Visual storytelling of scientific data: collaborations between art and physics in the college classroom



Collaboration for Student Success:

2019 Advising, Applied Learning and Student Success Summit

October 28, 2019

Dr. Eric Edlund and Dr. Szilvia Kadas SUNY Cortland



Common Problem Pedagogy (CPP)

The goal is to have teams develop cross

disciplinary perspectives, that adds

important dimensions to their effort.

Focus:

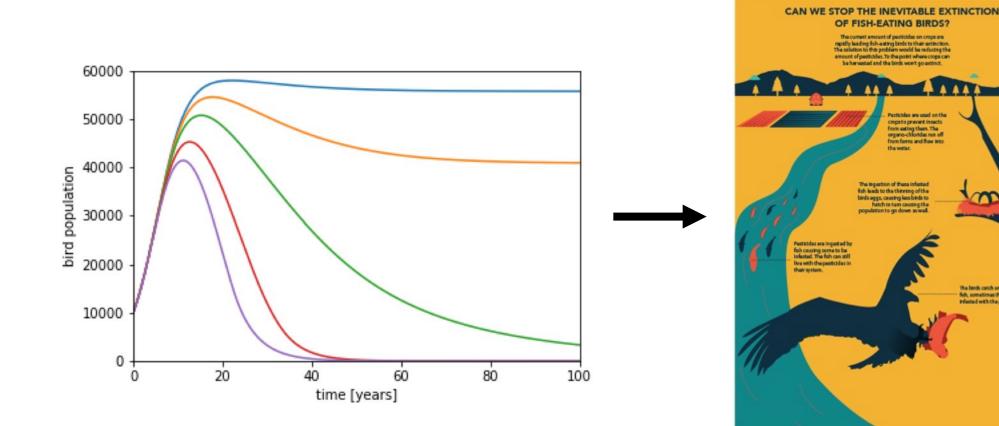
- Interdisciplinary teamwork
- Problem-solving
- Applied/experiential learning
- Socially conscience
- Funded by an NSF Grant
- SUNY Oneonta, SUNY Oswego, SUNY Cortland,

SUNY Plattsburgh



The birds catch and set the fish, sometimes the fish are Infected with the perticides

Connection between art and science

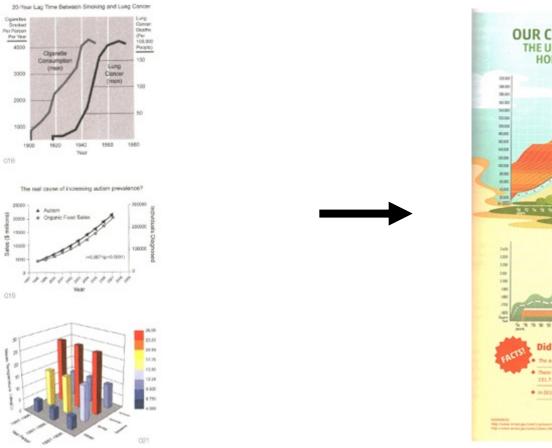


Student Project: Impact of organo-chlorides on birds of prey



Infographics

也

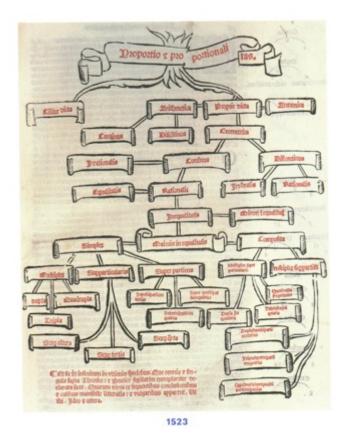




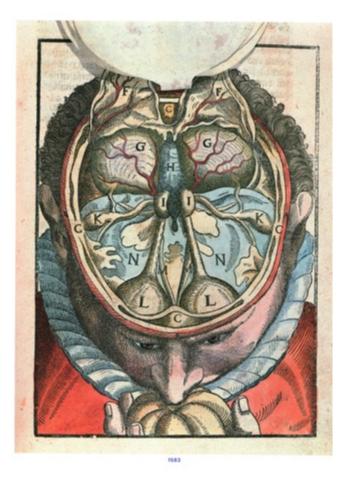
Yikum, K. & Zhao (2013) Visual Storytelling p. 27



Infographics – history



Summa de Arithmetica, Franciscan friar Luca Pacioli



Georg Bartisch, Ophthalmology Book, Rendgen, S. (2012) Information Graphics, (pp. 26-27), Taschen



Planning and organization

Our constraint:

• Asynchronous communication

Our solution:

- Division of work process
- Primary communication through Blackboard
- Exchange of data in technical reports



Students collaborating in the sole person-to-person meeting.



Timeline

- March 1 Design students list areas of social/environmental concern
- March 15 Preference for topical areas due
- March 25 Identification of four articles
- March 29 Definition of four specific questions
- April 3 Selection of specific question
- April 5 Development of the numerical model
- April 15 Report on numerical model
- April 21 Data available to Design Students
- April 22- Begin working with data: Lecture, Group Activity
- May 8- Final Project Due: Common Problem Project Presentations
- May 9-17 Project Exhibition: Dowd Hallway Gallery

Physics students

Design students



Modeling of social & environmental issues

Dr. Eric Edlund March 4, 2019

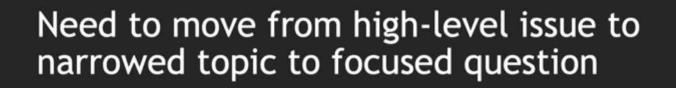


Our list of high-level topics to consider

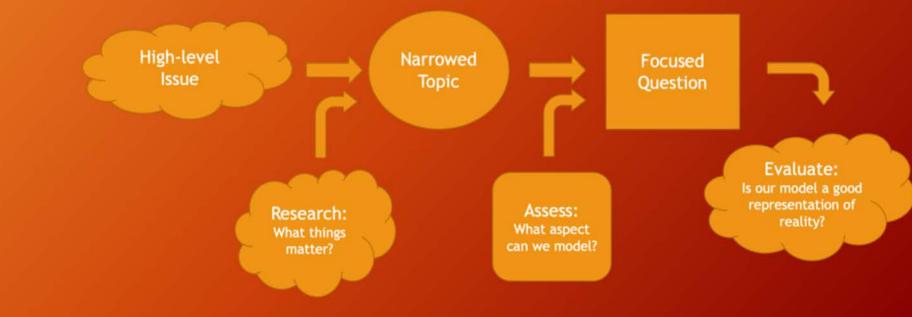
- Immigration
- Food supply
- Forest management
- Poverty
- Air/water pollution

- College debt
- Endangered species
- Political partisanship
- World population
- Ozone layer





• 3 levels of specification -> 2 levels of refinement





In recent news

https://www.nytimes.com/2019/02/28/climate/fish-climate-change.html

The World Is Losing Fish to Eat as Oceans Warm, Study Finds



"Fish make up 17 percent of the global population's intake of protein, and as much as 70 percent for people living in some coastal and island countries, according to the Food and Agriculture Organization of the United Nations."

