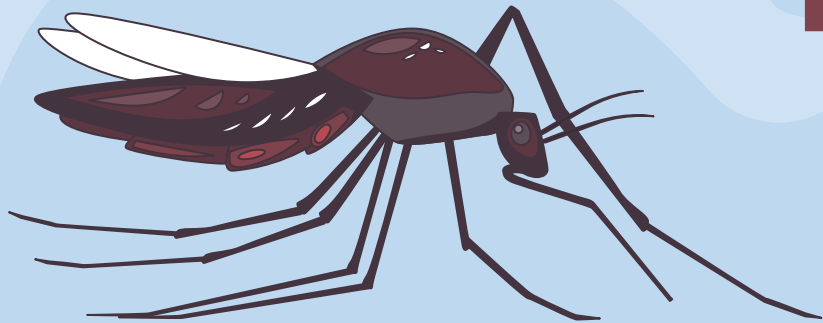


WNV **Prediction** **in Chicago**



Emma
Junhao
Benjamin
Gabriel

Overview

- **Problem Statement**
- **Interesting Features**
- **Model Selection**
- **Feature Importance**
- **Cost Benefit Analysis**
- **Conclusion/Recommendations**

Problem Statement

- We are a team of data scientists at the Disease And Treatment Agency. In the last few years, there have been several episodes of the West Nile Virus (WNV) outbreak in Chicago. The aim of our project is to leverage on weather, location and time data to predict West Nile Virus occurrences in Chicago.
- By **understanding these features and whether they can predict the virus**, we will then evaluate **whether spraying areas with pesticides will be an effective tool vis-a-vis medical and economic costs**

Interesting Features



Relative Humidity

Humidity - ambiguous relationship with WNV
Instead of using DewPoint x Tavg interaction
term - worked out $RH=100 \times (e / e_s)$

Lagged Weather Features

Culex: egg to adult ~7 to 10 days.
Lagged weather features by 14 days - factor in
time needed to pick up the virus



Risk Classification

136 unique trap addresses
5 categories based on WNV occurrences:
Low, Very Low, Medium, High, Very High



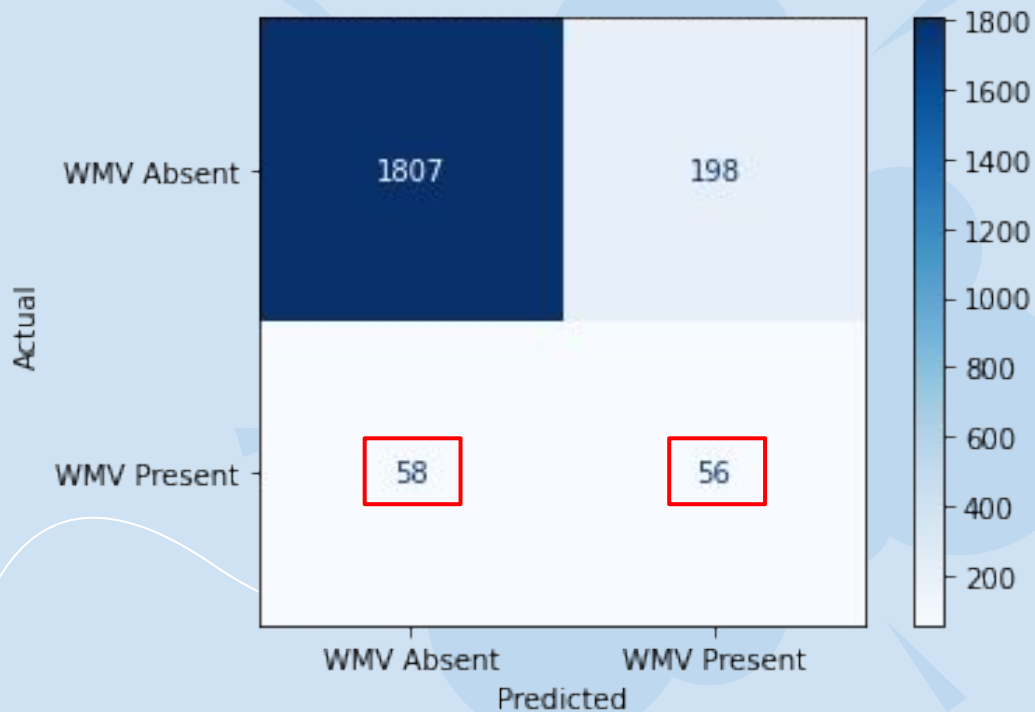
Which model is suitable?

(Selected Model)

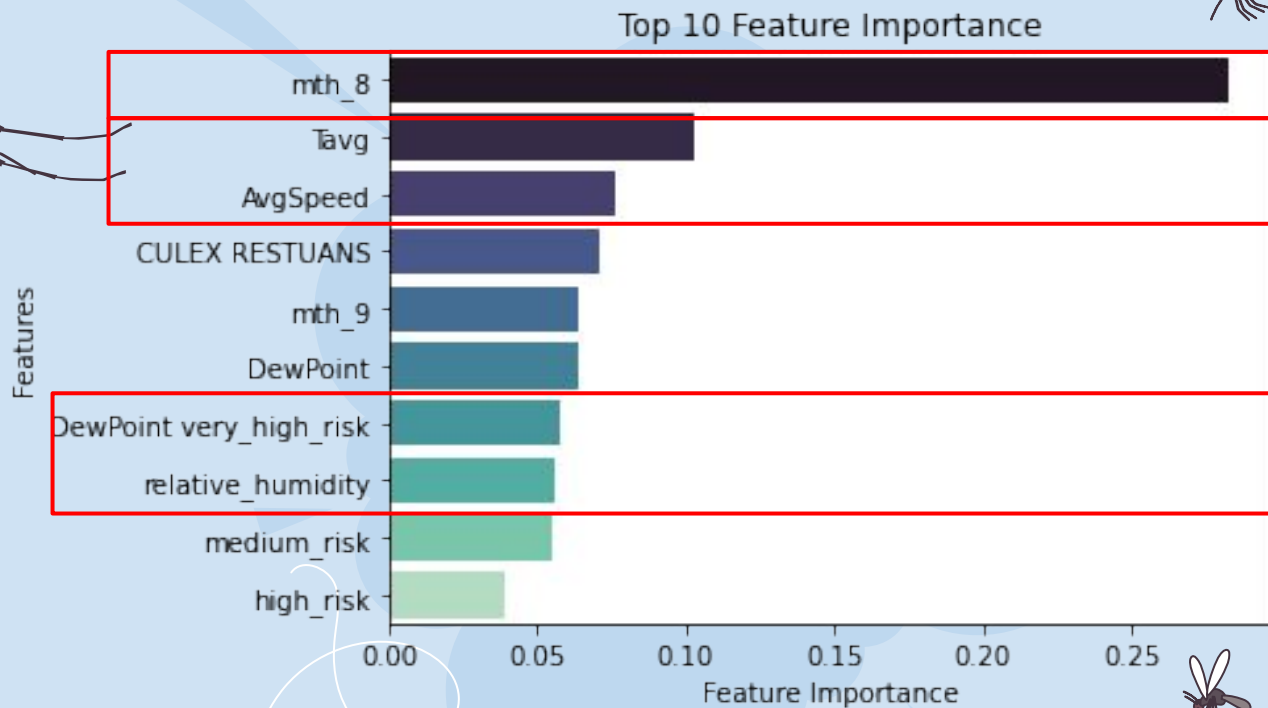


Logistic Regression	Gradient Boost	XGBoost	ADA Boost	Random Forest
81.8%	82.8%	82.9%	83.0%	81.5%
Test Score	Test Score	Test Score	Test Score	Test Score
84.5%	89.4%	89.6%	89.3%	93.7%
Train Score	Train Score	Train Score	Train Score	Train Score
<ul style="list-style-type: none">• Baseline• No parameter tuning	<ul style="list-style-type: none">• SMOTE• Best recall: 0.49• Precision: 0.22• Best F1: 0.3	<ul style="list-style-type: none">• SMOTE• Recall: 0.48• Precision: 0.21• F1: 0.29	<ul style="list-style-type: none">• SMOTE• Worst recall: 0.11• Best precision: 0.25• Worst F1: 0.15	<ul style="list-style-type: none">• SMOTE• Recall: 0.38• Most overfitted model

