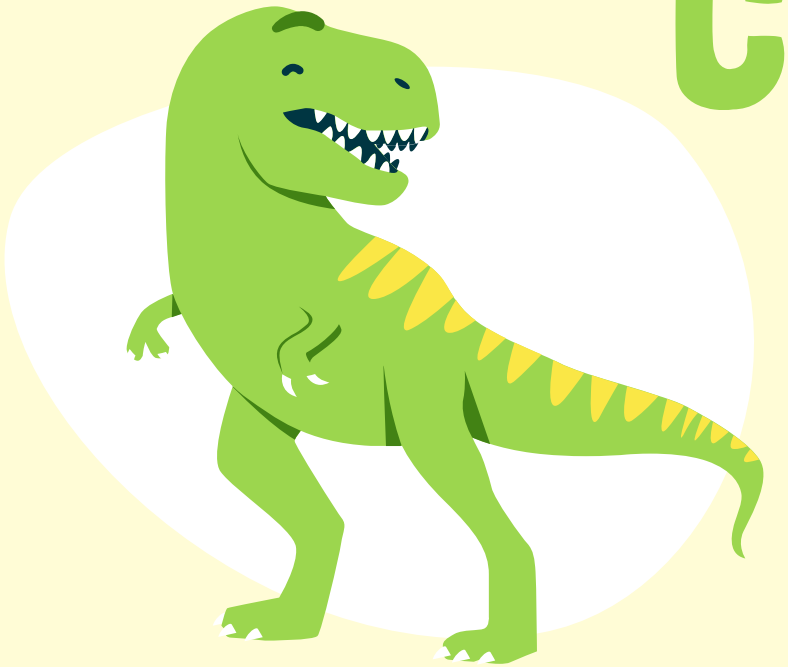
La biophy de la circulation

Dernière partie

Présenté par mathis AKA
Diabethis

COURS 3 :



Sommaire :

1. mesure des pressions

L'unité des pressions va dépendre des modes de mesures que l'on va utiliser.

On utilise principalement 2 unités qui sont hors S.I :

Le millimètre de mercure :

1mmHg = 133 Pa

Unité utilisée pour mesurer la **pression artérielle**.

Le centimètre d'eau :

1cmH_2O = 98 Pa

Unité utilisée pour mesurer la **pression veineuse centrale.**

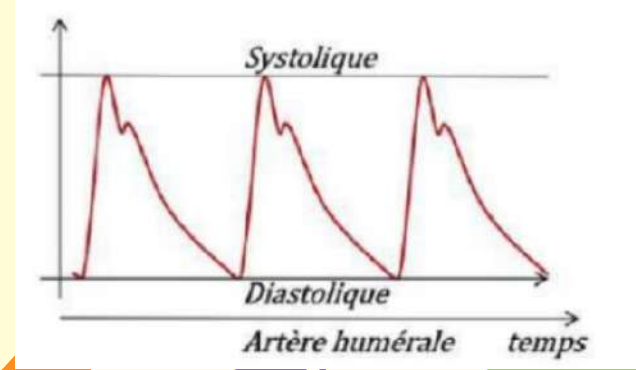
Les pressions dans le corps

A) La pression artérielle :

La PA (appelé à tort « tension artérielle »), c'est la pression du sang produite par le cœur dans les artères.

La pression artérielle moyenne est égale à 98 mmHg soit 13 kPa.

Mais elle est en fait variable au cours du cycle cardiaque. Elle évolue entre un minimum diastolique et un maximum systolique.



Mesure de la pression artérielle

Cette pression artérielle moyenne qui règne dans les artères correspond à la pression statique selon Bernoulli = la pression qui s'exerce sur les parois.

Pour la mesurer, on veut considérer la pression à la sortie du cœur, on se place donc au niveau du cœur = artère humérale. On peut la mesurer allongé et debout.

Mesure de la pression artérielle

Mesure de la PA allongé :

Ici la valeur de la PA sera toujours la même quelle que soit le niveau de mesure.

$$\rho g h + \frac{1}{2}\rho v^2 + PA = 13\ kPa$$
$$h = 0\ et\ v = 0 \Rightarrow PA = 13\ kPa$$
quelle que soit la position de mesure

Mesure de la PA debout :

Ici la valeur de la PA va varier en fonction de la mesure.
(PA tête ≠ PA pieds)

On réutilise l'équation de Bernoulli :

➔On prend pour valeur de référence la pression artérielle au niveau du cœur.

➔On prend PA(0) = 96 mmHg = 13 kPa

➔Et on soustrait à la PA (0) pgh, ce qui nous donne PA = 13 kPA – phg

EXEMPLE

Au niveau de la tête, si on considère la tête à une distance de 50 cm du coeur on obtient :

✓ Tête : $PA(+0{,}5) = 13.10^3 - (10^3 \times 9{,}8 \times 0{,}5)$

$= 13.10^3 - 4{,}9.10^3 = 8{,}1\ kPa \quad = \frac{8{,}1.10^3}{133} = 61\ mmHg$

Au niveau des pieds c'est pareil, si on considère que les pieds son situés en dessous du coeur à 1,30m on a :

✓ Pieds : $PA(-1{,}3) = 13.10^3 + (10^3 \times 9{,}8 \times 1{,}3)$

$= 13.10^3 + 12{,}74.10^3 = 25{,}74\ kPa$

$= \frac{25{,}74.10^3}{133} = 194\ mmHg$

Les pressions dans le corps

B) La pression veineuse centrale :

La pression veineuse est plus faible que la pression artérielle (valeur globalement faible).

✓ Est utilisée en pratique en réanimation

✓ La PVC (Pression Veineuse Centrale) = pression veineuse au niveau du coeur, est donc mesuré de façon DIRECTE par cathéter veineux.

Valeurs normales : PVC ≤ 1kPa

➔ En position debout, la valeur de la PVC dépend de la distance au cœur. Elle est plus importante au niveau des membres INFERIEURS (peut entrainer varices, œdèmes…)

Les pressions dans le corps

C) La pression du liquide céphalo-rachidien :

- Valeur proche de celle de la PVC
- Exprimée en cmH2O
- Peut être mesurée par ponction lombaire

D) La pression intra-oculaire :

- Exprimée en mmHg
- Valeur normale = 15 mmHg
- Augmente en cas de glaucome
- Mesurée par un tonomètre oculaire

2. Applications cliniques en santé

Le diamètre est un facteur de turbulence et est lié à la vitesse (elle-même un facteur de turbulence) : si d diminue, v augmente.

Si d diminue, le risque de turbulence diminue aussi.

ATTENTION +++ Ceci ne s'applique que si le diamètre varie de manière isolée

En pratique, si d diminue, v augmente (principe de continuité du débit). Il faut donc réécrire la formule en introduisant le débit, ce qui donne :

A débit constant, $Q = Sv$; avec une section circulaire : $Q = \frac{\pi d^2 v}{4} \Rightarrow d.v = \frac{4Q}{\pi.d}$

$$Re = \frac{\rho.d.v}{\eta} = \frac{\rho.4Q}{\eta.\pi.d}$$

Causes LÉSIONNELLES	d ↓ ✓ Souffle vasculaire : sténose vasculaire ✓ Souffle cardiaque : sténose ou fuite valvulaire cardiaque
Causes FONCTIONNELLES	Q ↑ η ↓ ✓ Souffle d'effort ✓ Souffle lié à l'anémie (anémie: n ↓ et Q ↑)

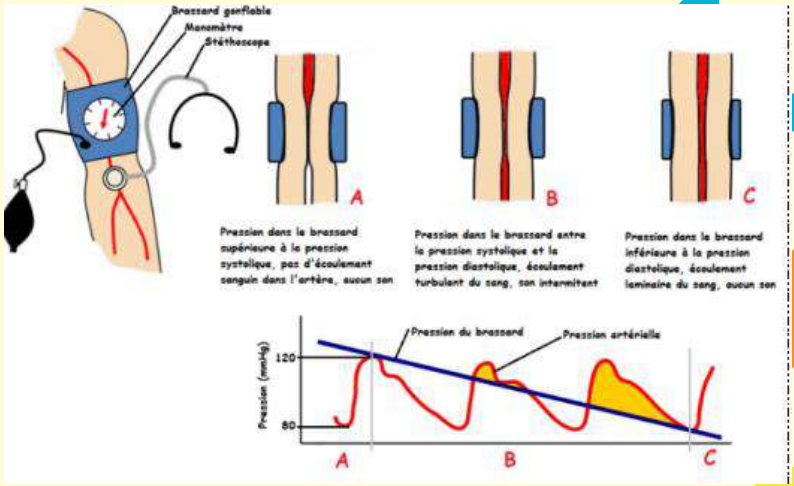
Souffle vasculaire ➔ Athérosclérose :

• Formation de plaques d'athérome -> diminution progressive du diamètre du vaisseau ; audible au stéthoscope.