"Warm areas fared even worse when they were overfished. The researchers suggested that overfishing made fish even more vulnerable to temperature changes by hurting their ability to reproduce and damaging the ecosystem."



Example: brainstorming for sustainability

Phase 2: Generate a specific question for each well-defined issue.

- How do variations in wind affect the price of electricity?
- How does a carbon tax that depends on the average annual global temperature affect economic growth?
- How does the use of a limited food resource affect population growth?
- How does the implementation of police suppression of riots affect the long-term tendency of a population to revolt?
- How does the number of vacation houses affect one's happiness?



The story of the fish and the fisher-people:

$$\frac{d}{dt}P_{fish} = \frac{1}{\tau_{fish}} \left(1 - \frac{P_{fish}}{P_{fish}^{max}}\right) P_{fish} - RP_{humans}$$

$$\frac{d}{dt}P_{humans} = \frac{1}{\tau_{humans}} \left(1 - \alpha \frac{P_{humans}}{P_{fish}}\right) P_{humans}$$

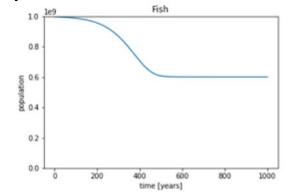


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Equilibrium

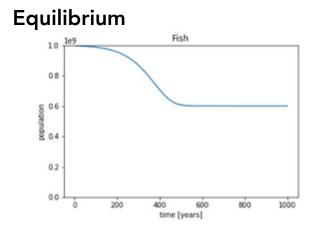




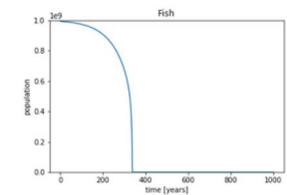
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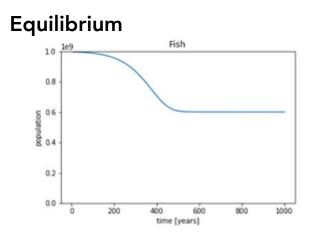


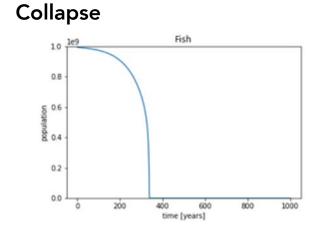


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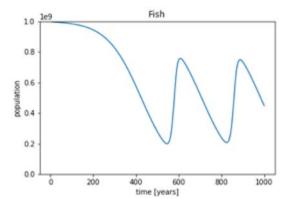
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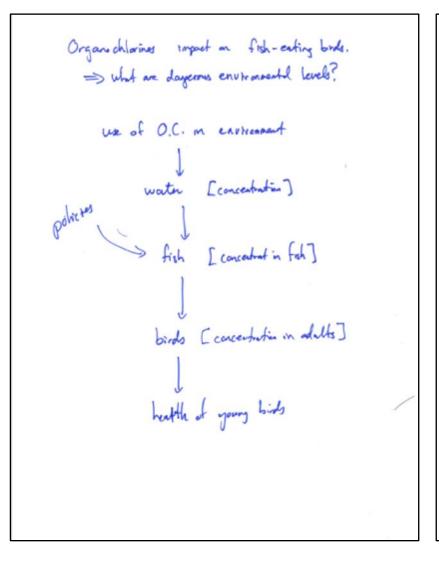


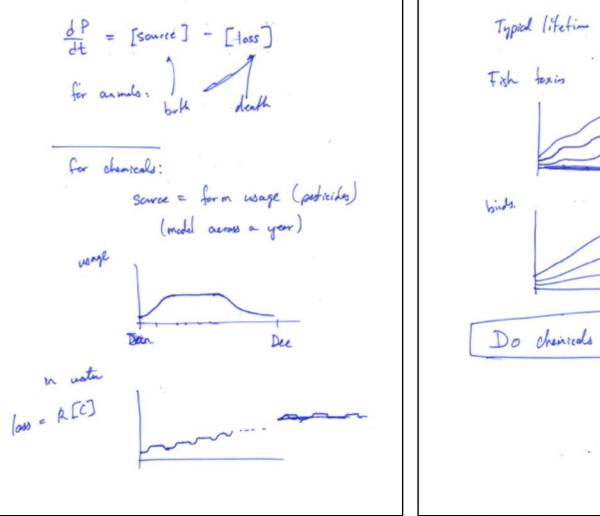


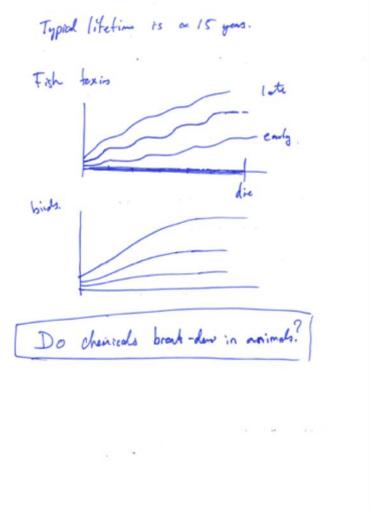
Oscillations













1#!/usr/bin/env python3 2# -*- coding: utf-8 -*-	
3 ***	
	birds of prey in response to environmental hloride pesiticides that affect bird birth e indirect route of water -> fish
9	
10 import numpy as np	
11 import matplotlib.pyplot as plt	
12 from scipy.signal import savgol_fi	lter as sfilt
13	
14 #	
15 # simulation setup 16	
17 # number of days per year	
18 Ndays = 360	
19 # time step in years	
20 dt = 1.0/Ndays	
21 # simulation duration	
22 tsim = 100	
23 # time array	
24 t = np.arange(0,tsim,dt)	
<pre>25 # number of entries in array 26 Nt = len(t)</pre>	
27	
28 # number of models to examine	
29 Nmodel = 5	
30	
31 # bird population	
<pre>32 P = np.zeros([Nmodel,Nt])</pre>	
33 # concentration in birds	
34 B = np.zeros([Nmodel,Nt])	
35 # chemical usage	
36 C = np.zeros([Nmodel,Nt]) 37 # concentration in water	
38 W = np.zeros([Nmodel,Nt])	
39 # concentration in fish	
40 F = np.zeros([Nmodel,Nt])	
41	
42 #	
43 # model parameters	
44 AE = initial bird constation	
45 # initial bird population 46 P0 = 1e4	
47	
48 # max bird population	
49 Pmax = 1e5	
50	
51 #initial pollutant concentration	
52 C0 = 0.0	
53 54 # critical chemical concentration	in hirde
55 Bcrit = 400	111 01103
56	
57 # critical chemical concentration	in birds
58 Fcrit = 100	
59	