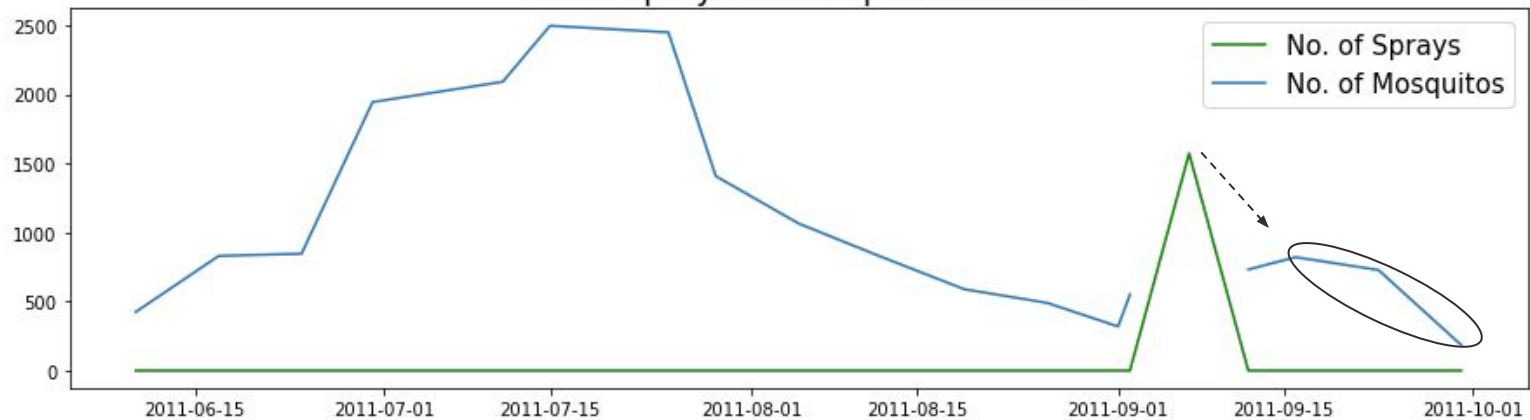
Confusion Matrix of Actual vs Predicted WMV



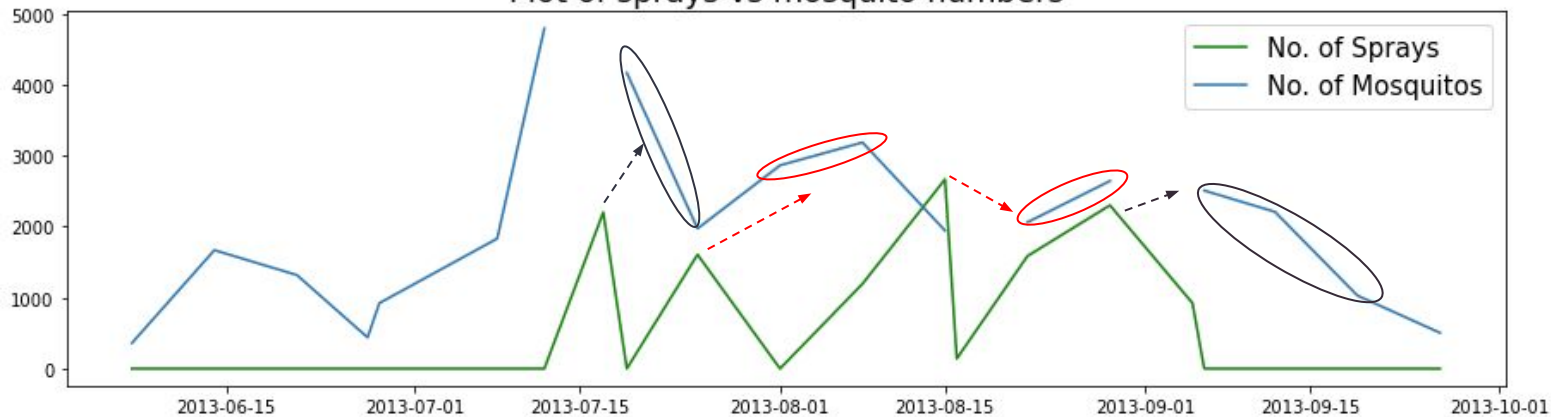
Top 10 Feature Importance



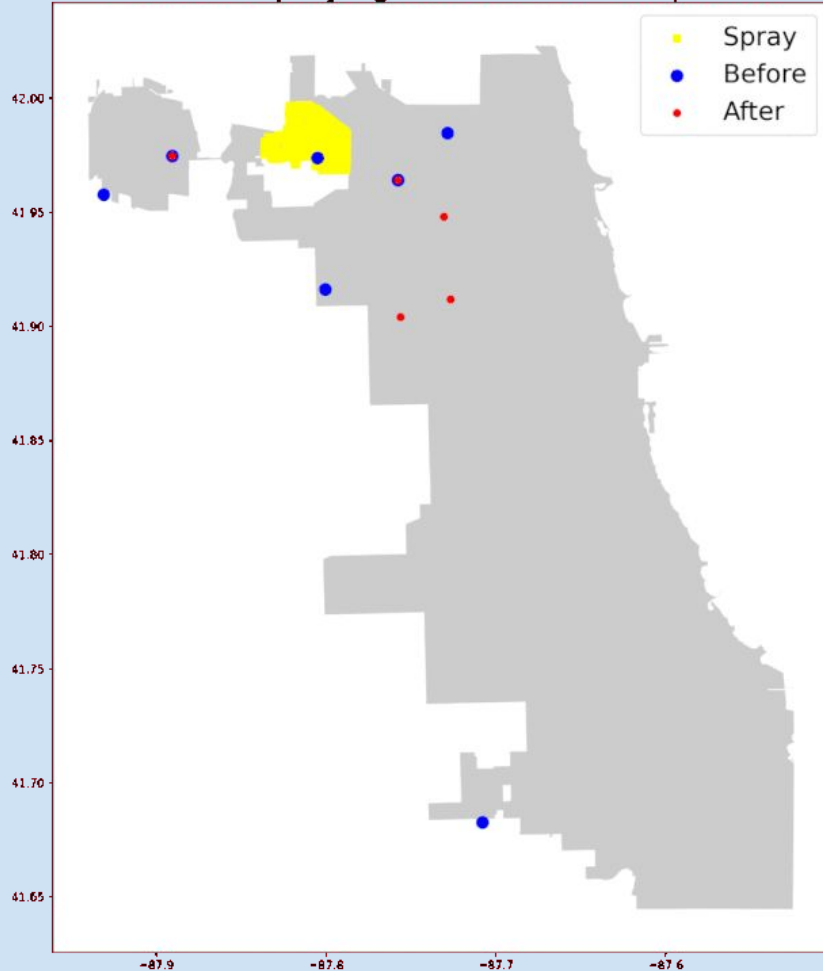
Plot of sprays vs mosquito numbers



Plot of sprays vs mosquito numbers



Effects of spraying 1 week after 7 Sep 2011



Date	Effective Areas	Ineffective Areas
7 Sep 2011	1	0
17 Jul 2013	1	1
25 Jul 2013	1	0
8 Aug 2013	2	0
15 Aug 2013	1	3
22 Aug 2013	0	3
29 Aug 2013	1	2
5 Sep 2013	0	1
Total	7	10

41.18% success rate!

