KIDNEY BEANS-** to represent the land acreage that is farmed/cultivated on the island
* **40 BLACK BEANS-** to represent the energy supply used by the people on the island
* **4 BLACK-EYED PEAS-** to represent the people originally on the island + a reserve of beans for future generations
* ***Reserve 2 extra cups for beans used and one for beans discarded during the game***

**Directions:**

* **BEFORE** you start **EACH** generation your group must decide what type(s) of energy your people will be using. ***You may have a combination of coal-fired electric utilities, nuclear, hydroelectric, solar, geothermal, or wind energy.***
* Your group must also decide on what **type(s) of employment** the people of the island have. Three-fourths (3/4) of the inhabitants have to the gainfully employed either as ***industrial workers (assembly line, construction, day laborers, etc.), service industry workers (computers, banking, lawyers, etc.), or agricultural workers (farmers, dairy processors, landscaping, etc.).***
* Where would the food come from that everybody eats? After you have made your decision for the 1st generation and recorded it on your data table go through items A-M and discard any beans that you have used as you proceed through the checklist. *(Put them in a cup that you designate for ‘used’ beans).*

**Hint:** *Wise choices in the beginning will help you continue through 8 generations. To that end, you might want to look through the following list before you make your energy and employment choices for the 1st generation.*

**Rules:**

1. Each person uses **1 water (NAVY) bean** every generation
2. **1 land (KIDNEY) bean & 1 water (NAVY) bean** supports 1-10 people for their food supply. *(For each additional group of 1-10 you will need to pay for their support)*
3. **1 land (KIDNEY) bean** is used to house 1-10 people. *This is NOT included with the land bean that supports them in their food requirement. (For each additional 1-10 people you will need to pay for their additional support)*
4. *A* coal-fired electric utility supports 1-10 people for their household needs but uses **1 energy (BLACK) bean, 2 land (KIDNEY) beans, and 1 water (NAVY) bean** EVERY generation. *(For each additional group of 1-10 people that use this energy you have to start another plant and pay for its support)*
5. A nuclear power plant supports 1-10 people for their household needs but uses up **1 energy (BLACK) bean, 1 land (KIDNEY) bean, and 1 water (NAVY) bean** every generation. *(For each additional group of 1-10 people that use this energy source you have to start another power plant- and also pay for its support.* Also, because of the need for storage of radioactive waste on site, it will cost you **an additional water (NAVY) bean and land (KIDNEY) bean** after every 3 generations
6. A hydroelectric plant supports 1-5 people for their household needs but uses **1 energy (BLACK) bean and 1 land (KIDNEY)** bean every generation. Also, for every 3 hydroelectric plants installed there is an additional **water (NAVY) bean** used every generation
7. Solar, geothermal, and wind energy are lumped together as *‘alternative energy’.* Each alternative energy source supports 1-5 people for their household needs. For each additional group of 1-5 people that use this energy you have to start another plant and pay its support. Also, for every 3 alternative energy sources there is **1 energy (BLACK) bean** used each generation
8. Each industrial plant supports 1-8 jobs but uses **2 land (KIDNEY) beans & 1 energy (BLACK) bean** every generation. *(If more than 8 people work in industry you have to start a 2nd plant and pay for its support)*
9. Each service industry supports 1-5 jobs but uses **1 land (KIDNEY) bean and 1 energy (BLACK) bean** every generation. (*If more than 5 people work in the service industry you have to start a 2nd service industry and pay for its support)*
10. Each farming operation supports 1-5 jobs but uses **1 land (KIDNEY) bean & 1 energy (BLACK) bean** every generation. *(If more than 5 people work on a farm you have to start a 2nd farm and pay for its support)*
11. **1 water (NAVY)** bean is used to water each farm each generation
12. **1 land (KIDNEY) bean** is used to support 1-20 people for their waste disposal needs in a sanitary landfill or equipment (bulldozers, trucks). For each additional 20 people, an additional energy **(BLACK) bean is used every year and an additional land (KIDNEY) bean** will be needed every 4 years.
13. **1 land (KIDNEY) bean** is used to support 1-20 people for the treatment of their drinking water and wastewater for 4 generations. **1 energy (BLACK) bean** is used each generation for running both treatment plants. Each group of 20 people will require additional water and wastewater treatment plants and also their support.