2	
"	definition of the chemical use patterns
t	1 = 50
	2 = 110
	3 = 181
t	4 = Ndays
t	emp0 = np.zeros(Ndays)
	$emp\theta[t1:t2] = (t[t1:t2] - t[t1])/(t[t2] - t[t2])$
	emp0[t2:t3] = 1.0
	$emp\theta[t3:t4] = temp[t3-2:0:-1]$
	in = 41
	ly = 1
	<pre>emp0 = np.abs(sfilt(temp0, win, ply))</pre>
	<pre>emp0 = np.abs(sfilt(temp0, win, ply))</pre>
+	emp = np.zeros(Nt)
ž	or 1 in range(tsim):
	temp[i*Ndays:(i+1)*Ndays] = temp0
	tent (a man) at (a man) at a compo
	model 1: very small usage
1	f j == 0:
	A = 3e - 3
	C[j,:] = A * temp
#	model 2: small usage
	f j == 1:
7	A = 1e-2
	C[j,:] = A * temp
	model 2: Incon ucano
1	model 3: large usage
1	j = 2:
	A = 2e-2
	C[j,:] = A * temp
	model 4: large usage
i	f j == 3:
	A = 4e-2
	C[j,:] = A * temp
8	model 5: large usage
	f j == 4:
	A = 6e - 2
	C[j,:] = A * temp
	simulation
	(a) a
P	[j,0] = P0
k	= 4e-4