Mesure auscultatoire de la PA

Cette mesure est :

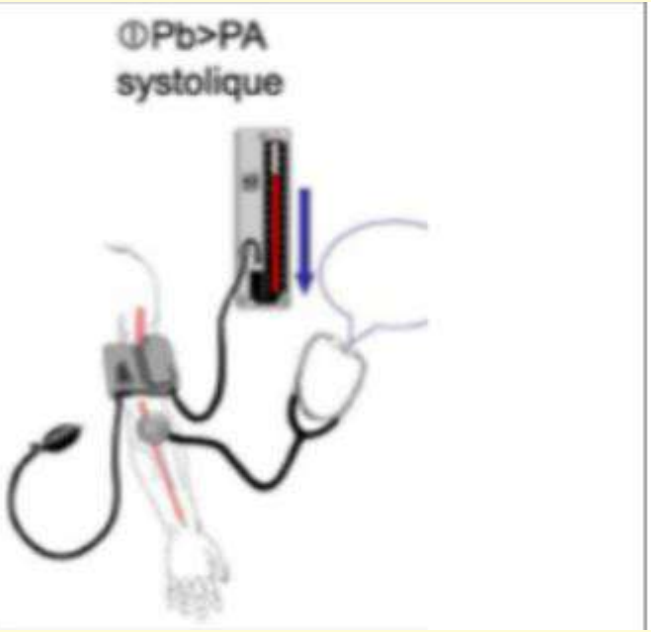
- Non-invasive
- Indirect
- Basée sur la création d'une sténose
- Réalisée au niveau de l'artère humérale
- Basée sur l'interprétation des bruits de KOROTKOV +++



1 - $P_{brassard}$ > $PA_{systole}$: aucun bruit

⇒ On gonfle le brassard jusqu'à contrer la PA : cela collabe l'artère

On n'entend **rien** car **le sang ne circule pas !**

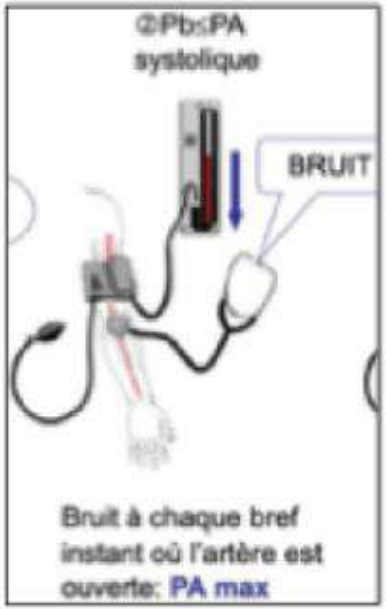


2 - $P_{brassard} \leq PA_{systole}$: Bruit sec intermittent

⇒ Peu à peu on diminue la pression du brassard jusqu'à passer en dessous de la PA maximale = $P_{systole}$

⇒ Bruit bref audible à chaque moment où l'artère est perméable (ouverte) sous l'effet de la pression artérielle

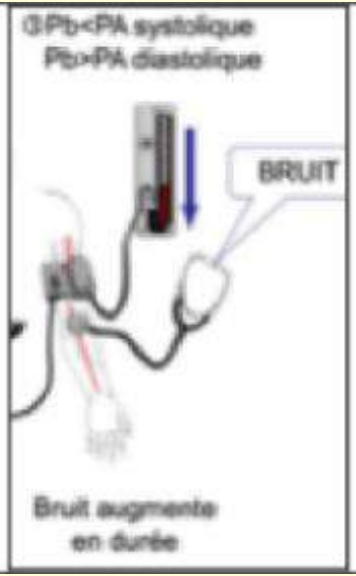
- ➪ On entend un bruit dû à l'écoulement **turbulent en systole**.
- ➪ **Apparition du 1er bruit sec: c'est la PA maximale soit la PA systolique**



3 - $PA_{diastole}$ < Pb < $PA_{systole}$:
Bruit qui s'allonge et qui persiste

⇒ On continue à diminuer la pression du brassard, on entend alors un **bruit qui augmente en durée et change de timbre**

⇒ **En systole, la circulation est redevenue laminaire, mais est turbulente en diastole**



4 - Pb < $PA_{diastole}$
Disparition de tout bruit

奈 On diminue toujours la pression du brassard jusqu'à ne plus rien entendre
le sang circule à nouveau de manière **laminaire** en **diastole** et en **systole**, l'artère n'est plus compressée.

On obtient donc la **PA minimale = PA diastolique ++**

④ Pb<PA diastolique

Disparition de tout bruit:
PA min

Pour finir (avec cette partie)

Du point de vue physique, les bruits de Korotkov correspondent aux limites entre écoulement laminaire et turbulent.

La pression maximale est exactement égale à la pression artérielle systolique ; mais la PA minimale surestime la pression diastolique car on mesure la PAmin lors du passage du sang en écoulement laminaire (on attend qu'il n'y ait plus du tout de bruit).

On considère que PAmin = PAdiast + 2mmHg. La Pression Artérielle moyenne est donnée par la relation suivante :

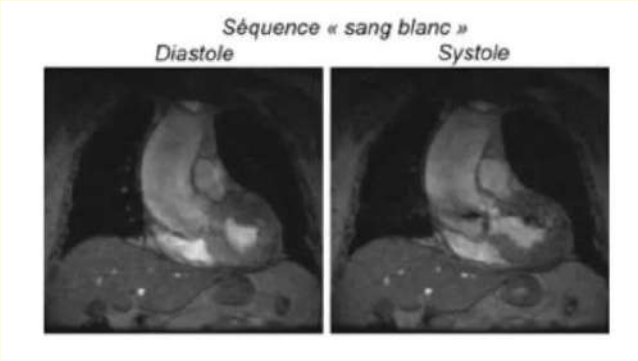
$$PAmoy = \frac{PAsys + 2PAdiast}{3} = 13\ kPa\ (98\ mmHg)$$

3. Application à l'imagerie médicale

L'IRM, c'est l'imagerie par résonnance magnétique nucléaire avec visualisation d'un signal lié aux protons.

On utilise 2 séquences différentes ;

- En « sang noir » = relaxation protons du sang en mouvement.
- En « sang blanc » = sang en hypersignal lié aux protons qui circulent en laminaire ; perte de signal si turbulent (sang noir).



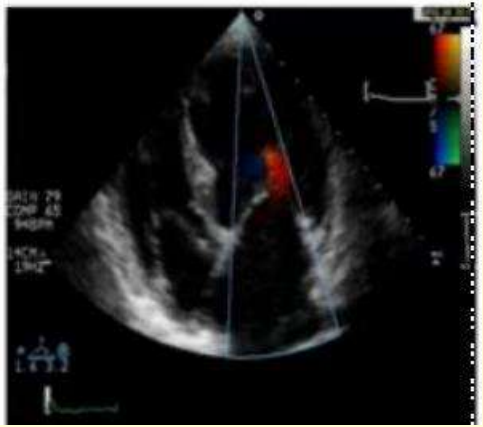
Echographies cardiaques

C’est une méthode d’imagerie qui utilise les ultrasons. On peut distinguer 2 types d’échographie :

- Echographie simple : pour analyser les structures
- Echographie Doppler : qui permet de mesurer les vitesses locales d’écoulement

Echographie anatomique

Echographie Doppler



Application de l'échographie doppler

On peut grâce à l'échographie simple et Doppler faire un certain nombre de mesure : mesurer la chambre de chasse (zone de VG) juste en amont la valve aortique, les vitesses à ce niveau et au niveau de la valve.