**Instructions:**

* Since water is a renewable resource, you may retrieve all but 2 of the **water (NAVY) beans** you discarded. ***The 2 you discard you will empty into another plastic cup labeled ‘discard’.*** The 2 that remain discarded were due to water evaporation and some contamination. However, you may regain **1 of these water (NAVY) beans** every generation by your group implementing ***water conservation methods***- at the **expense of 1 energy bean** every generation *(water conservation is an ongoing endeavor).* *Record your conservation efforts (if any) on your data table.*
* Since land is also a renewable resource you may retrieve all but 2 of the **land (KIDNEY) beans** you discarded, expect for any beans due to soil erosion. The 2 that remain discarded were due to poor farming and construction practices that lead to soil erosion and sedimentation. The ones you discard you will empty into another plastic cup labeled ‘discard’. However, you may regain 1 of these land (KIDNEY) beans every generation by your group implementing ***soil conservation methods***- at the expense of **1 energy bean (BLACK)** every generation *(soil conservation is an ongoing endeavor).* You may only use this option of land conservation 3 times during the 8 generations. *Record your conservation efforts (if any) on your data table.*
* Since most forms of energy cannot be returned to their once usable state *(natural gas and coal)*, all will be discarded expect for only those that dealt directly with alternative energy or hydroelectric. However, you may regain **3 of these energy (BLACK) beans** every generation by your group who are implementing *energy conservation methods- installing energy efficient lighting, appliances, regulated thermostats, recycling, etc.* at the expense of **1 energy (BLACK) bean.**  You may only use this option of energy conservation 3 times during the 8 generations.
* **Multiply the # of people by 1.75** to represent the increase in population due to births and immigration *(use rounding rules if it doesn’t come out to a whole number).* Add that number of black-eyed peas to your current population. **Take 20% of the current population** (rounding to the nearest whole number) and **discard that number of people due to death and emigration to another land).**
* **BEFORE** starting the 2nd and 3rd generations, you may change your type(s) of employment and energy. Record any changes.
* **BEFORE** starting the 4th generation, roll the die once. Record the number across from the generation on your data table. If you rolled a “6” then your population will remain the same throughout the upcoming generations- no additional births but you still have 20% death. If you rolled a “3” then your population will only increase by 1.35x the rate of the population, with the usual 20% deaths. **All other numbers-** will continue with the 1.75x rate of population and 20% deaths.
* **BEFORE** starting 5th, 6th, 7th and 8th generations, you may change your type(s) of employment and energy. *Record any changes.* If at any time you run out of any beans, your colony has died out due to lack of water, land resources, or energy needs. *If this happens, do NOT continue on the next generation but write on your data table what item you ran out of and why.*

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| **Generation #** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| **# of people at the start of generation** |  |  |  |  |  |  |  |  |
| ***Employment Type* and # of people it supports** |  |  |  |  |  |  |  |  |
| ***Energy Type* and # of people it supports** |  |  |  |  |  |  |  |  |
| **# of Water (NAVY) beans *(available)*** |  |  |  |  |  |  |  |  |
| **# of land (KIDNEY) beans *(available)*** |  |  |  |  |  |  |  |  |
| **# of energy (BLACK) beans *(available)*** |  |  |  |  |  |  |  |  |
| **# of used water (NAVY beans)** |  |  |  |  |  |  |  |  |
| **# of used land (KIDNEY) beans** |  |  |  |  |  |  |  |  |
| **# of used energy (BLACK) beans** |  |  |  |  |  |  |  |  |
| **(1.75x) population increase *(birth & immigration)*** |  |  |  |  |  |  |  |  |
| **-20% death & emigration** |  |  |  |  |  |  |  |  |
| **# of people at the end of the generation *(continue # to the top of the next column)*** |  |  |  |  |  |  |  |  |

***Employment Type*- Each generation *Energy Type-* Each generation**

**1. 1.**

**2. 2.**

**3. 3.**

**4. 4.**

**5. 5.**

**6. 6.**

**7. 7.**

**8. 8.**

***Analysis: (Each person will turn in the following items)***

* **Data Table**
* **Graph- *showing the growth of population versus generations as well as the use of water, land, and energy over those generations (color coded)***
* **Write a summary paragraph *that explains your reasons for choosing the types of employment and energy types over the generations and the effectiveness of your choices. Include alterations you would do if you were to do this activity over again and why. What did you learn by doing this activity?***