<pre>223</pre>			
<pre>dw = C[j,i] - kew[j,i-1] dw [j,i] = W[j,i-1] + dw # model the build-up in fish tau = 6eWdays for i in range[1,Nt): d = 1e=3eW[j,i] - (1.0/tau) * F[j,i-1] F[j,i] = F[j,i-1] + dF # model the build-up in birds tau = 12eWdays for i in range[1,Nt): d = 1e=3eF[j,i] - (1.0/tau) * B[j,i-1] B[j,i] = B[j,i-1] + dB # model the bird populations taud = 5eWdays for i in range[1,Nt): taub = 1e9 if f[j,i] = C[j,i-1] + dB d = (1.0/taub) * (1 - P[j,i-1]/Pmax) * P[j,i-1] - (1.0/taud)*P[j,i-1] P[j,i] = P[j,i-1] + dP d = (1.0/taub) * (1 - P[j,i-1]/Pmax) * P[j,i-1] - (1.0/taud)*P[j,i-1] P[j,i] = P[j,i-1] + dP d = data output d = data output d = fata output d = fata output d = fit.ge() j plt.plut(t[m(days]*365.0,temp[0:Ndays]) j plt.ylabel('time [days]') d plt.ylabel('time [days]') d plt.ylabel('time [days]') d plt.ylabel('time [days]') d plt.ylabel('time [qays]') d plt.ylab</pre>	128 # /	model the build-up in water	
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<pre>F[j,1] = F[j,1-1] + dF # model the build-up in birds tatue 12>Mdays for i in range(1,Nt): dB = 1e-3>F[j,1] - (1.0/tau) * B[j,1-1] B[j,1] = B[j,1-1] + dB # model the bird populations taud = 5>Mdays for i in range(1,Nt): taub = 120 taub = 120 taub = 2.0 * Ndays * Bcrit / (Bcrit - B[j,1-1]) dP = (1.0/taub) * (1 - P[j,1-1]/Pmax) * P[j,1-1] - (1.0/taud)*P[j,1-1] P[j,1] = P[j,1-1] + dP data output P[j,1] = P[j,1-1] + dP data output P[,1] = P[j,1-1] + dP data output plt.figure() figure() figure() fisplt.plot(t[0:Ndays]*365.0,temp[0:Ndays]) plt.figure() fisplt.stabel('time (days]') fisplt.stabel('time (days]') fisplt.stabel('time (years]') fic plt.klabel('time (years]') fic plt.figure() fic plt.figure() fic plt.stabel('time (years]') fic plt.figure() fic plt.figure() fic plt.figure() fic plt.figure() fic plt.figure() fic plt.stabel('time (years]') fic plt.figure() fic plt.stabel('time (years]') fic plt.stabel('time (years]') fic plt.figure() fic plt.fic plt.figure() fic plt.figure</pre>	128		
<pre>131 # model the build-up in birds 132 tau = 12+Mdays 133 for i in range(1,Nt): 134 dB = 1e=3+F[j,i] - (1.0/tau) * B[j,i=1] 135 B[j,i] = B[j,i=1] + dB 136 # model the bird populations 137 # model the bird populations 138 taud = 5+Mdays 139 for i in range(1,Nt): 130 taub = 1e9 131 if B[j,i=1] < Bcrit: 131 taub = 2.0 * Ndays * Bcrit / (Bcrit = B[j,i=1]) 132 dP = (1.0/taub) * (1 - P[j,i=1]/Pmax) * P[j,i=1] - (1.0/taud)*P[j,i=1] 134 dP = (1.0/taub) * (1 - P[j,i=1]/Pmax) * P[j,i=1] - (1.0/taud)*P[j,i=1] 135 dP = (1.0/taub) * (1 - P[j,i=1]/Pmax) * P[j,i=1] - (1.0/taud)*P[j,i=1] 136 dP = (1.0/taub) * (1 - P[j,i=1]/Pmax) * P[j,i=1] - (1.0/taud)*P[j,i=1] 135 plt.juli(1,1,2) 136 plt.figure() 135 plt.juli(1,1,2) 135 plt.juli(1,1,2) 136 plt.stabel('time [days]') 137 plt.ylabel('daily chemical usage [a.u.]') 139 plt.ylabel('water pesticide concentration [ppm]') 130 plt.ylabel('water chemical.png') 131 132 plt.xlabel('time [years]') 133 plt.ylabel('fish pesticide concentration [ppm]') 134 plt.xlabel('time [years]') 135 plt.ylabel('fish pesticide concentration [ppm]') 137 plt.ylabel('fish pesticide concentration [ppm]') 139 plt.ylabel('fish pesticide concentration [</pre>	129		
<pre>131 # model the build-up in birds 132 tau = 12+Mdays 133 for i in range(1,Nt): 134 dB = 1e=3+F[j,i] - (1.0/tau) * B[j,i=1] 135 B[j,i] = B[j,i=1] + dB 136 # model the bird populations 137 # model the bird populations 138 taud = 5+Mdays 139 for i in range(1,Nt): 130 taub = 1e9 131 if B[j,i=1] < Bcrit: 131 taub = 2.0 * Ndays * Bcrit / (Bcrit = B[j,i=1]) 132 dP = (1.0/taub) * (1 - P[j,i=1]/Pmax) * P[j,i=1] - (1.0/taud)*P[j,i=1] 134 dP = (1.0/taub) * (1 - P[j,i=1]/Pmax) * P[j,i=1] - (1.0/taud)*P[j,i=1] 135 dP = (1.0/taub) * (1 - P[j,i=1]/Pmax) * P[j,i=1] - (1.0/taud)*P[j,i=1] 136 dP = (1.0/taub) * (1 - P[j,i=1]/Pmax) * P[j,i=1] - (1.0/taud)*P[j,i=1] 135 plt.juli(1,1,2) 136 plt.figure() 135 plt.juli(1,1,2) 135 plt.juli(1,1,2) 136 plt.stabel('time [days]') 137 plt.ylabel('daily chemical usage [a.u.]') 139 plt.ylabel('water pesticide concentration [ppm]') 130 plt.ylabel('water chemical.png') 131 132 plt.xlabel('time [years]') 133 plt.ylabel('fish pesticide concentration [ppm]') 134 plt.xlabel('time [years]') 135 plt.ylabel('fish pesticide concentration [ppm]') 137 plt.ylabel('fish pesticide concentration [ppm]') 139 plt.ylabel('fish pesticide concentration [</pre>	130		
<pre>133 for i in range(1,Nt): 134 dB = 1=3+F[j,i] - (1.0/tau) * B[j,i-1] 135 B[j,i] = B[j,i-1] + dB 136 for i in range(1,Nt): 137 # model the bird populations 138 taud = 5+Ndays 139 for i in range(1,Nt): 140 taub = 1e9 141 if B[j,i-1] < Bcrit: 142 taub = 2.0 * Ndays * Bcrit / (Bcrit - B[j,i-1]) 143 dP = (1.0/taub) * (1 - P[j,i-1]/Pmax) * P[j,i-1] - (1.0/taud)*P[j,i-1] 144 P[j,i] = P[j,i-1] + dP 145 146 data output 148 data output 149 149 plt.figure() 150 plt.figure() 151 plt.plot(t[0:Ndays]*365.0,temp[0:Ndays]) 152 plt.xim(0,365) 153 plt.yim(0,1.2) 154 plt.xlabel('time [days]') 155 plt.ylabel('daily chemical usage [a.u.]') 155 plt.ylabel('daily chemical usage [a.u.]') 156 plt.savefig('daily.png') 157 plt.ylabel('water pesticide concentration [ppm]') 169 plt.ylabel('water chemical.png') 160 for j in range(Nmodel): 161 plt.savefig('water-chemical.png') 162 plt.tabel('time [sears]') 163 plt.ylabel('daily chemical.png') 164 for j in range(Nmodel): 170 plt.ylabel('fine [sears]') 170 plt.ylabel('time [sears]') 171 plt.ylabel('time [sears]') 172 plt.xlabel('time [sears]') 173 plt.ylabel('fine [sears]') 174 plt.xlabel('time [sears]') 175 plt.ylabel('fine [sears]') 176 plt.savefig('fish=chemical.png') 177 plt.ylabel('fish=chemical.png') 177 plt.savefig('fish=chemical.png') 177 plt.ylabel('fish=chemical.png') 177 plt.ylabel('fish=chemical.png') 177 plt.savefig('fish=chemical.png') 177 plt.savefig('fish=chemical.png') 177 plt.savefig('fish=chemical.png') 177 plt.savefig('fish=chemical.png') 177 plt.ylabel('fish=chemical.png') 177 plt.savefig('fish=chemical.png') 177 plt.ylabel('fish=chemical.png') 177 plt.ylabel('fish=chemical.png')</pre>	131 0 1	model the build-up in birds	