Cost Benefit Analysis

With Model -> 49% success rate



Spray

2012

No Spray

Benefit



Reduce disease in population



Lower load on hospital services



Approximate medical cost savings of \$4.5 million with our model



Approximate cost of spraying \$1.5 million

Cost



High Medical Expenses



Loss of Workplace Productivity



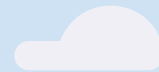
More death rates



Approximate medical cost of \$9 million without spraying

Savings of \$3 million

Conclusion



- **Gradient Boost Classifier** has a roc-auc score of **83%** with highest recall score of **49%**
- Concentrate spray efforts during month of **August**
- Consolidate weather information on **Temperature / Wind Speed / Humidity**
- **Location** is a relatively strong predictor. However, WNV may be **transient** and occur where conditions are best for breeding

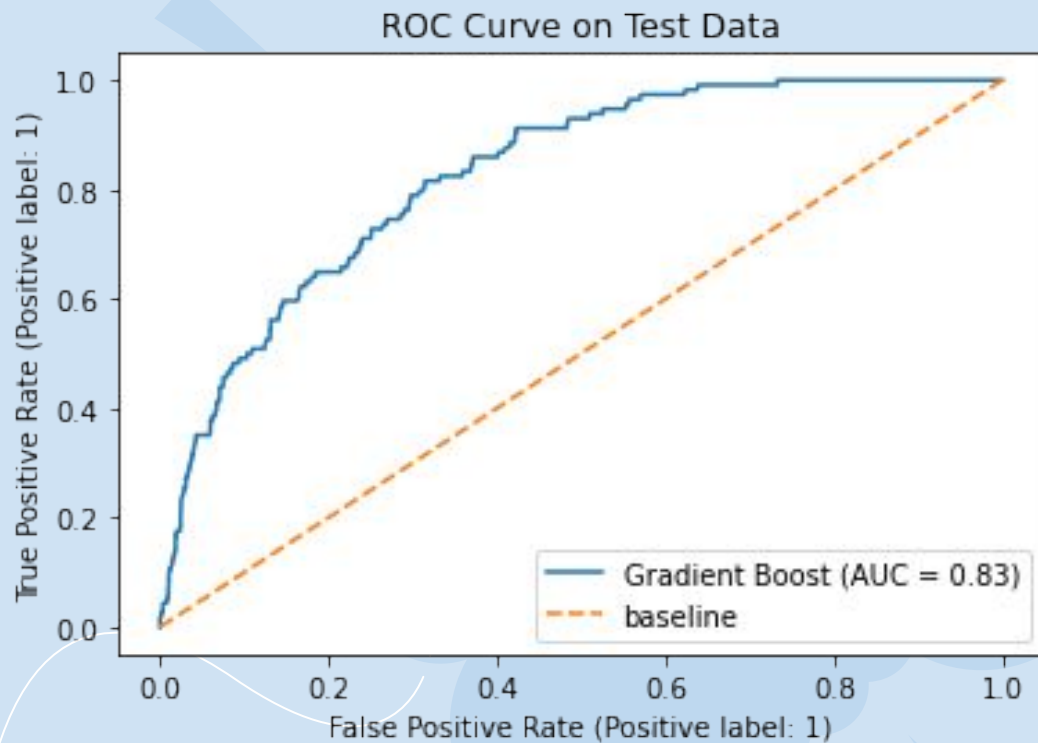


Recommendations

Adult Control	Spray during month of August
Larval Control	Larva-ciding water bodies
Public Education	Educated public on personal protection
Bird Surveillance	Monitor birds known to be carriers, data collected to enhance model