- Utilisation du principe de continuité du débit

$$S_1 v_1 = S_2 v_2$$

$$S_2 = \frac{S_1 v_1}{v_2}$$

$$\frac{\pi}{4}(d_2)^2 = \frac{\pi}{4}(d_1)^2 \frac{v_1}{v_2}$$

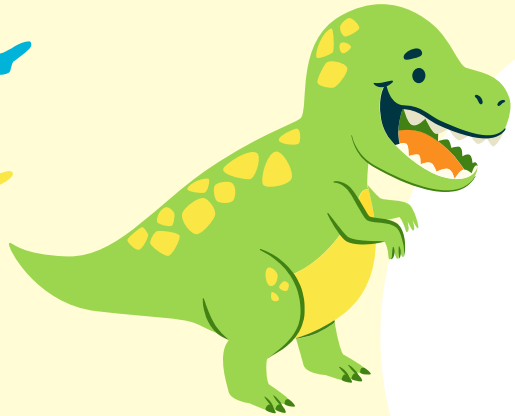
$$d_2 = d_1 \sqrt{\frac{v_1}{v_2}} = 20 \sqrt{\frac{1}{4}} = 10\ mm$$

(Ce calcul est important ça tombe souvent)

QCM

A) Un mmHg vaut 98 Pa.
B) La pression artérielle moyenne est de 13 kPa.
C) La pression artérielle est maximale en diastole.
D) La pression artérielle est produite par les artères dans le cœur.
E) Les réponses A, B, C, D sont fausses

REPONSE

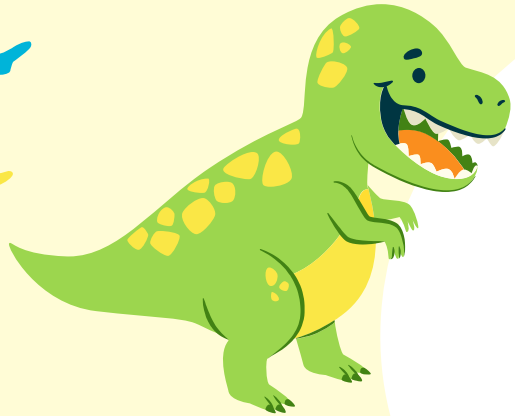


B

QCM

A) Quand on mesure la PA sur un patient allongé, celle-ci ne change pas en fonction de l'endroit de la mesure
B) La pression sera plus forte au niveau des pieds chez une personne debout.
C) La mesure de la PA se fait grâce à l'artère humérale.
D) La pression veineuse centrale est plus faible que la PA
E) Les réponses A, B, C, D sont fausses.

REPONSE

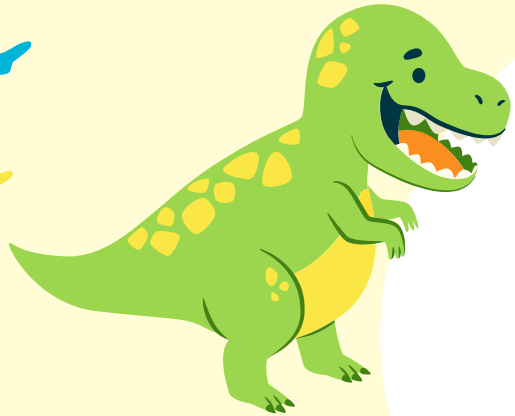


A/B/C/D

QCM

A) La mesure de la pression artérielle est invasive.
B) Quand Pbrassar > Psystole on n’entend aucun bruit.
C) Les bruits de Korotkov correspondent à la limite entre écoulement laminaire et turbulent.
D) L’IRM utilise les ultrasons contrairement à l’échographie.
E) Les réponses A, B, C, D sont fausses.

REPONSE



B/C

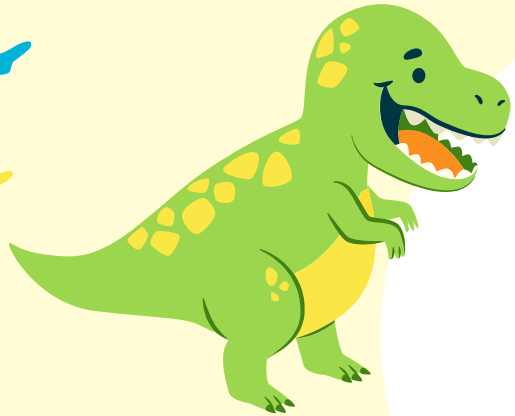
QCM

QCM 2 : Une artère présente une sténose localisée (on suppose les sections circulaires et l'écoulement continu laminaire). Par échographie Doppler, on mesure en amont de la sténose un diamètre de 3 mm et une vitesse d'écoulement égal à 1 $m.s^{-1}$. Au niveau de la sténose, on mesure une vitesse d'écoulement égal à 4 $m.s^{-1}$. On considère le sang comme un fluide de viscosité apparente égal à 3.10^{-3} Pa.s . Quel est, en millimètres le diamètre de l'artère au niveau de la sténose ?

A) 0,75
B) 1
C) 1,5
D) 4,5
E) 6

REPONSE

C



BRAVO C'EST FINI VOUS AVEZ SURVECU A LA BIOPHI CIRCU !!!

THE THREE OLDEST DINOSAURS

MARS

Despite being red, Mars is a cold place

JUPITER

It’s the biggest planet and a gas giant

MERCURY

Mercury is the closest planet to the Sun

DINOSAUR: HABITAT, BEHAVIOR AND DIET

MARS

Despite being red, Mars is a cold place

MERCURY

Mercury is the closest planet to the Sun

JUPITER

Jupiter is the biggest planet and a gas giant

SATURN

Saturn is a gas giant and has several rings

MEET OUR DINOSAURS!

MERCURY

It’s the closest planet to the Sun

VENUS

It’s the second planet from the Sun

MARS

Despite being red, Mars is a cold place

DINOSAUR: HABITAT, BEHAVIOR AND DIET

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A PICTURE ALWAYS REINFORCES THE CONCEPT

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

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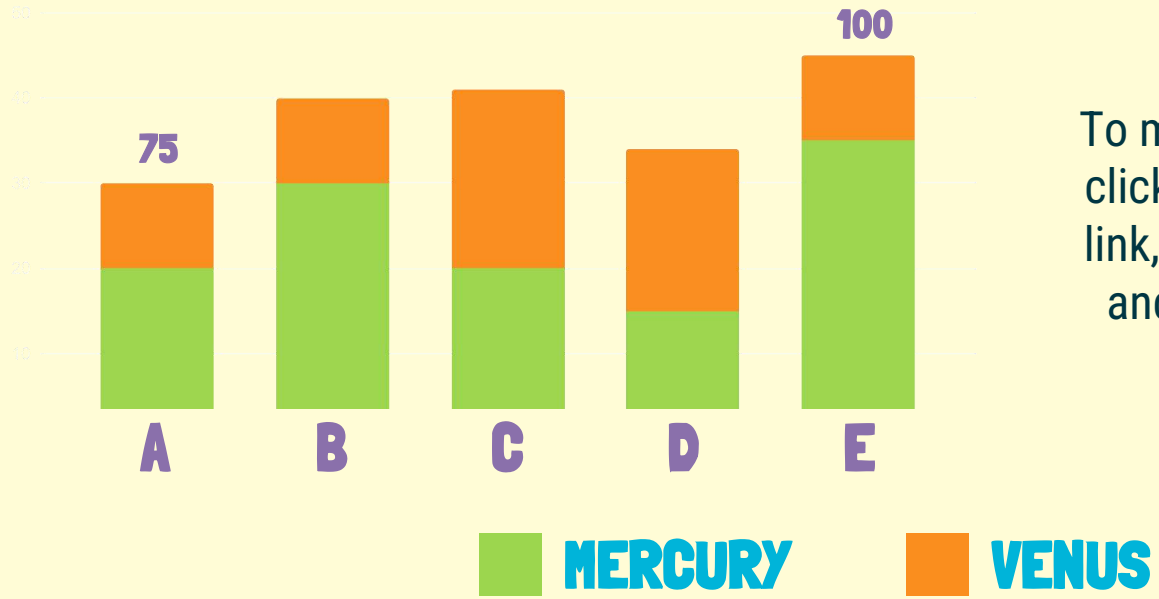
DOES THE DINOSAUR NEED A GRAPH?