<pre>134 dB = 1e-3*F[j,i] - (1.0/tau) * B[j,i-1] 135 B[j,i] = B[j,i-1] + dB 136 for i in range[1,Nt]: 137 # model the bird populations 138 taud = 5*Ndays 139 for i in range[1,Nt]: 140 taub = 1e9 141 if B[j,i-1] < Bcrit: 142 taub = 2.0 * Ndays * Bcrit / (Bcrit = B[j,i-1]) 143 dP = (1.0/taub) * (1 - P[j,i-1]/Pmax) * P[j,i-1] - (1.0/taud)*P[j,i-1] 144 P[j,i] = P[j,i-1] + dP 145 146 147 # 148 # dats output 149 149 149 149 150 plt.figure() 151 plt.plott[0:Ndays]*365.0,temp[0:Ndays]) 152 plt.xlim(0,365) 153 plt.ylim(0,1.2) 154 plt.xlabel('time [days]') 155 plt.ylabel('daily chemical usage [a.u.]') 155 plt.savefig('daily.png') 157 158 159 plt.figure() 160 for j in range(Nmodel): 161 plt.ylabel('time [yeers]') 162 plt.xlabel('time [yeers]') 163 plt.savefig('water-chemical.png') 164 165 plt.figure() 167 167 168 169 plt.figure() 169 plt.figure() 169 plt.savefig('tish pesticide concentration [ppm]') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.ylabel('fish pesticide concentration [ppm]') 172 plt.xlabel('time [yeers]') 173 plt.ylabel('fish pesticide concentration [ppm]') 174 plt.xlim(0,100) 175 plt.ylabel('fish pesticide concentration [ppm]') 176 plt.savefig('fish-chemical.png') 177 178 178 178 178 178 178 178</pre>	132 ta		
<pre>136 37 # model the bird populations 38 taud = S+Ndays 39 for i in range(1,Nt): 40 taub 1e9 41 if B[j,i-1] < Bcrit: 42 taub 2.0 * Ndays * Bcrit / (Bcrit - B[j,i-1]) 43 dP = (1.0/taub) * (1 - P[j,i-1]/Pmax) * P[j,i-1] - (1.0/taud)*P[j,i-1] 44 P[j,i] = P[j,i-1] + dP 45 46 47 48 49 49 50 plt.figure() 51 plt.plot(t[0:Ndays]*365.0,temp[0:Ndays]) 52 plt.xlm(0,365) 53 plt.ylim(0,1.2) 54 plt.xlabel('time [days]') 55 plt.ylabel('daily chemical usage [a.u.]') 55 plt.ylabel('daily chemical usage [a.u.]') 55 plt.ylabel('time [days]') 55 plt.ylabel('time [days]') 56 plt.savefig('daily.png') 57 56 57 56 60 plt.savefig('water-chemical.png') 66 60 plt.figure() 66 60 plt.figure() 67 68 69 plt.figure() 68 69 plt.figure() 77 77 77 77 77 77 77 77 77 7</pre>	133 fo		
<pre>136 37 # model the bird populations 38 taud = S+Ndays 39 for i in range(1,Nt): 40 taub 1e9 41 if B[j,i-1] < Bcrit: 42 taub 2.0 * Ndays * Bcrit / (Bcrit - B[j,i-1]) 43 dP = (1.0/taub) * (1 - P[j,i-1]/Pmax) * P[j,i-1] - (1.0/taud)*P[j,i-1] 44 P[j,i] = P[j,i-1] + dP 45 46 47 48 49 49 50 plt.figure() 51 plt.plot(t[0:Ndays]*365.0,temp[0:Ndays]) 52 plt.xlm(0,365) 53 plt.ylim(0,1.2) 54 plt.xlabel('time [days]') 55 plt.ylabel('daily chemical usage [a.u.]') 55 plt.ylabel('daily chemical usage [a.u.]') 55 plt.ylabel('time [days]') 55 plt.ylabel('time [days]') 56 plt.savefig('daily.png') 57 56 57 56 60 plt.savefig('water-chemical.png') 66 60 plt.figure() 66 60 plt.figure() 67 68 69 plt.figure() 68 69 plt.figure() 77 77 77 77 77 77 77 77 77 7</pre>	134		
<pre>137 # model the bird populations 138 taud = 5.44days 139 for i in range(1,Nt): 140 taub = 1e9 141 if B[j.i-1] < Bcrit: 142 taub = 2.0 * Ndays * Bcrit / (Bcrit - B[j,i-1]) 143 dP = (1.0/taud) * (1 - P[j,i-1]/Pmax) * P[j,i-1] - (1.0/taud)*P[j,i-1] 144 145 P[j,i] = P[j,i-1] + dP 146 147 #</pre>	135	B[],1] = B[],1-1] + dB	
<pre>139 for i in range(1,Nt): 140 taub = 1e9 141 if B[j,i-1] < Bcrit: 142 taub = 2.0 * Ndays * Bcrit / (Bcrit - B[j,i-1]) 143 dP = (1.0/taub) * (1 - P[j,i-1]/Pmax) * P[j,i-1] - (1.0/taud)*P[j,i-1] 144 P[j,i] = P[j,i-1] + dP 145 146 147 # 148 # data output 149 149 149 149 149 149 149 149</pre>	130	and the bird annulations	
<pre>139 for i in range(1,Nt): 140 taub = 1e9 141 if B[j,i-1] < Bcrit: 142 taub = 2.0 * Ndays * Bcrit / (Bcrit - B[j,i-1]) 143 dP = (1.0/taub) * (1 - P[j,i-1]/Pmax) * P[j,i-1] - (1.0/taud)*P[j,i-1] 144 P[j,i] = P[j,i-1] + dP 145 146 147 # 148 # data output 149 149 149 149 149 149 149 149</pre>	130 +3		
<pre>140 taub = 1e9 141 if B[j,i-1] < Bcrit: 142 taub = 2.0 * Ndays * Bcrit / (Bcrit - B[j,i-1]) 143 dP = (1.0/taub) * (1 - P[j,i-1]/Pmax) * P[j,i-1] - (1.0/taud)*P[j,i-1] 144 P[j,i] = P[j,i-1] + dP 145 146 147 # 148 # data output 148 # data output 148 # data output 149 150 plt.figure() 151 plt.plot(t[0:Ndays]*365.0,temp[0:Ndays]) 152 plt.xlim(0,365) 153 plt.ylabel('time [days]') 155 plt.ylabel('time [days]') 156 plt.savefig('daily.png') 157 158 159 plt.figure() 160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 162 plt.xlabel('time [years]') 163 plt.ylabel('water pesticide concentration [ppm]') 164 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 169 169 plt.figure() 169 169 plt.figure() 169 169 plt.savefig('mater-chemical.png') 167 168 169 plt.savefig('mater-chemical.png') 169 169 plt.savefig('mater-chemical.png') 169 169 plt.xlabel('time [years]') 170 plt.xlabel('time [years]') 171 plt.savefig('fish=chemical.png') 175 plt.ylabel('fish pesticide concentration [ppm]') 176 plt.xlabel('time [years]') 177 plt.xlabel('time [years]') 178 plt.ylabel('fish pesticide concentration [ppm]') 179 plt.xlabel('fish pesticide concentration [ppm]') 179 plt.savefig('fish=chemical.png') 177 178</pre>	139 fo		
<pre>141 if B[j,i-1] < Bcrit:</pre>	148		
<pre>143 dP = (1.0/taub) * (1 - P[j,i-1]/Pmax) * P[j,i-1] - (1.0/taud)*P[j,i-1] 144 P[j,i] = P[j,i-1] + dP 145 146 147 #</pre>	141		
<pre>143 dP = (1.0/taub) * (1 - P[j,i-1]/Pmax) * P[j,i-1] - (1.0/taud)*P[j,i-1] 144 P[j,i] = P[j,i-1] + dP 145 146 147 #</pre>	142		
<pre>144 P[j,i] = P[j,i-1] + dP 145 146 147 #</pre>	143		
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<pre>146 s 147 s 148 f data output 149 149 149 150 plt.figure() 151 plt.plot(t[0:Ndays]*365.0,temp[0:Ndays]) 152 plt.xlim(0,365) 153 plt.ylim(0,1.2) 154 plt.xlabel('time [days]') 155 plt.ylabel('daily chemical usage [a.u.]') 156 plt.savefig('daily.png') 157 158 159 plt.figure() 160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 162 plt.xlabel('time [years]') 163 plt.ylabel('water pesticide concentration [ppm]') 164 plt.xlim(0,100) 165 plt.ylim(0,100) 166 plt.figure() 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F[j,:]) 172 plt.xlabel('fish pesticide concentration [ppm]') 174 plt.xlabel('fish pesticide concentration [ppm]') 174 plt.xlim(0,100) 175 plt.ylim(0,200) 176 plt.savefig('fish=chemical.png') 177 177 178</pre>	145		
