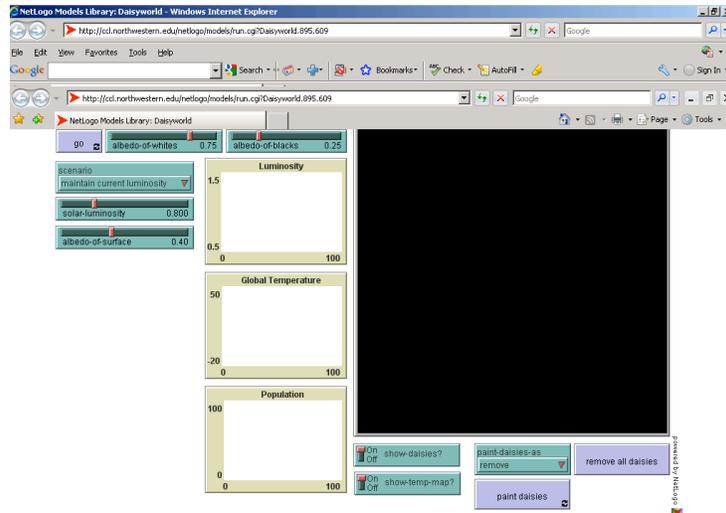


Explore the reciprocal influence of living organisms on the physical properties of an ecosystem.

1. Go to the following website <http://ccl.northwestern.edu/netlogo/models/Daisyworld>
2. Click on Run *Daisyworld in your browser*. This is the screen that you will get



3. This simulation will allow you to see the influence of organisms on the environment (climate change) and *vice versa*.
4. **Daisyworld** is a world that can have white daisies which have a high albedo and therefore cool the environment and black daisies that have a low albedo and therefore heat up the environment. However, plants respond to environmental conditions, so they will, in turn, increase or decrease in population size (boom or bust).

The *albedo* is a property of an object that represents the fraction of sunlight it reflects.

The albedo of the Earth is 0.39. This is a function of the “stuff” on the surface. For example a large expanse of snow reflects more sunlight than a large expanse of dark soil. Such changes affect the equilibrium temperature of the Earth.

Other factors can also affect global (and local) temperature:

- a) An increase in greenhouse gases, by trapping infrared radiation, can lower the albedo of the earth and cause global warming.
- b) The landscaping in cities can also affect local climate by producing heat islands. A large expanse of concrete will have a higher albedo effect than plants.
- c) Converting natural ecosystems to monoculture ecosystems can also change the albedo effect because different plants reflect sunlight differently.

Simulation

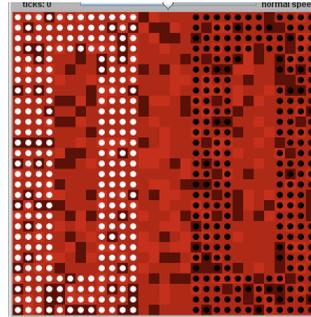
Click on **Setup** to populate Daisyworld with daisies. Click **Go** to start the simulation. Run the simulation using the default values for 3 to 5 minutes and click on **Go** to stop the simulation. Answer the following questions:

- a) How is **Global Temperature** and the **Population Size** of the white and the black daisies related? You can move the mouse over the graphs to get the values on the X and Y axes.

b) Run the simulation without any daisies (Click on **Remove all Daisies** before clicking on **Go**). What happens when there are no plants? _____

c) What happens when you have **only** black daisies or **only** white daisies? _____

Remove all the daisies and plant daisies in a pattern. For example, a patch of white daisies on the left (with a hole in the middle), no daisies in the middle, and a patch of black daisies on the right (with a hole in the middle). Use the **paint daisies** as and **paint daisies** controls as needed.



Place the **Show-daisies** slider to Off so that you can see local temperature changes. Light red represents hotter temperatures, and darker red represents colder temperatures

d) What happens to global temperatures? What happens to the relative amounts of white and black daisies? _____

e) Can you set the values such that you have constant temperatures, and a population of black and white daisies that coexist? _____

Additional Questions/Challenges

- **What happens to the daisies? Do the populations ever remain stable? Are there ever population booms and busts? If so, what causes them?**
- **What happens if boom and bust cycles just keep getting bigger and bigger? The swings can't keep getting bigger forever.**
- **Does the planet ever become completely filled with life, or completely devoid of life?**
- **Try running the simulation without the daisies. What happens to the planet's temperature? How is it different from what happens with the daisies?**
- **Try running the model with SHOW-DAISIES? off and SHOW-TEMP-MAP? on. You might be able to see interesting spatial patterns that emerge in temperature concentrations and periodic redistricting of temperature regions more easily in this mode.**
- **Try adjusting the fixed temperature diffusion setting in the procedures (change it from 0.5). What happens to the behavior of Daisyworld if temperature is never diffused (set to 0.0)?**