ROC-AUC



Mosquito Breeding Cycle



Phase 1

Eggs

Hatch from a few days to several months

Phase 2

Larvae

Larvae are aquatic and develop into pupae in 5 days

Phase 3

Pupae

Develops in 2-3 days

Phase 4

Adult

Females start breeding cycle



Chicago landscape

333,000.00

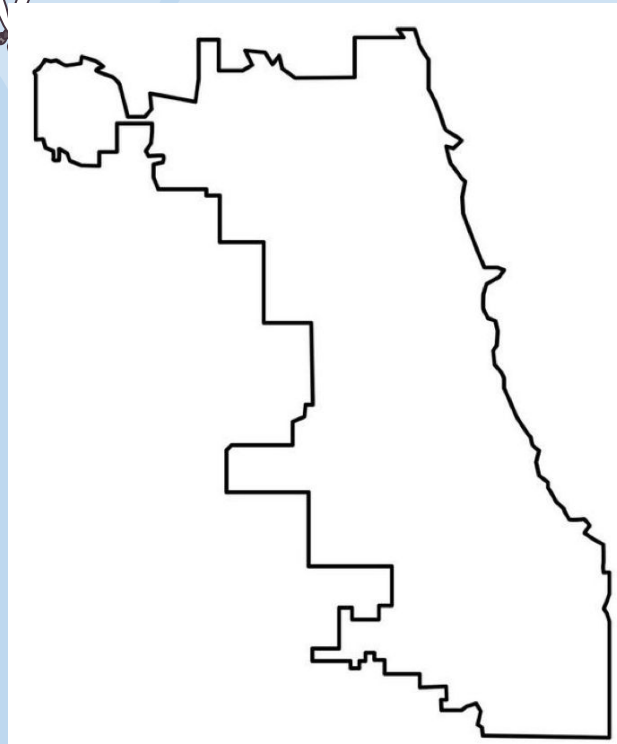
earths is the Sun's mass

2,710,000

Population

606.1 km²

Area of Chicago

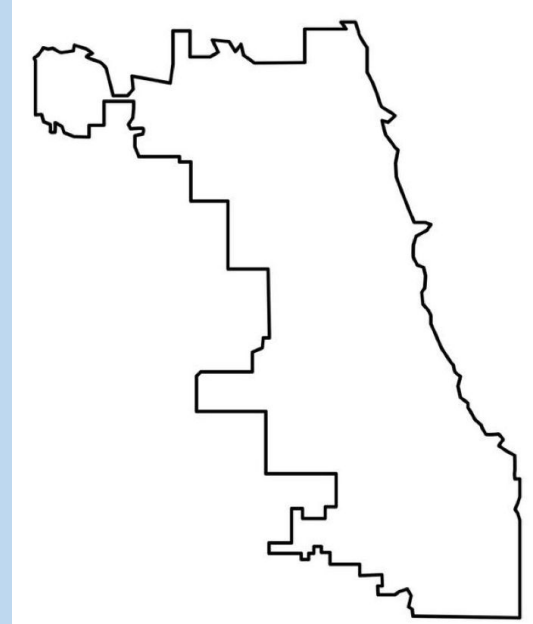


Chicago landscape



Chicago

It was the country where a disease was first linked to mosquitoes in the 1970s



Recommendation



Spray

Spray during month of
August

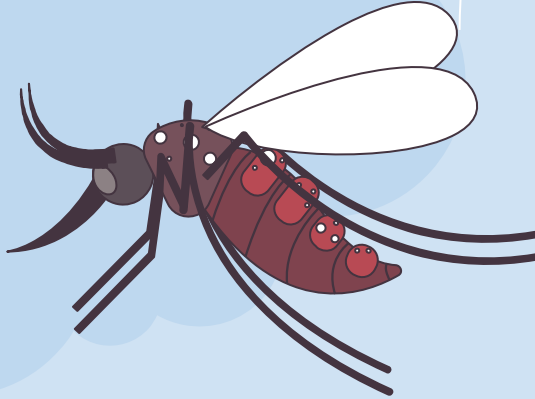


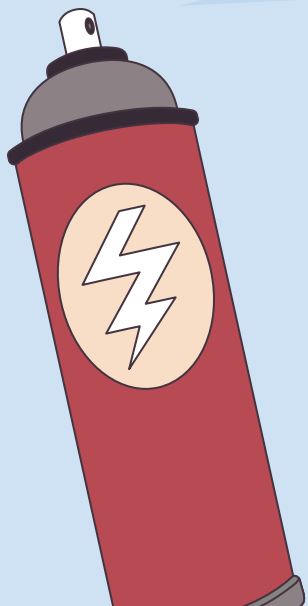
Where

Where best conditions
emerge



What

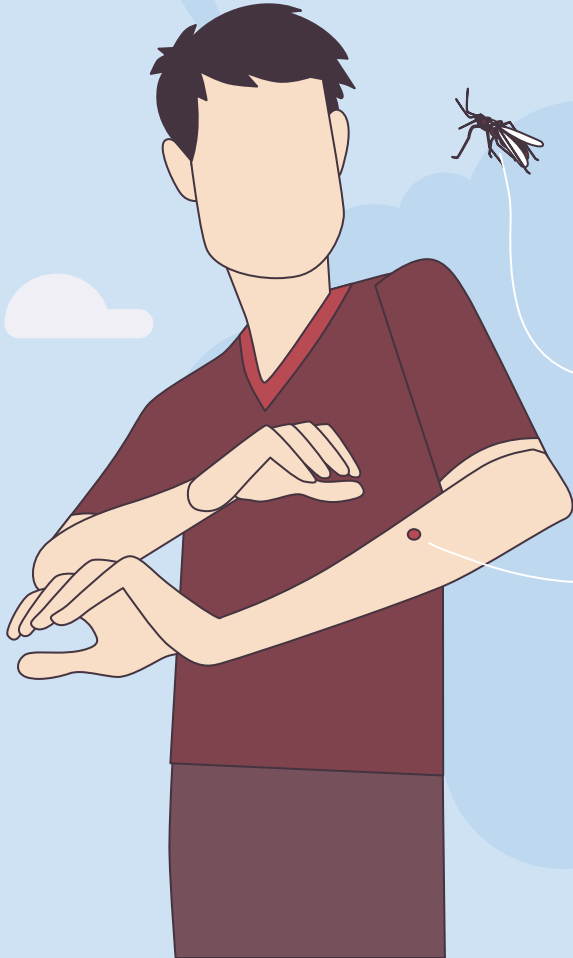




Whoa!

This can be the part of the presentation where you can introduce yourself, write your email...





“This is a quote, words full of wisdom that
someone important said and can make
the reader get inspired”

—Someone Famous



01

Mercury

You can enter a subtitle here in
case you need it

The slide title goes here!

Do you know what helps you make your point clear? Lists like this:

- They're simple
- You can organize your ideas
- You'll never forget to buy milk!

And the audience won't miss the point of your presentation



What about these two concepts?



Ronald Ross

He studied the blood of people who had malaria



Malaria

Ronald Ross dissected and studied mosquitoes extensively



Use three columns, why not?



Bite

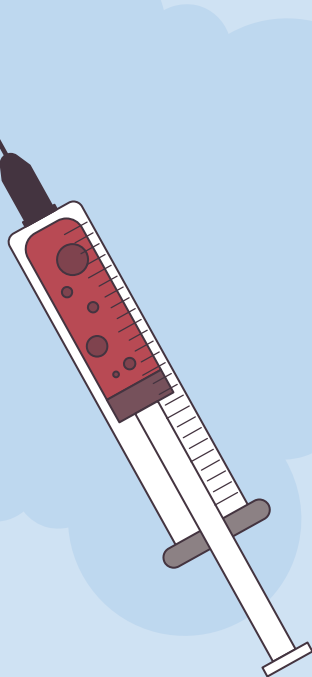
Ronald Ross demonstrated that the route of infection is the mosquito's own bite

Nobel Prize

In 1902 he was awarded the Nobel Prize in Physiology and Medicine

Parasites

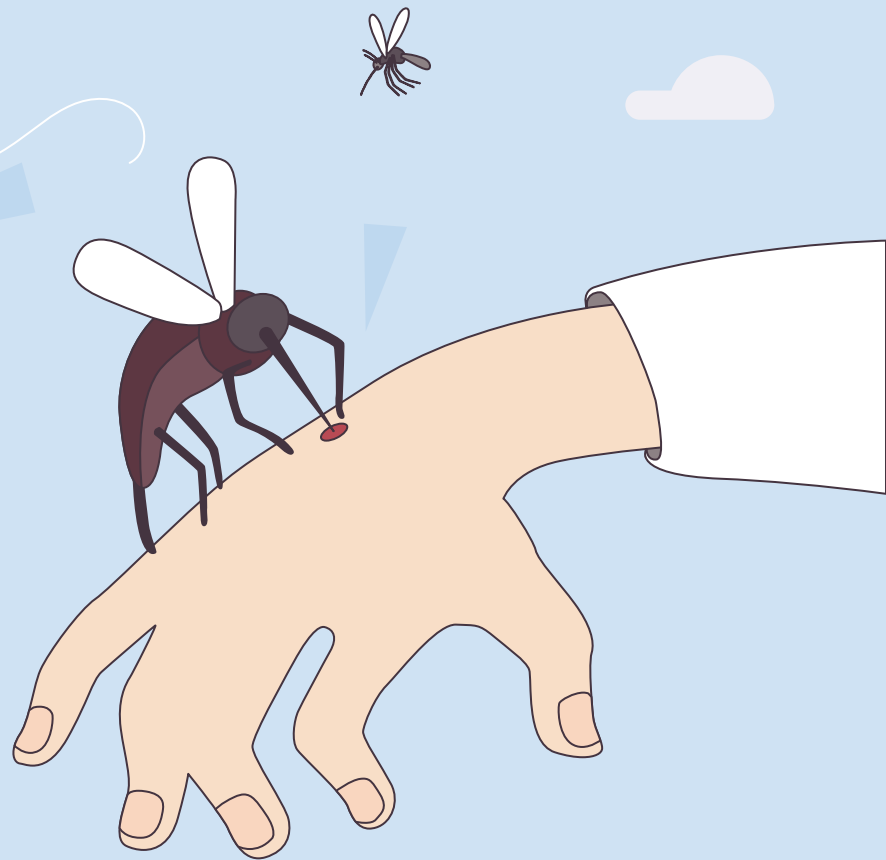
He showed that the developmental phase of malaria parasites occurs in mosquitoes



02

Venus

You can enter a subtitle
here in case you need it





A picture always reinforces the concept

Images reveal large amounts of data, so remember:
use an image instead of a long text

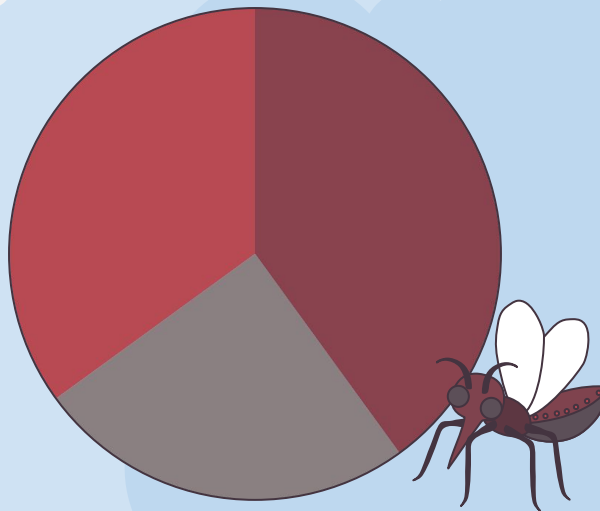
Our data

Mars 35%

Despite being red, Mars is a cold place

Venus 25%

Venus is the second planet from the Sun



Neptune 40%

Neptune is the farthest from the Sun

Follow the link in the graph to modify its data and then paste the new one here. **For more info, click here**