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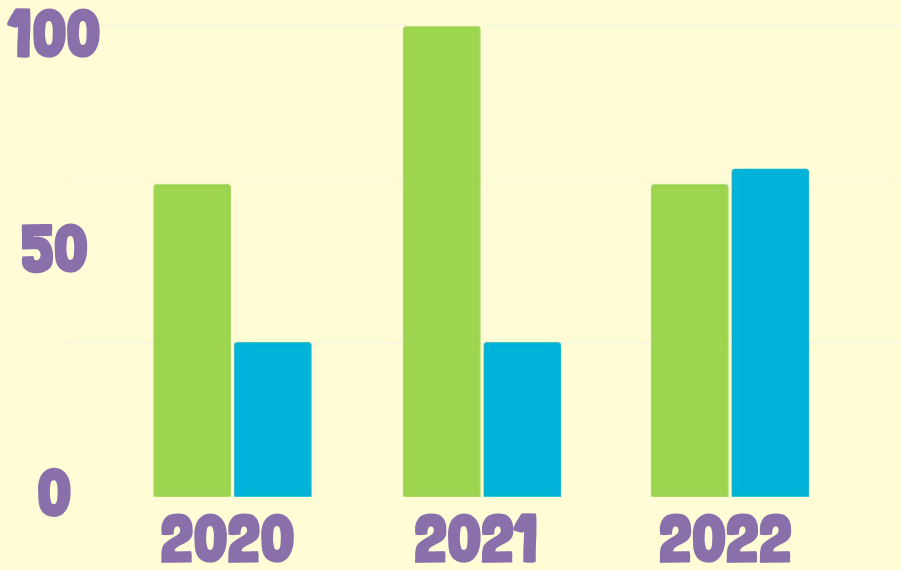
DOES THE DINOSAUR NEED A GRAPH?



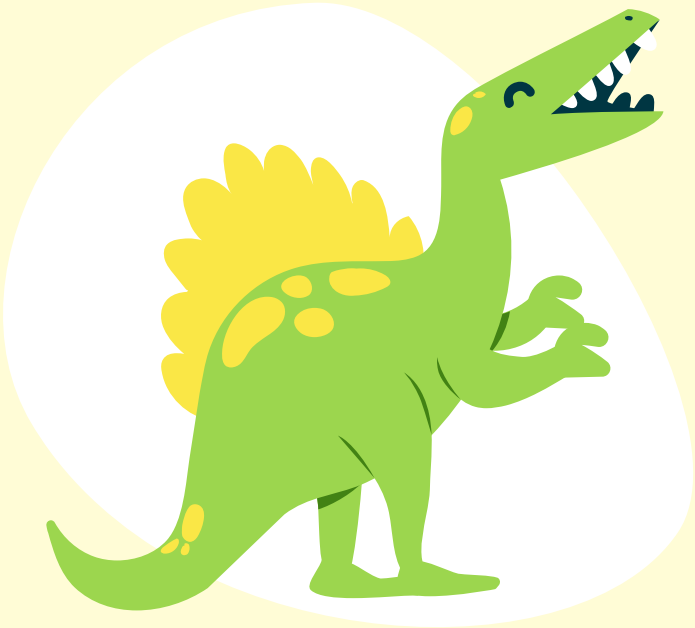
MERCURY

It’s the closest planet to the Sun and the smallest one in the Solar System

VENUS

It has a beautiful name and is the second planet 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**



02

SECTION

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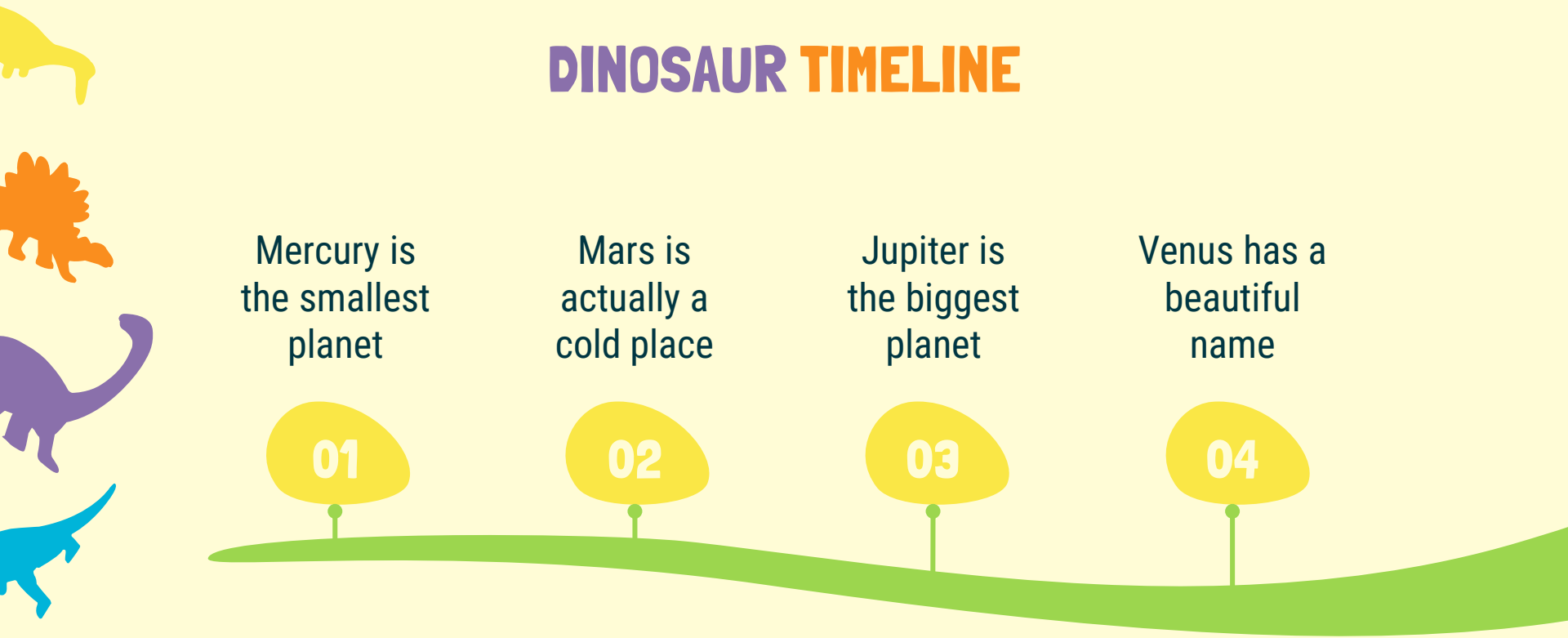
here if you need it

02

SECTION

You can enter a subtitle here
if you need it

DINOSAUR TIMELINE



THE FOUR OLDEST DINOSAURS

MERCURY

It’s the closest planet to the Sun

VENUS

It’s the second planet from the Sun

MARS

Despite being red, Mars is a cold place

01 02 03 04 05

JUPITER

It’s the biggest planet of them all

SATURN

It’s a gas giant and has several rings

THE 6 MAIN DINOSAUR TYPES

MERCURY
It’s the closest planet to the Sun

VENUS
It’s the second planet from the Sun

MARS
Despite being red, Mars is a cold place

JUPITER
It’s the biggest planet of them all

SATURN
It’s a gas giant and has several rings

NEPTUNE
It’s the farthest planet from the Sun

THE 5 MAIN DINOSAUR TYPES

MERCURY
It’s the closest planet to the Sun

VENUS
It’s the second planet from the Sun

MARS
Despite being red, Mars is a cold place

JUPITER
It’s the biggest planet of them all

SATURN
It’s a gas giant and has several rings

WHEN DID DINOSAURS LIVE?

B

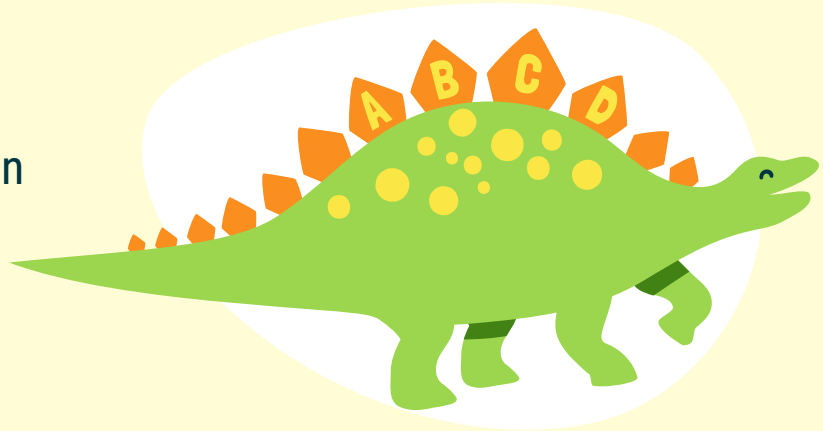
Jupiter is the biggest of them all

C

Venus has a beautiful name

A

Mercury is the closest to the Sun



D

Despite being red, Mars is cold

WHEN DID DINOSAURS LIVE?

