School Name: Mesa View Middle School 2017
Team: MesaViewMid-4
Area of Science: Air and Water Pollution
Project Title: Gold King Mine Spill
Team Members and Emails

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- **Source Code: Uri Wilensky (1998) "Percolation"**
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Background

The Animas River flows from Colorado, through New Mexico and finally empties into Lake Powell on the Utah/Arizona border. In 2015, Gold King Mine EPA workers breached a barrier wall and spilled polluted, concentrated mining water into the river. Beside the water appearing cloudy and orange, it including arsenic, lead, barium and mercury, among other heavy metals. These particular minerals and heavy metals can cause health defects, birth defects, and result in shorter life spans for potentially any animal, plant or human that consumes or has extended exposed to these elements.

Executive Summary

The Animas and San Juan Rivers were contaminated with lead and arsenic due to the Gold King Mine. The spill spread approximately 375 miles long from Silverton, Colorado, to Lake Powell in Arizona. Three million gallons of contaminated water that contained lead, mercury and arsenic entered the watershed rapidly. This was important because humans, livestock and crops are located near these rivers and depend on the water for drinking water, bathing, and watering crops, among other things.

Statement of Problem

The problem resulting from the Gold King Mine spill is that heavy metals and other concentrated minerals rapidlydumped into the Animas River in Colorado, traveled down the watershed, into New Mexico, and may have gone

all of the way to Lake Powell. Currently, we do not know the long term effects that this spill may have on humans and animals. We used a computational model to help study the spill.

Description of Method

We used NetLogo 5.3.1 to model the spill

Validating the Model

We will run the model several times to validate the model. Presently, this is a weak point that we would like to improve on in the future.

Results

We have learned as much as we could about how the spill affected communities now and in the future. We were able to demonstrate how lead can seep into the base of the riverbed.

Overview

Subcategory A: This model represents concentrated lead seeping into the riverbed of the Animas River Watershed. The orange color represents the lead seeping into the riverbed. The blue represents the riverbed of the watershed. The riverbed ends up being saturated, therefore sending lead farther down the watershed.

Subcategory B: We found a program that simulates waterflow in a watershed. However our expertise was lacking in the ability to superimpose the program onto GIS coordinates. We would like to remedy this in the future.

Conclusion

We have learned alot in our Super Computing. We have learned about the Gold King Mine Spill and basic coding. One of our favorite things we

learned was the minerals/metals that were spilled into the watershed/riverbed

Signifacant Achievements

One of our most signifacnt achievements was learning how to code on NetLogo. We also learned so much about The Gold King Mine Spill

Acknowledgements

We would like to thank Ms. Gabrel for helping us find tutorials, coding, going to the Farmington Citizen's Water Committee meeting and helping us find contacts in the community.

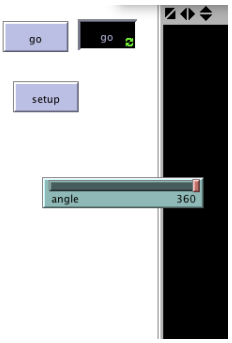
We would like to thank Evan O'Keefe, GIS Supervisor at San Juan County, for sharing Excel sheets, etc. related to GIS and other data, including from the EPA.

We would like to also thank Mr. Henegar, from Mesa View Middle School, who has agreed to help us with coding when we are confused.

We would like to thank Mr. Jimmy E. Johnson, Jr., who has also volunteered to help with GIS + NetLogo 5.3.1

Finally, we would also like to thank Uri Wilensky for the original coding of "Percolation," that we utilized for Subcategory A programming.

Screenshots:

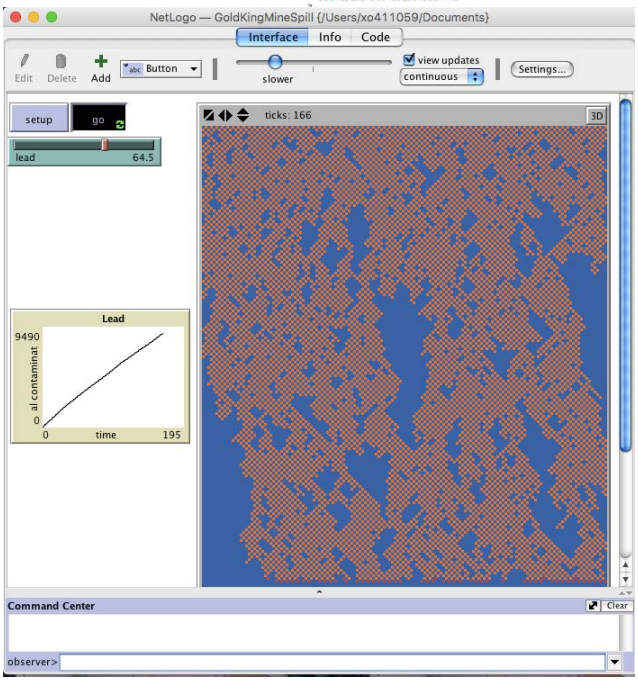


```
to setup
  clear-all
  reset-ticks
  create-turtles 1 [
    pen-down]
end

to go
  tick
  ask turtles [
    set heading (heading + (angle / 2) - (random angle))
     forward 1
  ]
end
```

```
ask current-row with [pcolor = red] [

  ask patches at-points [[-1 -1] [1 -1]]
    [ if (pcolor = blue) and (random-float 100 < 70)
        [ set pcolor red ] ]
  set pcolor orange
  set total-oil total-oil + 1
```



Code:

```
globals [
  current-row
  total-oil

]

to setup
  clear-all
  set total-oil 0

  ask patches [
    reset-color
  ]

  ;; set up top row
  set current-row patches with [pycor = max-pycor]
  ask current-row [
    if pxcor mod 2 = 1
      [ set pcolor red ]

  ]
  reset-ticks
end


to reset-color
    ifelse (pxcor + pycor) mod 2 = 1
      [ set pcolor blue ]
      [ set pcolor blue ]
end

to go
  if not any? current-row with [pcolor = red]
    [ stop ]
  percolate
  wrap-oil
  tick
end
ask current-row with [pcolor = red] [

   ask patches at-points [[-1 -1] [1 -1]]
     [ if (pcolor = blue) and (random-float 100 < 70)
         [ set pcolor red ] ]
   set pcolor orange
   set total-oil total-oil + 1
]

  set current-row patch-set [patch-at 0 -1] of current-row
end



to wrap-oil
  if [pycor = min-pycor] of one-of current-row
  [
    ask current-row [
      ask (patch-at 0 -1)
        [ set pcolor [pcolor] of myself ]
    ]
    ask patches with [ pycor < max-pycor ] [
      reset-color
    ]
    set current-row patch-set [patch-at 0 -1] of current-row
  ]
end
```

References

"Gold King Mine Spill." Gold King Mine Spill | Superfund. N.p., n.d. Web. 27 Mar. 2017.

"Emergency Response to August 2015 Release from Gold King Mine." EPA. Environmental Protection Agency, 17 Mar. 2017. Web. 27 Mar. 2017.

Ap. "EPA says it won't repay claims for spill that caused yellow rivers." CBS News. CBS Interactive, 13 Jan. 2017. Web. 27 Mar. 2017.

Phippen, J. Weston. "The Navajo, the EPA, and the Accident That Turned a River Orange." The Atlantic. Atlantic Media Company, 16 Aug. 2016. Web. 27 Mar. 2017.