Sometimes, reviewing concepts is good



Mercury

Mercury is the closest planet to the Sun



Venus

Venus is the second planet from the Sun



Mars

Despite being red, Mars is a cold place



Saturn

Saturn is a gas giant and has several rings



Jupiter

It's the biggest planet in the Solar System



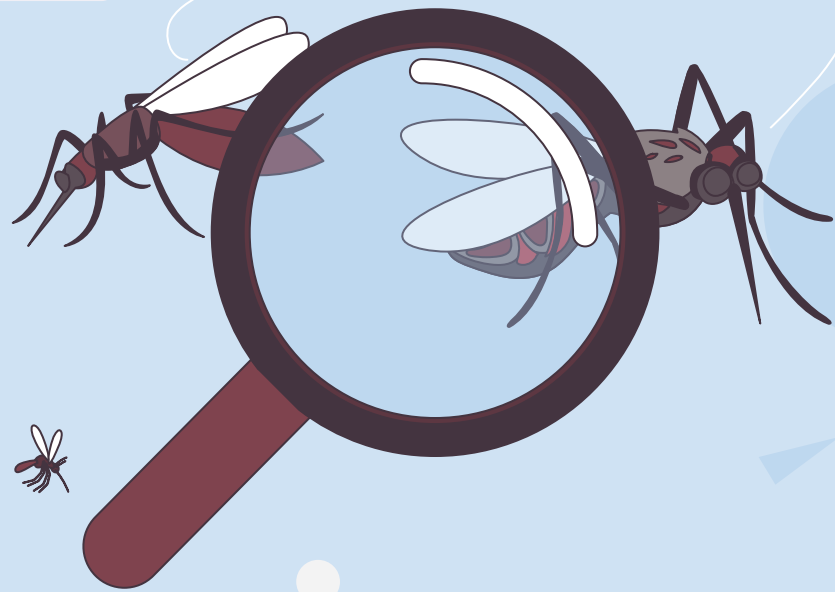
Neptune

Neptune is the farthest planet from the Sun



**A picture is
worth a
thousand
words**





03

Mars

You can enter a subtitle
here in case you need it

This is an infographic



Mars

Despite being red, Mars is a cold place

Venus

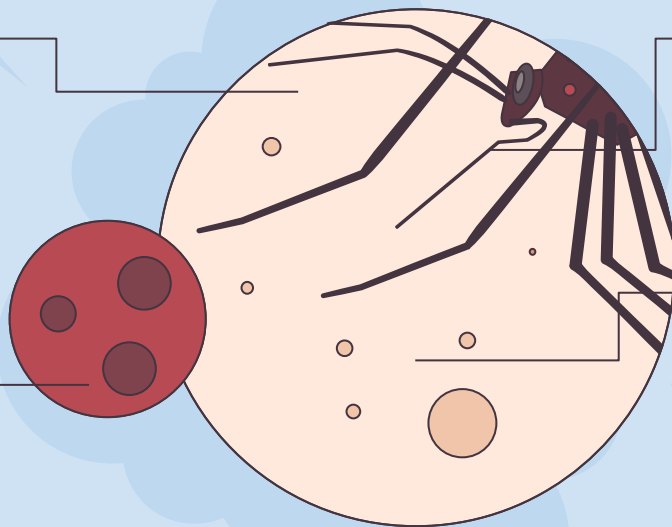
Venus is the second planet from the Sun

Neptune

Neptune is the farthest from the Sun

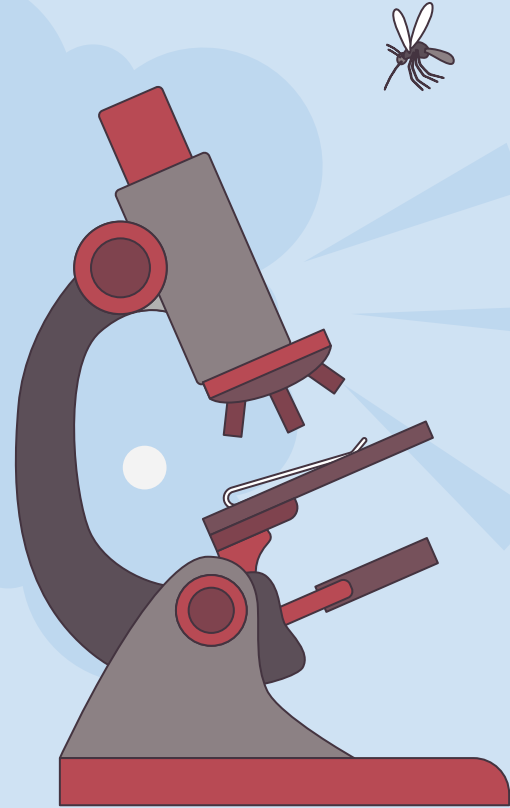
Jupiter

It's the biggest planet in the Solar System



And this is a table

Bite	Despite being red, Mars is a cold place
Malaria	Mercury is the closest to the Sun
Blood	Venus is the second planet from the Sun
Parasite	Neptune is the farthest from the Sun



04 Saturn


You can enter a subtitle here in
case you need it



An illustration of a light-skinned hand reaching out from the left side of the frame. A mosquito is shown biting the wrist, with a small red blood droplet visible. Another mosquito is flying in the air above the hand. The background is a light blue sky with stylized white clouds, a white sun, and blue geometric shapes like triangles and circles.

1897

Year in which female mosquitoes were found
to transmit malaria between humans

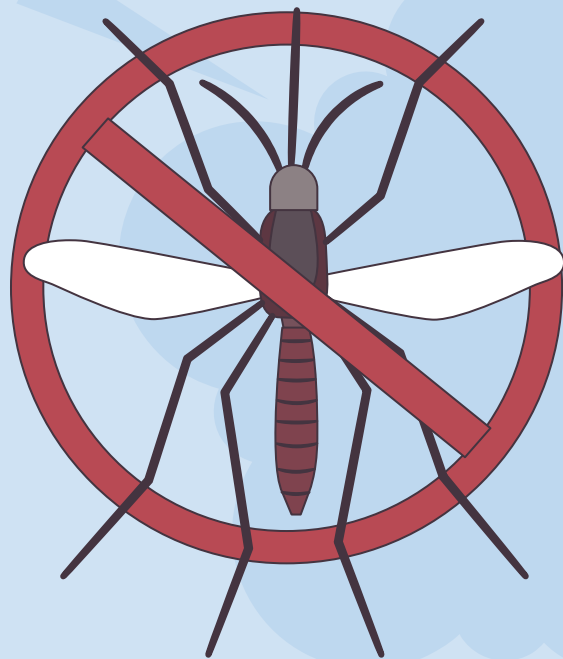
A small illustration of a mosquito with a red body and white wings, positioned in the bottom right corner of the image.

This is another table

Mars	Despite being red, Mars is a cold place	Saturn is the ringed one and a gas giant
Mercury	Mercury is the closest planet to the Sun	It's the biggest planet in the Solar System
Venus	Venus is the second planet from the Sun	Neptune is the farthest from the Sun



Need more columns of text?



Mercury

Mercury is the closest planet to the Sun

Venus

Venus is the second planet from the Sun

Mars

Despite being red, Mars is a cold place

Saturn

Saturn is a gas giant and has several rings



Calendar



August						
Mo	Tu	We	Th	Fr	Sa	Su
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

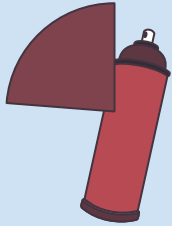
20th of August

World Mosquito Day is celebrated, commemorating the discovery of the British physician Sir Ronald Ross in 1897



These are some percentages

25%



Mercury

Mercury is the closest
to the Sun

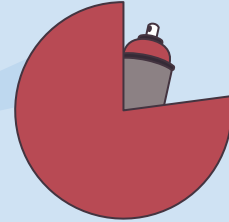
58%



Venus

Venus is the second
planet from the Sun

82%



Mars

Despite being red, Mars
is a cold place

This is a diagram



Mercury

Mercury is the closest
to the Sun

Mars

Despite being red, Mars
is a cold place

Venus

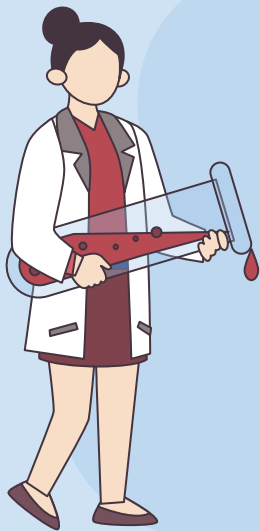
Venus is the second
planet from the Sun



Our team

Helena James

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image on the screen
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John Doe