A

Despite being red, Mars is a cold place

C

Mercury is the closest planet to the Sun

B

Jupiter is the biggest planet of them all

D

Saturn is a gas giant and has rings

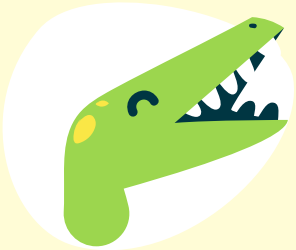
EXPLORE THE AGE OF THE DINOSAURS

	2010	2015	2020
MERCURY	3,000,000	4,000,000	5,000,000
VENUS	1,500,000	2,000,000	2,500,000

WORLD'S BIGGEST DINOSAURS

NAME	SIZE	WEIGHT	DESCRIPTION
Argentinosaurus	36-40 m	77 - 100 t	You can write the description here
Puertasaurus	30-35 m	80-100 t	You can write the description here
Patagotitan	37 m	69-77 t	You can write the description here
Alamosaurus	28-30 m	44-88 t	You can write the description here

MEET OUR DINOSAURS!



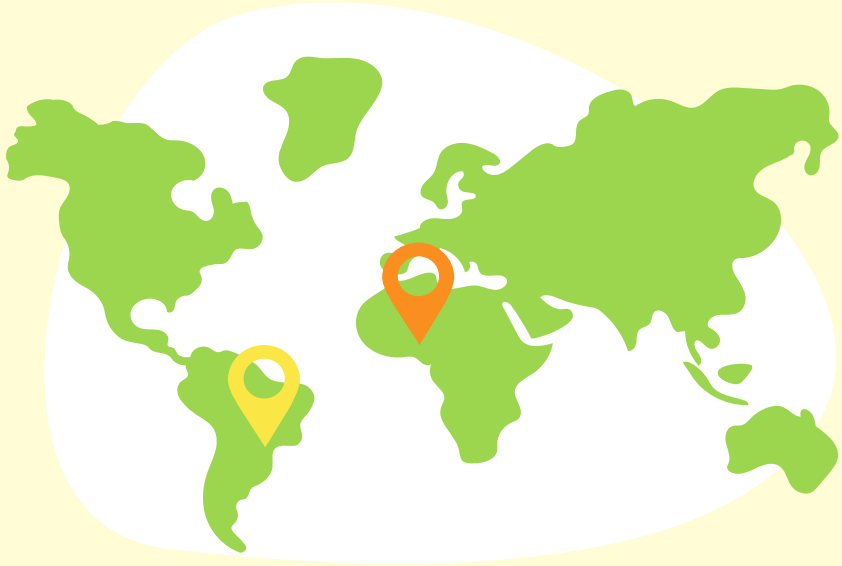
JENNA DOE

You can replace the image on the screen with your own one

JOHN JAMES

You can replace the image on the screen with your own one

WHERE DID DINOSAURS LIVE?



50,000

Despite being red, Mars is actually a cold place

650,000

Venus is the second planet from the Sun

WHERE DID DINOSAURS LIVE?

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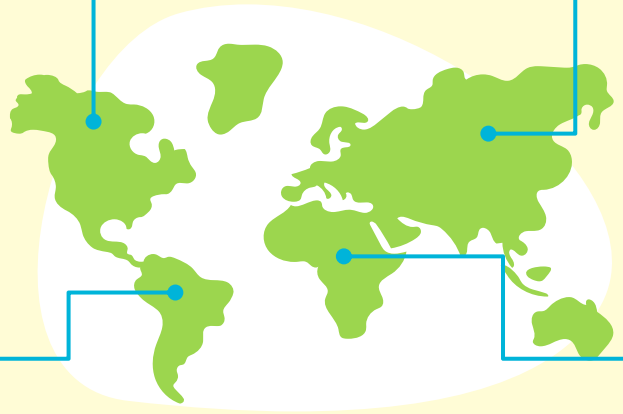
JUPITER

It’s the biggest planet and a gas giant



MERCURY

Mercury is the closest planet to the Sun

SATURN

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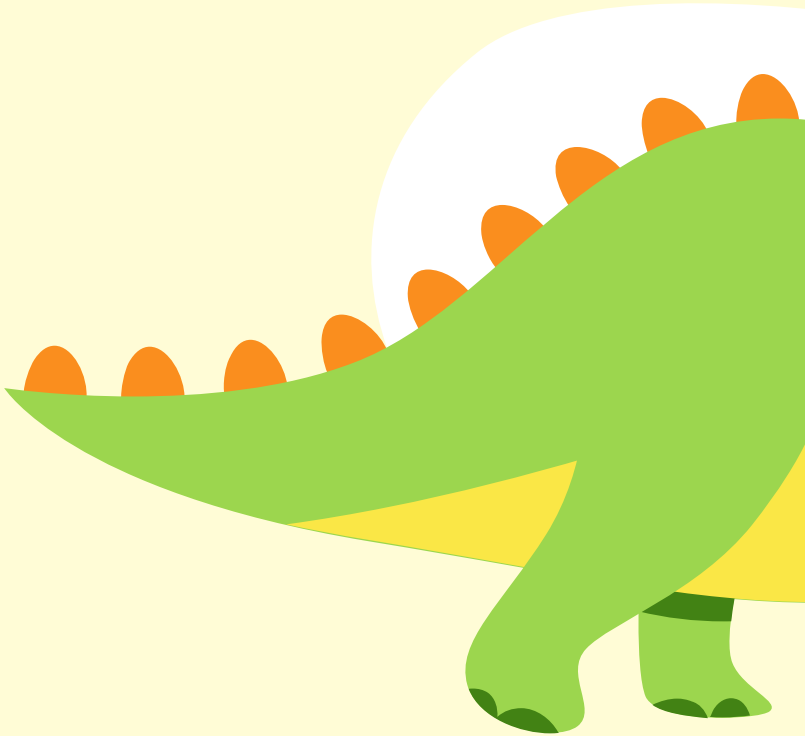
HOW TO COOK A TRICERATOPS EGG

01

VENUS

Venus has a beautiful name and is the second planet from the Sun. It’s terribly hot



HOW TO COOK A TRICERATOPS EGG

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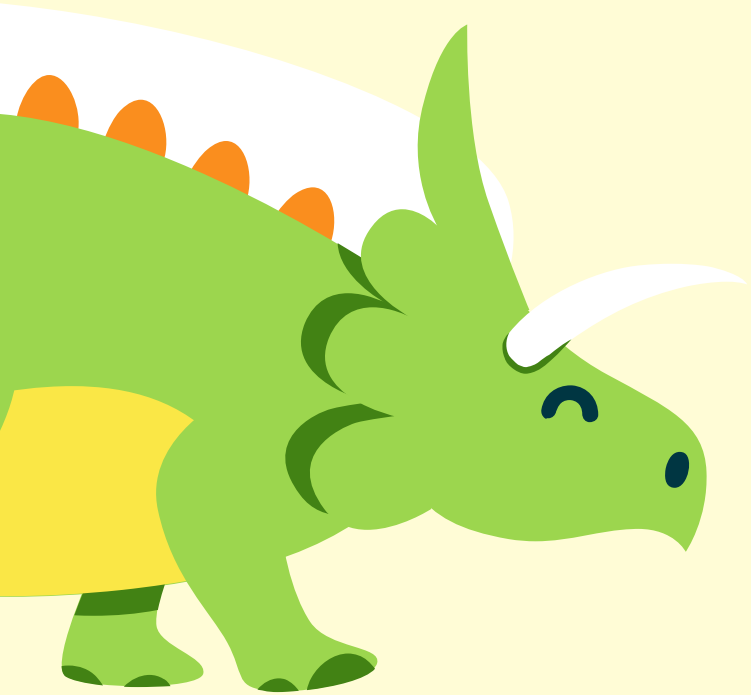
HOW TO COOK A TRICERATOPS EGG