<pre>137 138 139 plt.figure() 160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 162 plt.xtabel('time [years]') 163 plt.ytabel('time [years]') 164 plt.xtim(0,100) 165 plt.ytim(0,100) 166 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F[j,:]) 172 plt.xtabel('time [years]') 173 plt.ytabel('time [years]') 174 plt.xtim(0,100) 175 plt.ytim(0,200) 176 plt.savefig('fish=chemical.png') 177 177 </pre>	146		
<pre>137 138 139 plt.figure() 160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 162 plt.xtabel('time [years]') 163 plt.ytabel('time [years]') 164 plt.xtim(0,100) 165 plt.ytim(0,100) 166 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F[j,:]) 172 plt.xtabel('time [years]') 173 plt.ytabel('time [years]') 174 plt.xtim(0,100) 175 plt.ytim(0,200) 176 plt.savefig('fish=chemical.png') 177 177 </pre>	147 #		
<pre>137 138 139 plt.figure() 160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 162 plt.xtabel('time [years]') 163 plt.ytabel('time [years]') 164 plt.xtim(0,100) 165 plt.ytim(0,100) 166 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F[j,:]) 172 plt.xtabel('time [years]') 173 plt.ytabel('time [years]') 174 plt.xtim(0,100) 175 plt.ytim(0,200) 176 plt.savefig('fish=chemical.png') 177 177 </pre>	148 # data	output	
<pre>137 138 139 plt.figure() 160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 162 plt.xtabel('time [years]') 163 plt.ytabel('time [years]') 164 plt.xtim(0,100) 165 plt.ytim(0,100) 166 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F[j,:]) 172 plt.xtabel('time [years]') 173 plt.ytabel('time [years]') 174 plt.xtim(0,100) 175 plt.ytim(0,200) 176 plt.savefig('fish=chemical.png') 177 177 </pre>	149		
<pre>137 138 139 plt.figure() 160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 162 plt.xtabel('time [years]') 163 plt.ytabel('time [years]') 164 plt.xtim(0,100) 165 plt.ytim(0,100) 166 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F[j,:]) 172 plt.xtabel('time [years]') 173 plt.ytabel('time [years]') 174 plt.xtim(0,100) 175 plt.ytim(0,200) 176 plt.savefig('fish=chemical.png') 177 177 </pre>	150 plt.figure()		
<pre>137 138 139 plt.figure() 160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 162 plt.xtabel('time [years]') 163 plt.ytabel('time [years]') 164 plt.xtim(0,100) 165 plt.ytim(0,100) 166 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F[j,:]) 172 plt.xtabel('time [years]') 173 plt.ytabel('time [years]') 174 plt.xtim(0,100) 175 plt.ytim(0,200) 176 plt.savefig('fish=chemical.png') 177 177 </pre>	<pre>151 plt.plot(t[0:Ndays]*365.0, temp[0:Ndays])</pre>		
<pre>137 138 139 plt.figure() 160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 162 plt.xtabel('time [years]') 163 plt.ytabel('time [years]') 164 plt.xtim(0,100) 165 plt.ytim(0,100) 166 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F[j,:]) 172 plt.xtabel('time [years]') 173 plt.ytabel('time [years]') 174 plt.xtim(0,100) 175 plt.ytim(0,200) 176 plt.savefig('fish=chemical.png') 177 177 </pre>	152 p(t,x(1m(0,35))		
<pre>137 138 139 plt.figure() 160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 162 plt.xtabel('time [years]') 163 plt.ytabel('time [years]') 164 plt.xtim(0,100) 165 plt.ytim(0,100) 166 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F[j,:]) 172 plt.xtabel('time [years]') 173 plt.ytabel('time [years]') 174 plt.xtim(0,100) 175 plt.ytim(0,200) 176 plt.savefig('fish=chemical.png') 177 177 </pre>	154 plt.ylabel('time (daysl')		
<pre>137 138 139 plt.figure() 160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 162 plt.xtabel('time [years]') 163 plt.ytabel('time [years]') 164 plt.xtim(0,100) 165 plt.ytim(0,100) 166 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F[j,:]) 172 plt.xtabel('time [years]') 173 plt.ytabel('time [years]') 174 plt.xtim(0,100) 175 plt.ytim(0,200) 176 plt.savefig('fish=chemical.png') 177 177 </pre>	155 plt. vlabel ('daily chemical usage [a.u.l')		
<pre>160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 163 plt.ylabel('water pesticide concentration [ppm]') 164 plt.xlim(0,100) 165 plt.ylim(0,100) 166 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F[j,:]) 172 plt.xlabel('fish pesticide concentration [ppm]') 173 plt.ylabel('fish pesticide concentration [ppm]') 174 plt.xlim(0,100) 175 plt.ylim(0,200) 176 plt.savefig('fish=chemical.png') 177</pre>	156 plt.sa	vefic('daily.png')	
<pre>160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 163 plt.ylabel('water pesticide concentration [ppm]') 164 plt.xlim(0,100) 165 plt.ylim(0,100) 166 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F[j,:]) 172 plt.xlabel('fish pesticide concentration [ppm]') 173 plt.ylabel('fish pesticide concentration [ppm]') 174 plt.xlim(0,100) 175 plt.ylim(0,200) 176 plt.savefig('fish=chemical.png') 177</pre>	157		
<pre>160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 163 plt.ylabel('water pesticide concentration [ppm]') 164 plt.xlim(0,100) 165 plt.ylim(0,100) 166 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F[j,:]) 172 plt.xlabel('fish pesticide concentration [ppm]') 173 plt.ylabel('fish pesticide concentration [ppm]') 174 plt.xlim(0,100) 175 plt.ylim(0,200) 176 plt.savefig('fish=chemical.png') 177</pre>	158		
<pre>160 for j in range(Nmodel): 161 plt.plot(t,W[j,:]) 163 plt.ylabel('water pesticide concentration [ppm]') 164 plt.xlim(0,100) 165 plt.ylim(0,100) 166 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F[j,:]) 172 plt.xlabel('fish pesticide concentration [ppm]') 173 plt.ylabel('fish pesticide concentration [ppm]') 174 plt.xlim(0,100) 175 plt.ylim(0,200) 176 plt.savefig('fish=chemical.png') 177</pre>	159 plt.fi	gure()	
<pre>163 plt.ylabel('water pesticide concentration [ppm]') 164 plt.xlim(0,100) 165 plt.ylim(0,100) 166 plt.savefig('water-chemical.png') 167 168 169 plt.figure() 170 for j in range(Nmodel): 171 plt.plot(t,F(j,:)) 172 plt.xlabel('fish pesticide concentration [ppm]') 173 plt.ylabel('fish pesticide concentration [ppm]') 174 plt.xlim(0,100) 175 plt.ylim(0,200) 176 plt.savefig('fish=chemical.png') 177 178</pre>	160 for j	in range(Nmodel):	
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XXXXXXX XXXXXX Physics 203 April 16th, 2019