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with your own



Conclusions



Mercury

Mercury is the closest planet to the Sun



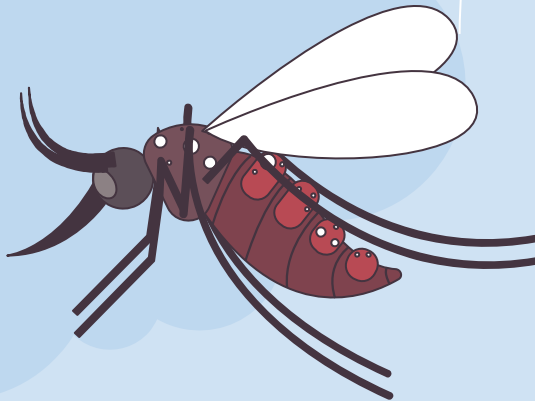
Venus

Venus is the second planet from the Sun



Mars

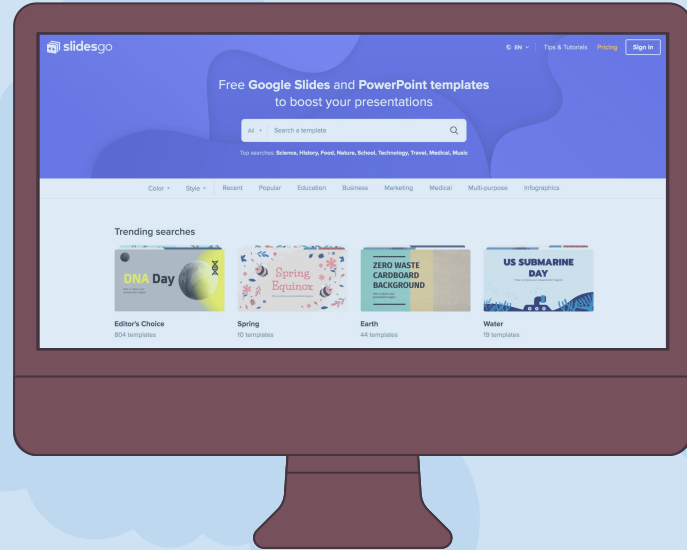
Despite being red, Mars is a cold place



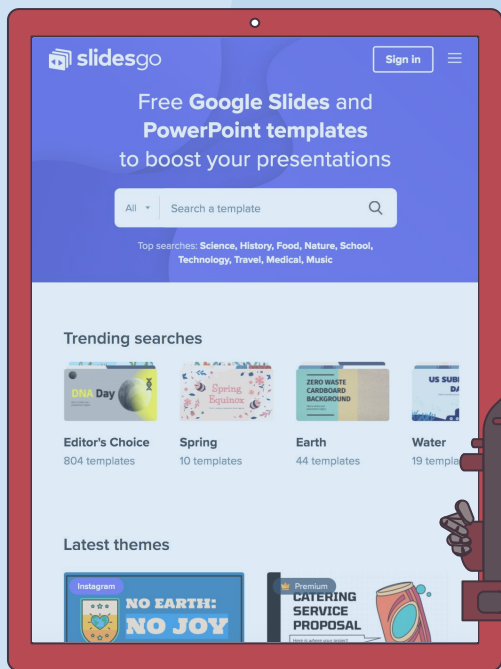
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Tablet app



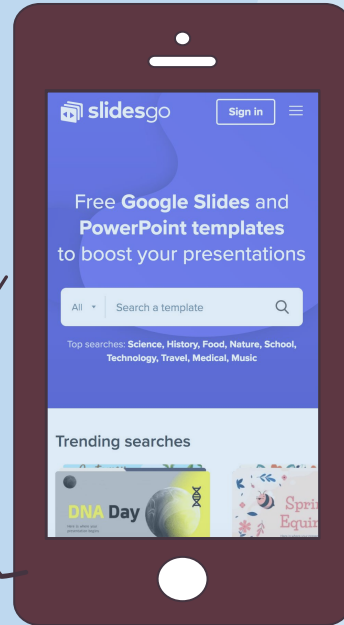
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Mobile web



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Thanks

Do you have any questions?

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yourcompany.com

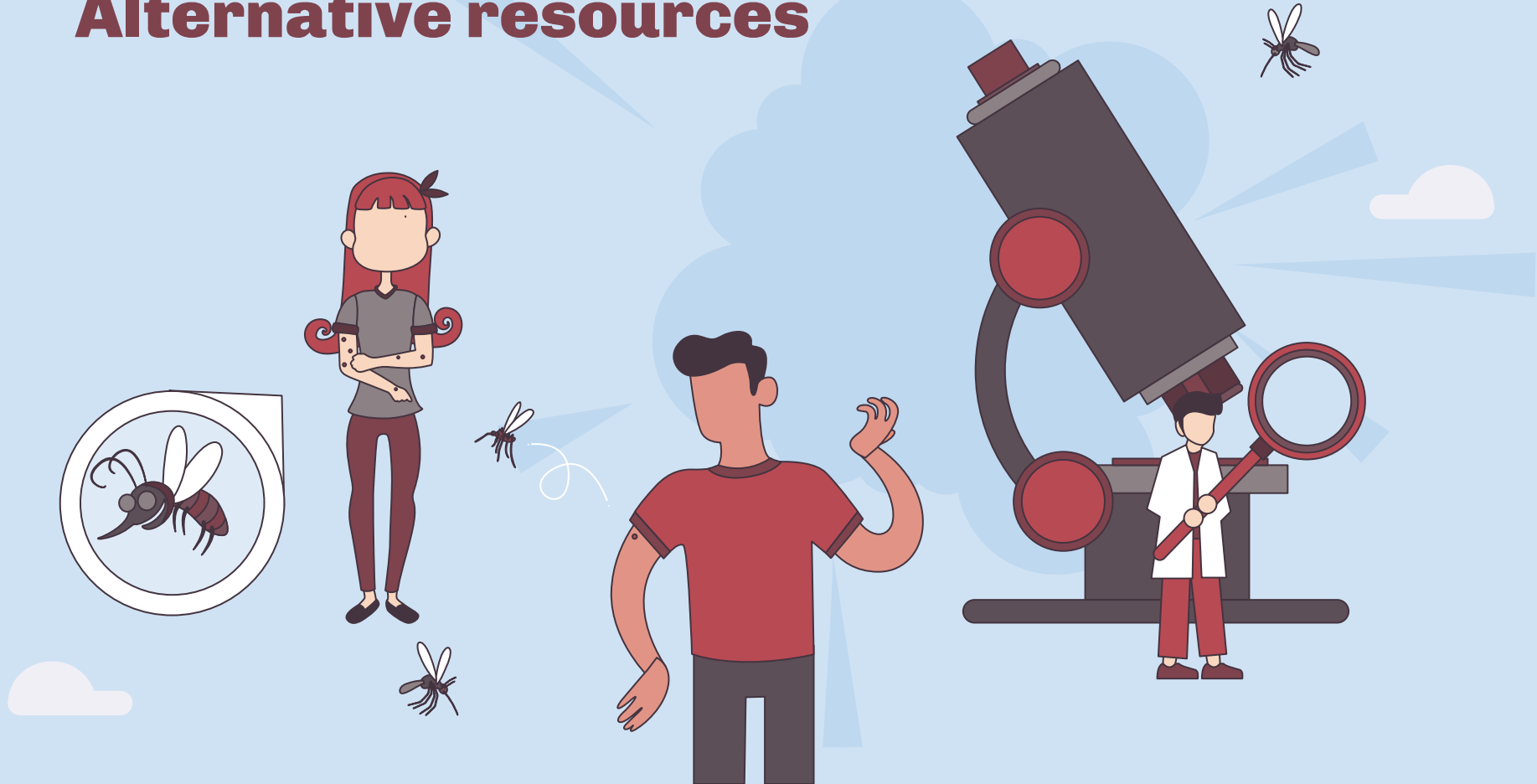


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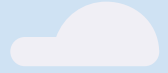
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Alternative resources