02

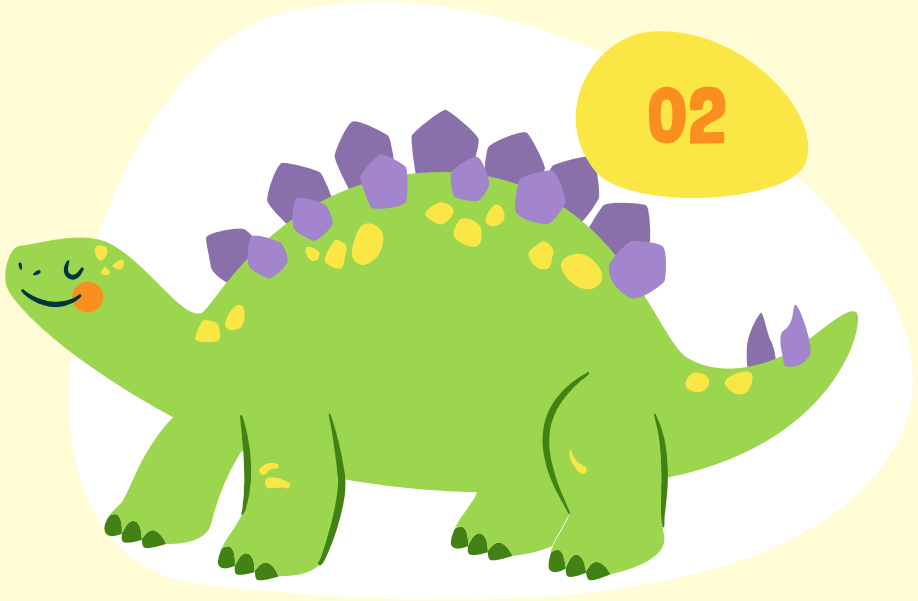
MERCURY

Mercury is the closest planet to the Sun and the smallest one in the Solar System

HOW TO COOK A STEGOSAUR EGG

VENUS

Venus has a beautiful name and is the second planet from the Sun. It’s terribly hot



4,498,3000

Big numbers catch your
audience’s attention

5,000,0000

Big numbers catch your audience’s attention

333,000.00

The Sun’s mass compared to Earth’s

9h 55m 23s

Jupiter’s rotation period

386,000 km

Distance between Earth and the Moon

386,000 km

Distance between Earth and the Moon

333,000.00

The Sun’s mass compared to Earth’s

9h 55m 23s

Jupiter’s rotation period

THE DINOSAUR MUSEUM TICKETS

$0

Mercury is the closest planet to the Sun

MERCURY

$5

Despite being red, Mars is actually a cold place

MARS

$10

Venus is the second planet from the Sun and is terribly hot

VENUS

THE DINOSAUR MUSEUM TICKETS

MERCURY

$4

Mercury is the closest planet to the Sun

MARS

$5

Despite being red, Mars is actually a cold place

VENUS

$8

Venus is the second planet from the Sun and is terribly hot

SATURN

$9

Jupiter is the biggest planet in the Solar System

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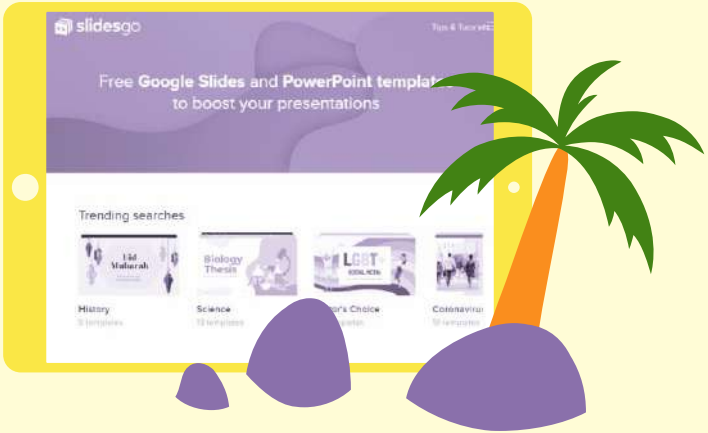

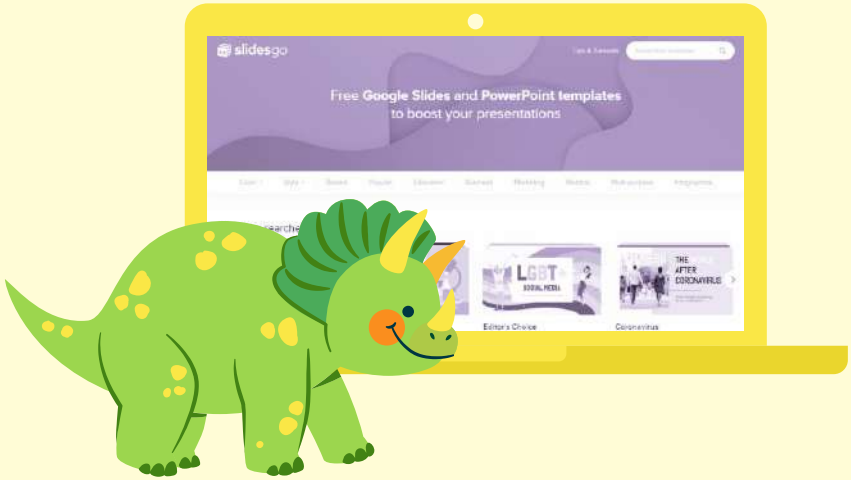

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DINOSAUR ICON PACK

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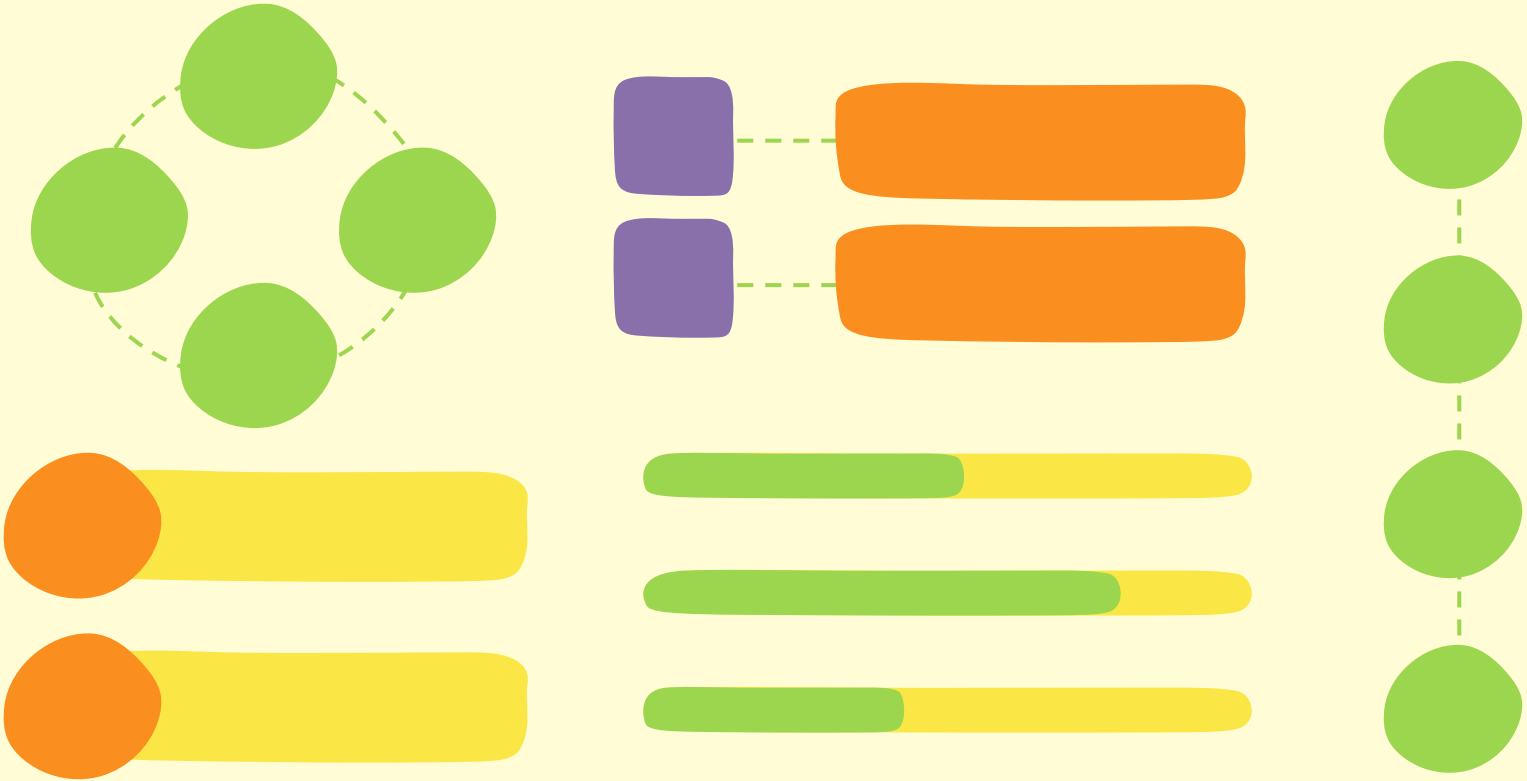