The Common Problem Project

Question: At what levels of organo-chlorides do they become dangerous to fish-eating birds?

1) This project focuses on the effects of organo-chlorides on fish-eating birds, and more specifically, the amount of organo-chlorides that could be consumed before reaching a dangerous level. Organo-chlorides are common in pesticides, insecticides, and insulators. When water runoff from farms and businesses goes into streams and lakes it gets absorbed by the fish and is held in body tissues or organs. Most fish can withstand an incredible amount of toxins, but the birds that prey on them can not. When too many toxins are consumed the birds eggs are thinned, causing them to break and their population to decrease. This project illustrates the effect the use of pesticides has on fish-eating birds lives.

2) The biggest issue in this project is clearly the amount of organo-chlorides present in natural water sources, which then effects the fish, the birds, and eventually the eggs of the birds—thus declining the population. Creating a law that would limit the amount of pesticide use or creating a better system to direct the drainage of water to avoid natural water sources would both drastically improve the the life of the fish and birds in the environment.

3) This project has a lot of variables, as an ecosystem is so interconnected. The usage of organo chlorides has a effect on the pesticide concentration in water with a positive relationship. As the amount of organo-chlorides used in farms increases, the concentration in the water increases. This then causes the amount of concentration of toxins in the fish to increase! More pesticides in the state, more pesticides in the fish. The increase of toxins in the fish increases the amount of toxins that are in the birds. The more fish that the birds eat, the more toxins that are kept in their bodies. With this, the higher amount of toxins in a bird, the more thin their shells become when giving birth. Amount of toxins and weakness of shells have a direct correlation, as the amount of toxins increase, the shells become thinner eventually being smashed before birth. Lastly, the amount of shells smashed and babies killed obviously decreases the amount of birds that survive, declining the population.

Technical Report:

The report starts by stating the central question:

At what levels do organo-chlorides become dangerous to fish-eating birds?

Then provides further context and a description of the series of connections between agricultural use of organo-chlorides and build-up in birds of prey.



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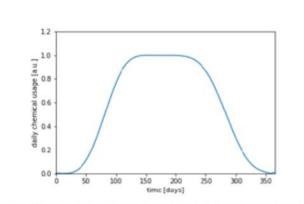
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Then provides further context and a description of the series of connections between agricultural use of organo-chlorides and build-up in birds of prey.

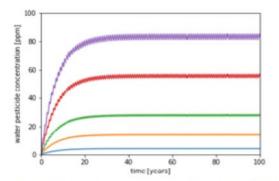
The report then sets the framework for the modeling:

Creating a law that would limit the amount of pesticide use or create a better system to direct the drainage of water to avoid natural water sources would both drastically improve the life of the fish and birds in the environment.

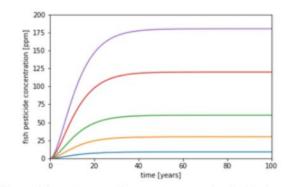


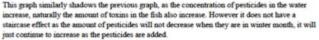


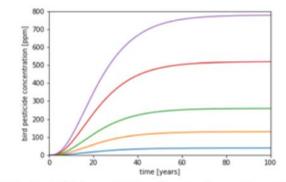
This graph shows the relationship between time and daily chemical usage in a year. The graph has a steady rise to represent spring and summer when more pesticides are used, and a decline during the colder months.



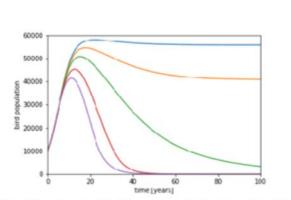
This graph shows the relationship between time and water pesticide concentration. This shows as years go on the amount of pesticides steadily increase. They eventually flatten out, as the amount of pesticides cannot fully replace a lake or big body of water, as some will naturally wash ashore and be taken out by other elements. It has a stair-like trend to represent the amount of pesticides entering the water each year, which fluctuates with the seasons as shown in the graph before.







This graph again is directly connected to the previous graph, as the amount of concentration of toxins in the fish increases, the more that goes into the birds bodies. As seen in the graph, as the birds consume more fish they have higher rates of toxins in their bodies as the fish, for the fish are measured on how much is in their system and the birds have multiple fish in their system.



This graph shows the overall effects of the use of organo-chlorides on the population of fisheating birds. This graph is what means the most in the project, as the population sharply starts to decline. As the birds continue to eat the fish with the toxins it adds up in their bodies, which affects the thinness of their eggs and the lives of their children. As shown, the first few years seem to be unaffected, but as the eggs continue to get smashed and not hatch it not only affects that individual bird, but all of the birds that could've been descendants as well. This is shown by the sharp decline when the population of the birds starts low and the lack of incline for all predictions. The affect of organo-chlorides on birds is shown as clearly detrimental in this graph.

5. With this data there are two opposing views that the information can be involved in. There's an environmentalist standpoint, which would concerns the amount of birds that are dying from unnatural causes. The population decline of fish-eating birds doesn't just happen in one specific area, but is seen all around the U.S. and in various other countries. The decline of the birds not only is a danger to them, but also the ecosystem around them as there are much less predators of the fish and prey for other animals. To help fix this situation, would be to control the runoff of the organo-chlorides and ensure none entered any natural water source, or to create a pesticide that will be non-toxic to the birds. The latter would be much harder to accomplish, so the most realistic solution would be to create a way to dispose of the runoff, or to limit the amount of pesticide usage, so although it would still have effects, they would be much smaller.

However, limiting the use of pesticides would affect farmers greatly. By limiting their use, it would be most likely that less of their crops would survive, giving them less money and putting them. in more of an economic hardship. Although the pesticides are harming fish and birds, it is more beneficial for the farmers and businesses to continue to use pesticides to support their own lifestyle.

Overall, I believe the majority of people would side with the environmental argument with this information, the people directly involved with the use of pesticides would hold an opposing position.

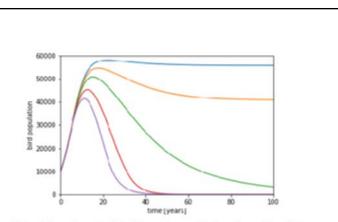


The report concludes with the most important graph that shows the culminating effects of organo-chlorides on a bird-of-prey population for different levels of usage.

... there are two opposing views...

There's the environmental standpoint, which concerns the number of birds that are dying from unnatural causes...