Alternative resources



Vectors:

- Mosquito biting person with flat design
- Mosquito biting person
- Flat design biotechnology concept illustrated

Photos:

- Close up microscope glass slide
- Medium shot scientists laboratory
- Close up researcher working with microscope
- Front view science elements with chemicals composition
- Scientists working with microscope
- Defocused female scientist with safety glasses
- Doctor analyzing with microscope



Resources



Vectors:

- Mosquito control background
- Mosquito biting person with flat design
- Hand with mosquito spray
- Hand drawn composition mosquito biting
- Mosquito biting person with flat design
- Mosquito biting person
- Mosquito biting with flat design
- Mosquito biting person with flat
- Coronavirus vaccine phases info
- Hand drawn composition mosquito biting
- Science concept with microscope
- Flat design scientific research
- Hand drawn composition mosquito
- Mosquito biting person with flat
- Mosquito control background
- Mosquito biting
- Flat illustration biotechnology concept
- Flat biotechnology concept illustrated
- Health clinic landing page template



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#####

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Pana



Amico



Bro



Rafiki

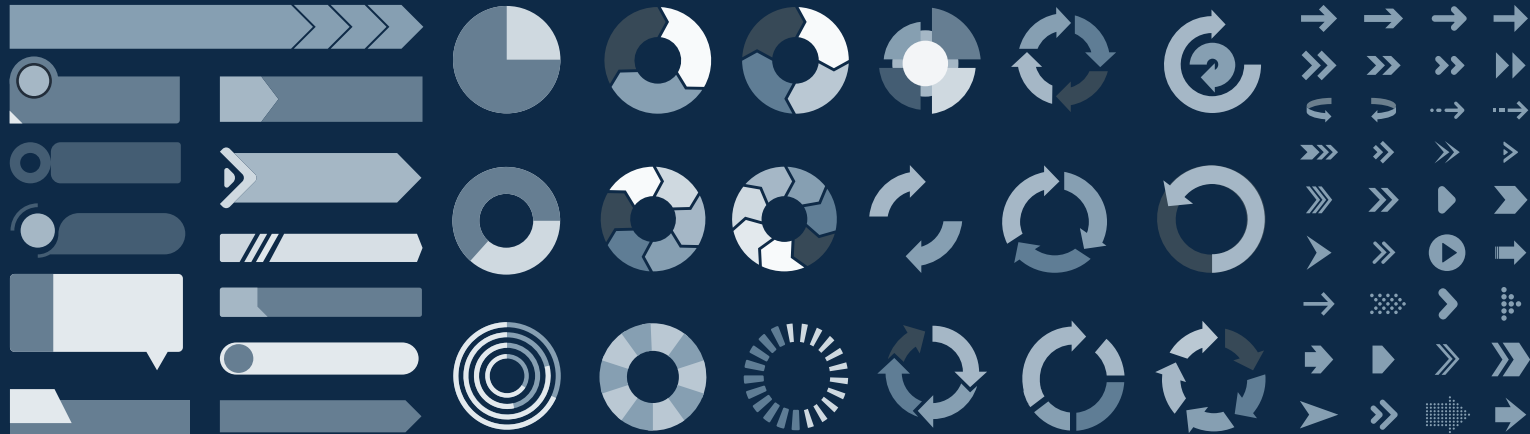


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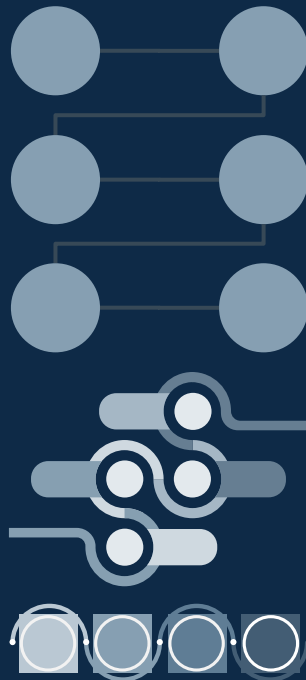
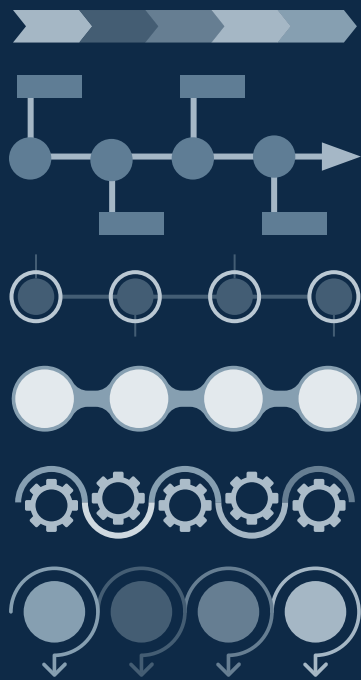
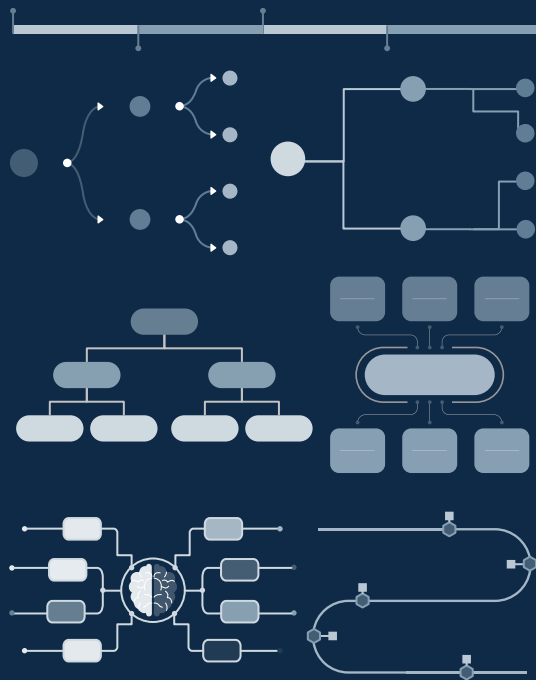
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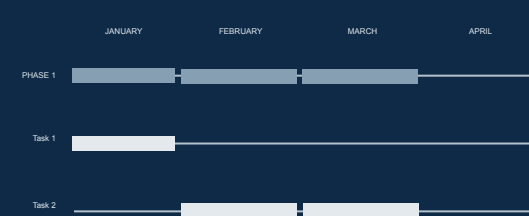
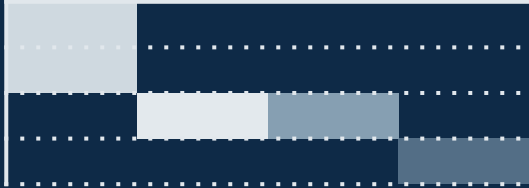
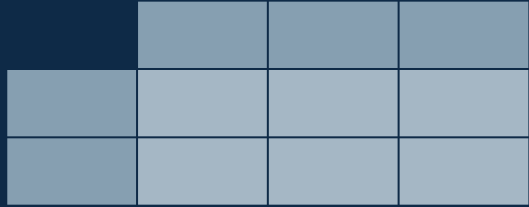
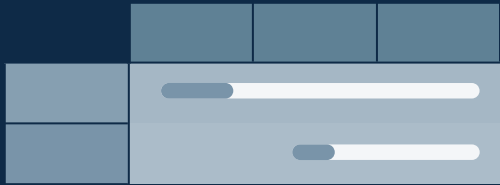
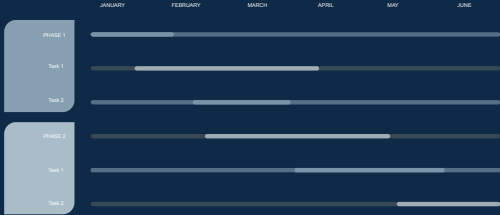
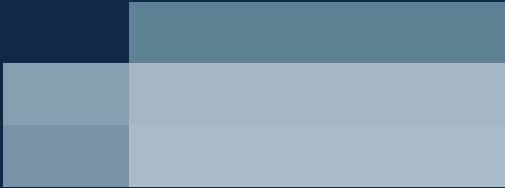
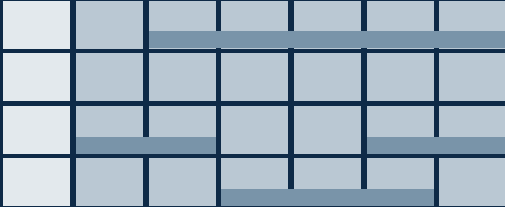
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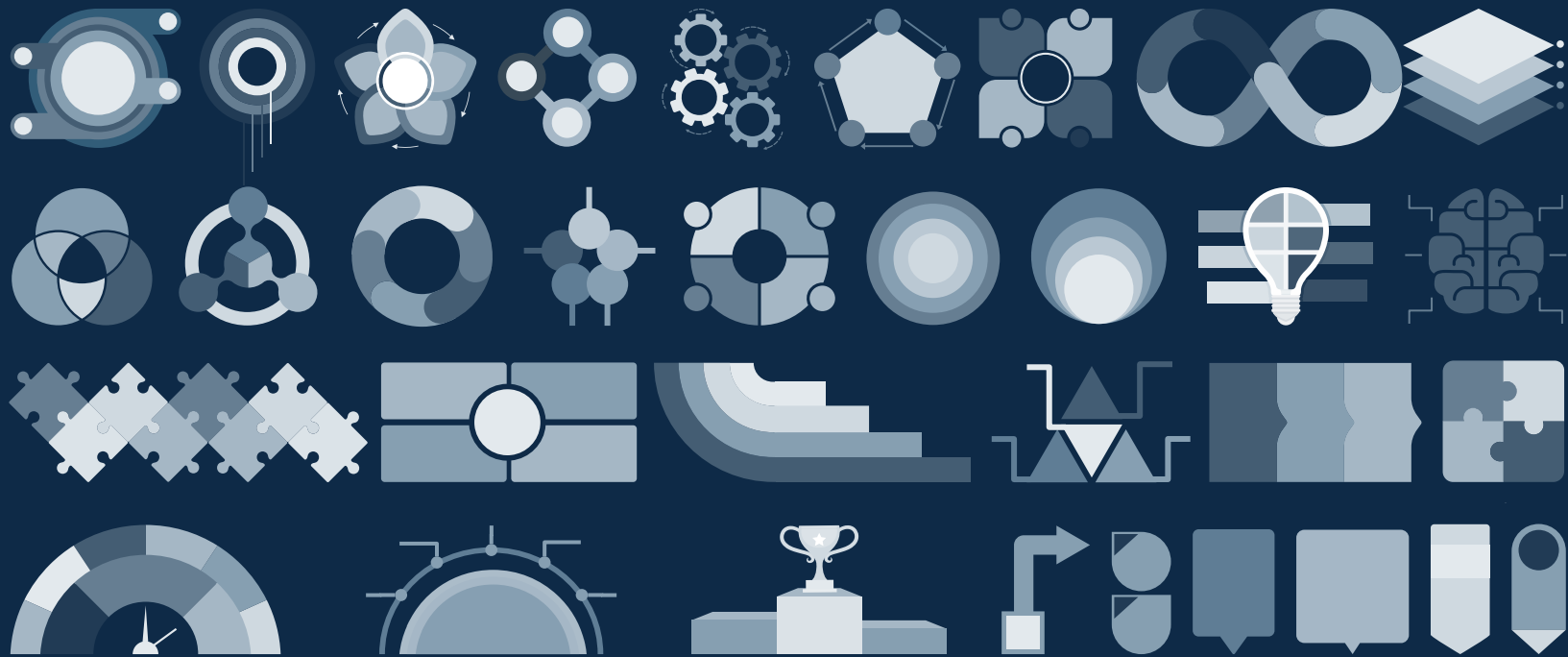
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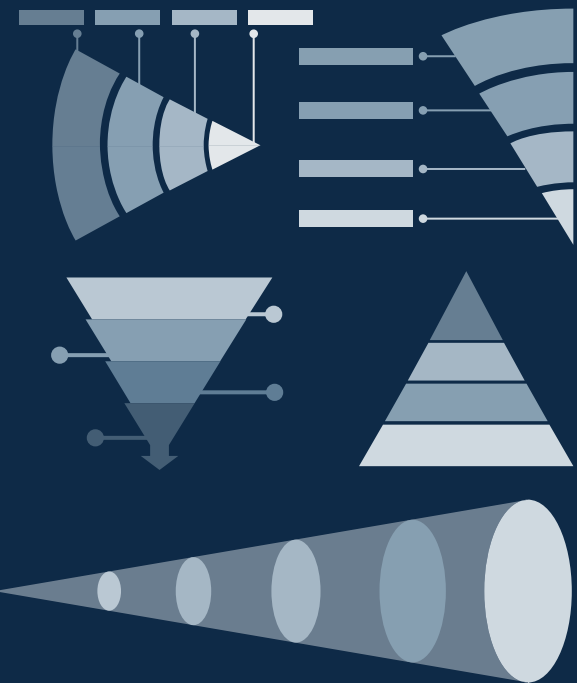
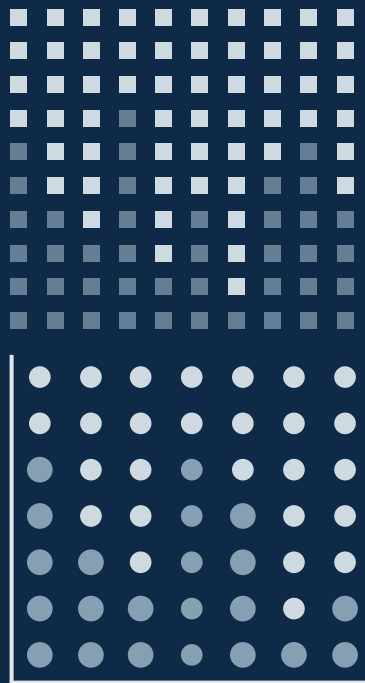












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Educational Icons



Medical Icons



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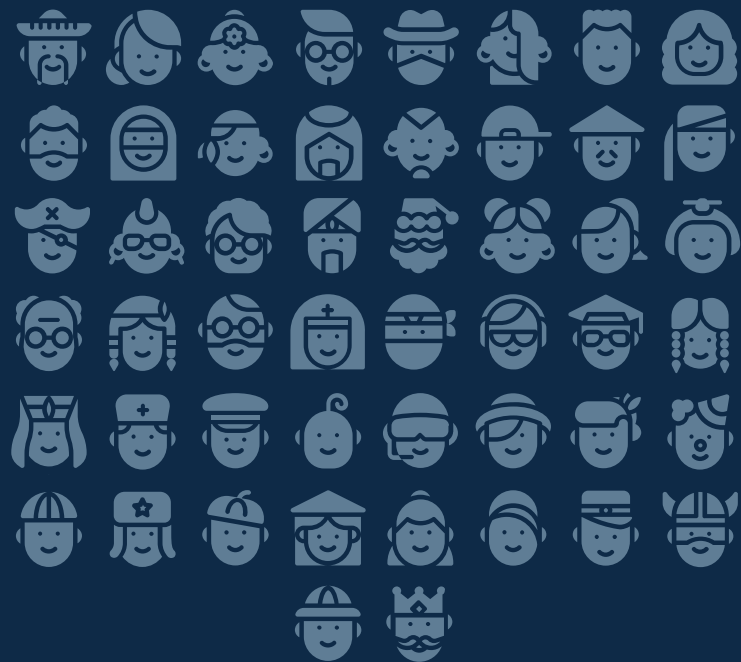
Teamwork Icons



Help & Support Icons



Avatar Icons



[illegible]

Nature Icons



SEO & Marketing Icons