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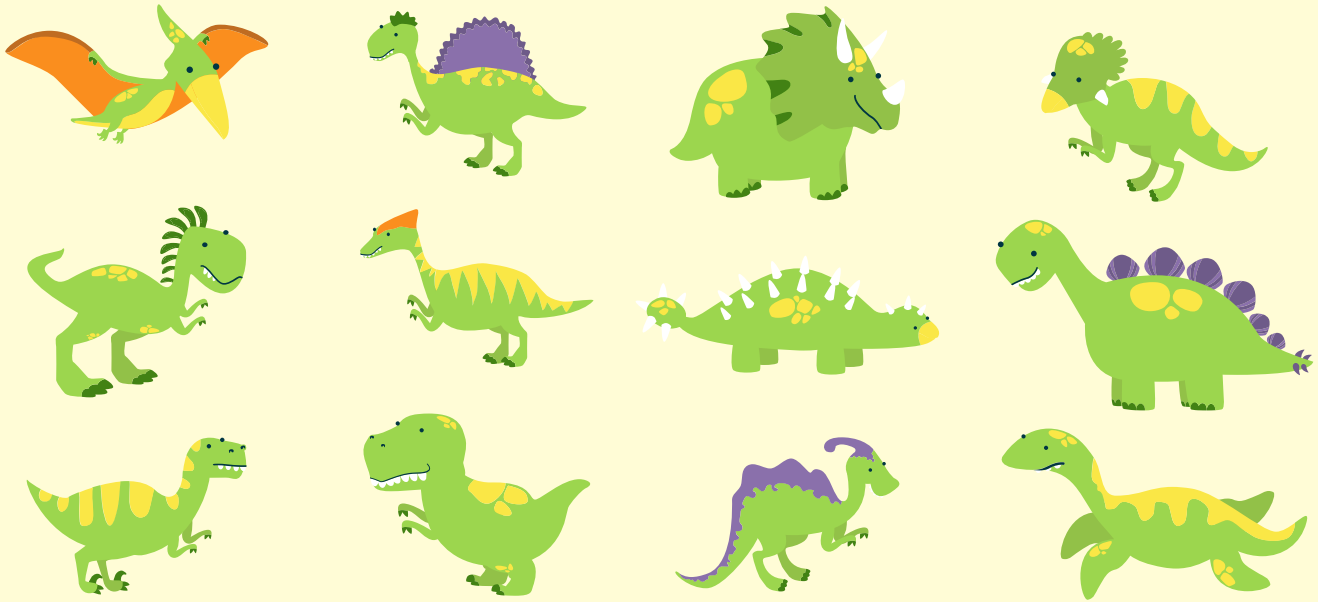

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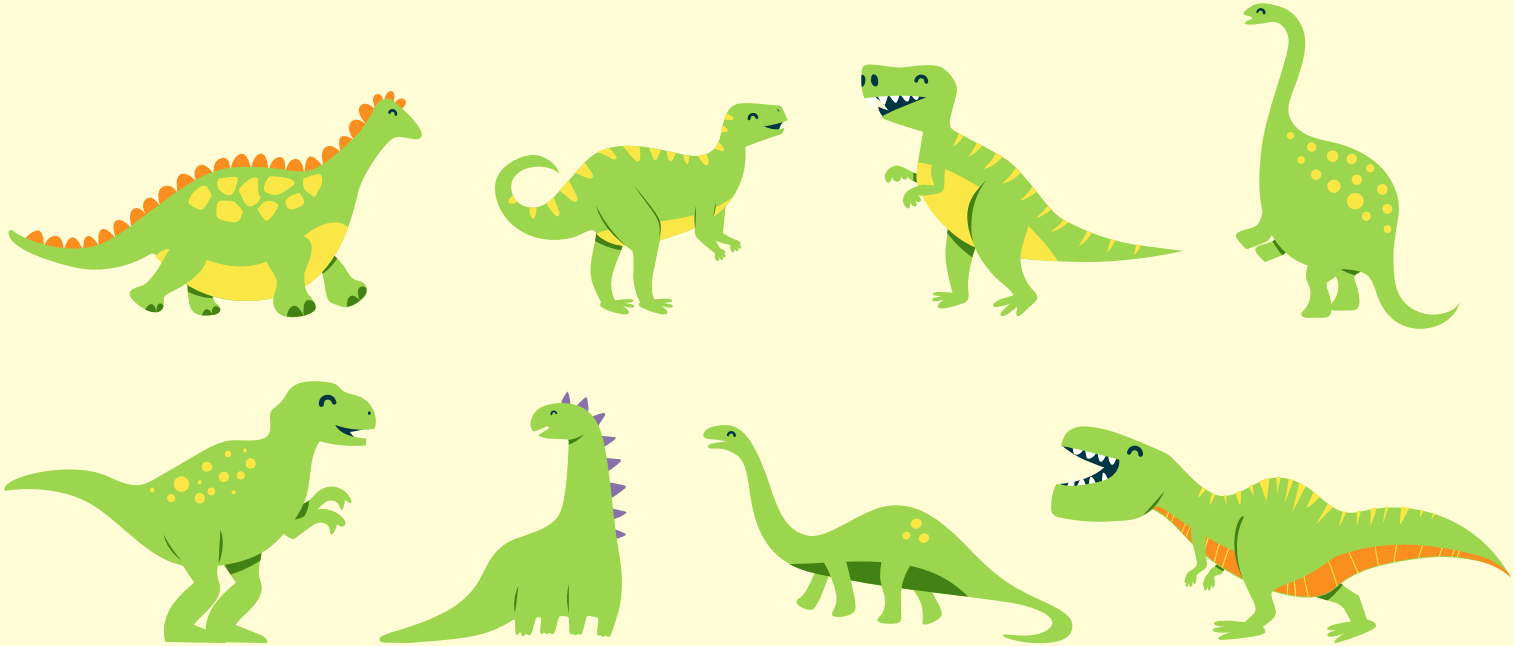

ALTERNATIVE RESOURCES

ICONS

- Dinosaurs Icons Pack

VECTORS

- Hand drawn dinosaur collection
- Hand drawn dinosaur collection (I)

PHOTOS

- Boy in dinosaur costume with toy
- Kid playing with toy dinosaurs
- Kid playing with toy dinosaurs (I)

RESOURCES

VECTORS

- Online Conference Video Calling
- Hand Drawn T-Rex Background
- Birthday Invitation Template
- Flat Dinosaur Pattern
- Dinosaur Pattern
- Hand Drawn Dinosaur Pattern
- Wild Dinosaurs Pattern
- Colorful Doodle Dinosaurs
- Hand Drawn Dinosaur Collection
- Dinosaur Collection

PHOTOS

- Side View Boy Playing
- Kid With Toy Dinosaurs

RESOURCES

VECTORS

- Dinosaur collection
- Dinosaur collection (I)