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Linear visual narrative structure for time-based media model





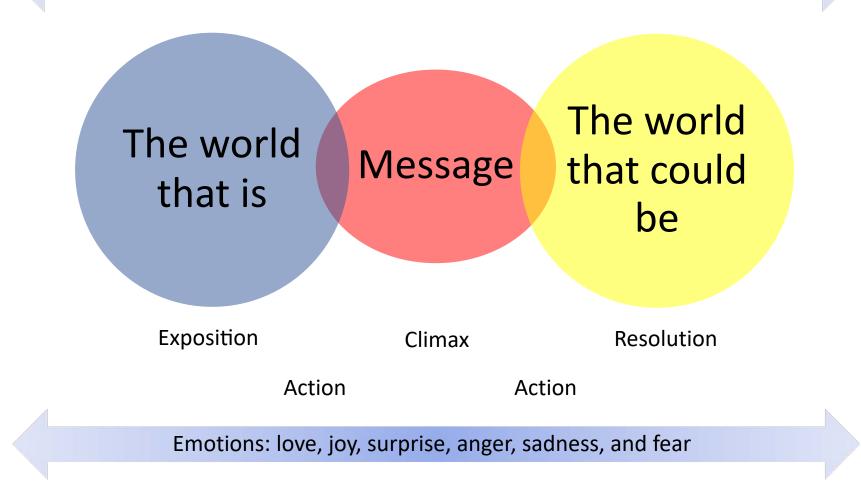
Where and when does the plot take place \rightarrow **Tone** Who are the protagonist and antagonist? \rightarrow **Tension** What is at stake? \rightarrow **Value** Tension Rising Climax Falling End: **Beginning**: Exposition Action Action Resolution ----Chronological events in the...

Freytag pyramid, a technique of the five step dramatic structure



Single image narrative model

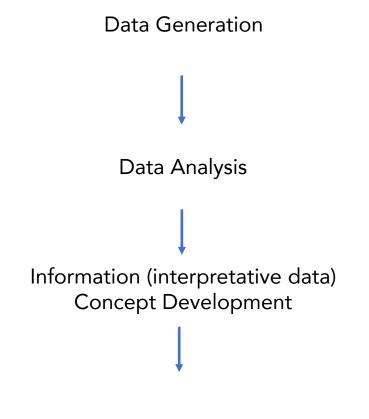
Tension is created by the contrast of the two opposing worlds





Design process Design THINKING

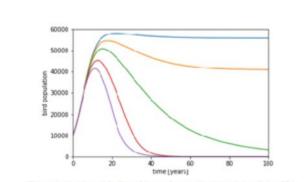




Infographics (visualized data) Telling the story of the data

Design students brainstorming in class





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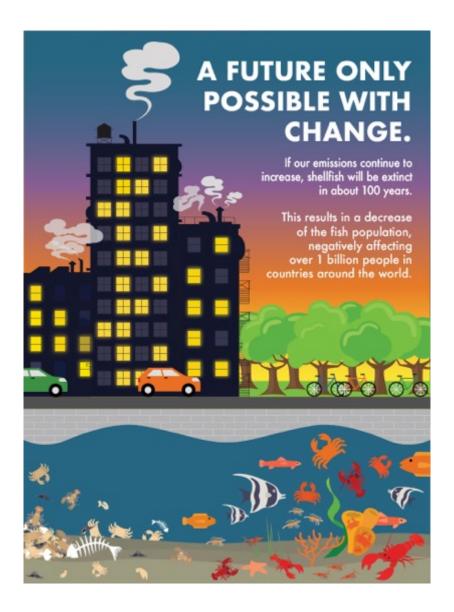




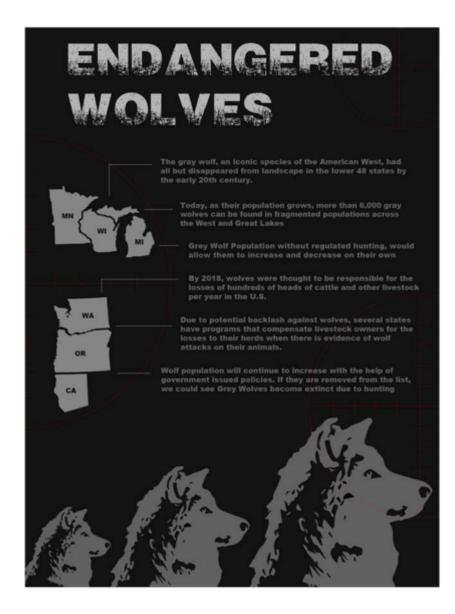






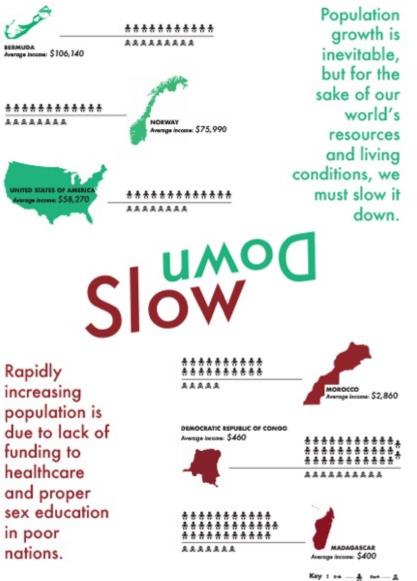






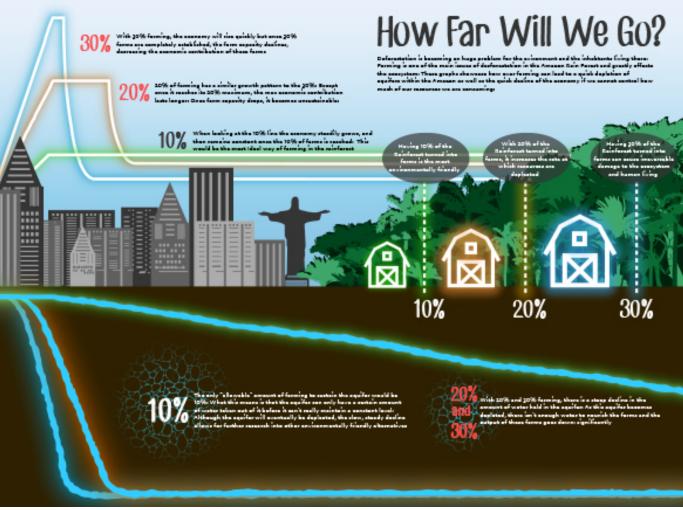














Exhibition

CONNECTIONS



Connections



Student learning outcomes

Design students

- Translate scientific data (quantitative information) into visual forms
- Use information graphics skills: Use color coded charts, maps, time-lines, or diagrams, and create a legend or key
- Apply visual narrative techniques: to tell the story that is embedded in the data and contextualize the phenomena
- Communicate and collaborate online in a multidisciplinary environment

Physics students

- Visualize the series of connections required in a complex model
- Translate a series of statements about interactions into equations
- Define a set of simulation parameters that effectively illustrate a point
- Communicate findings in a technical report.