PHOTOS

- Boy in dinosaur costume playing at home
- Side view boy in dinosaur costume

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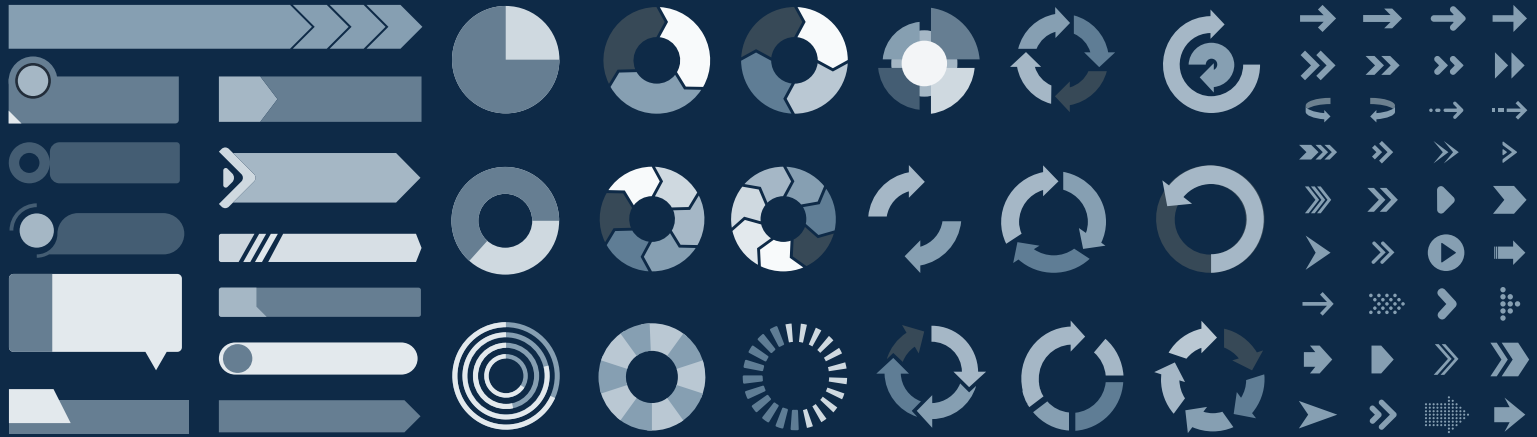






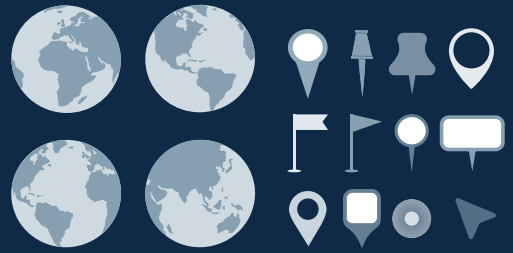

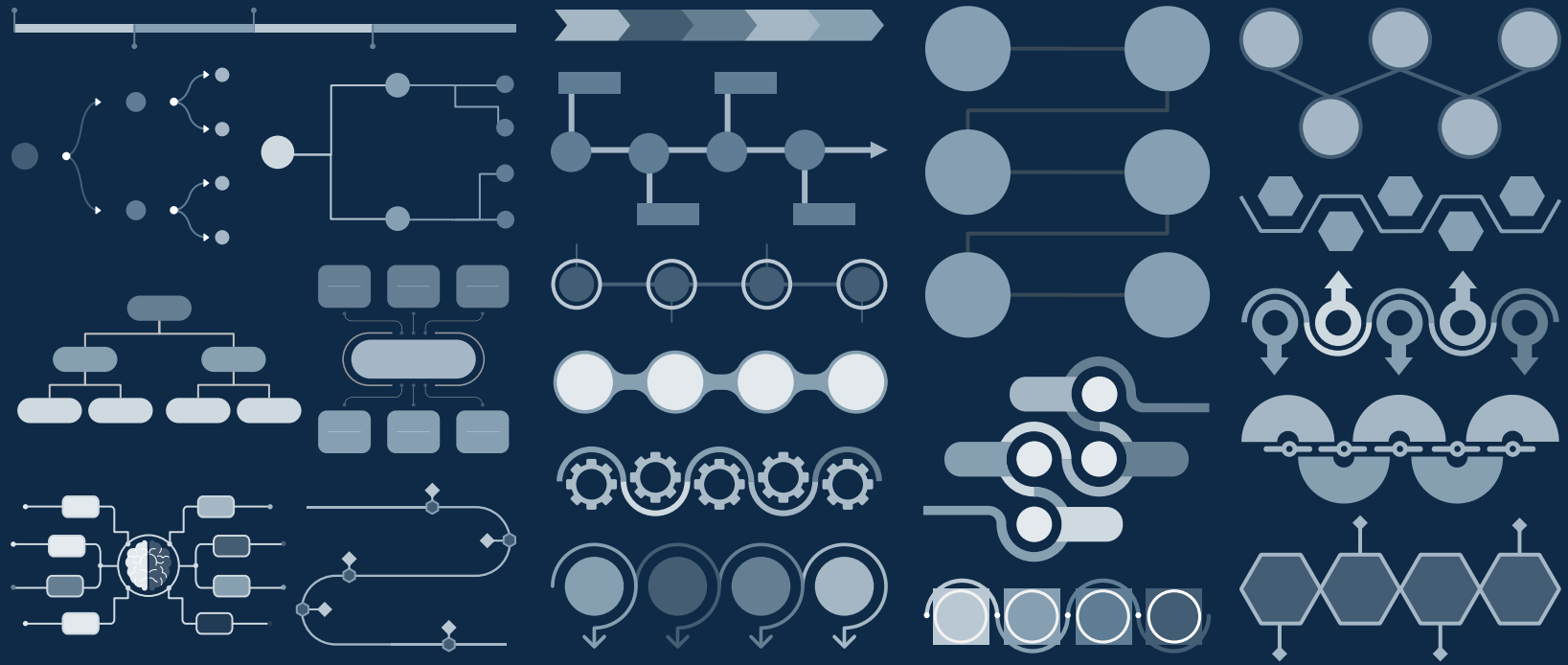

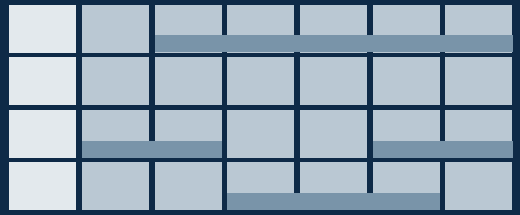

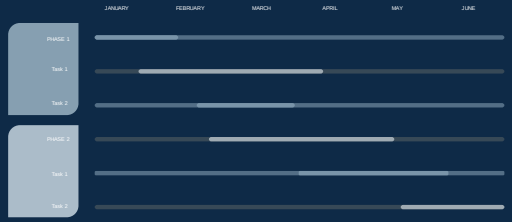
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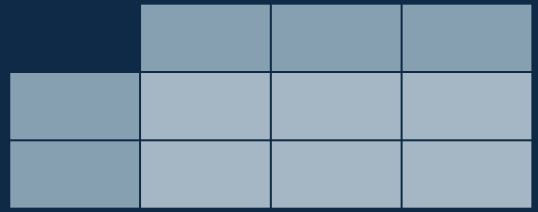

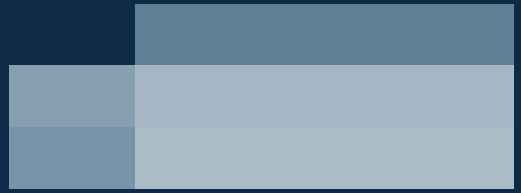

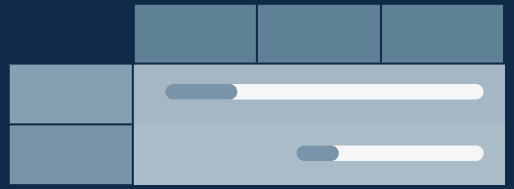

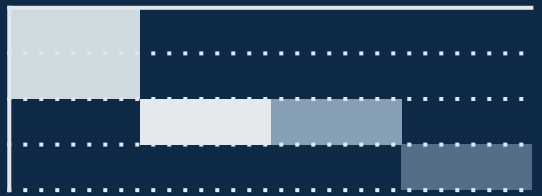

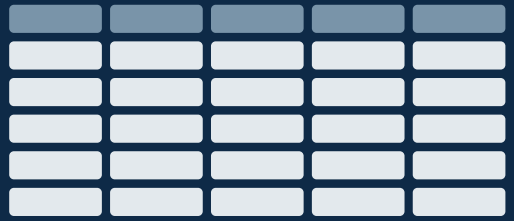

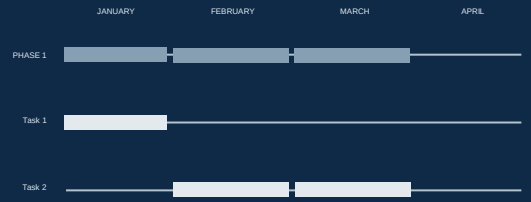
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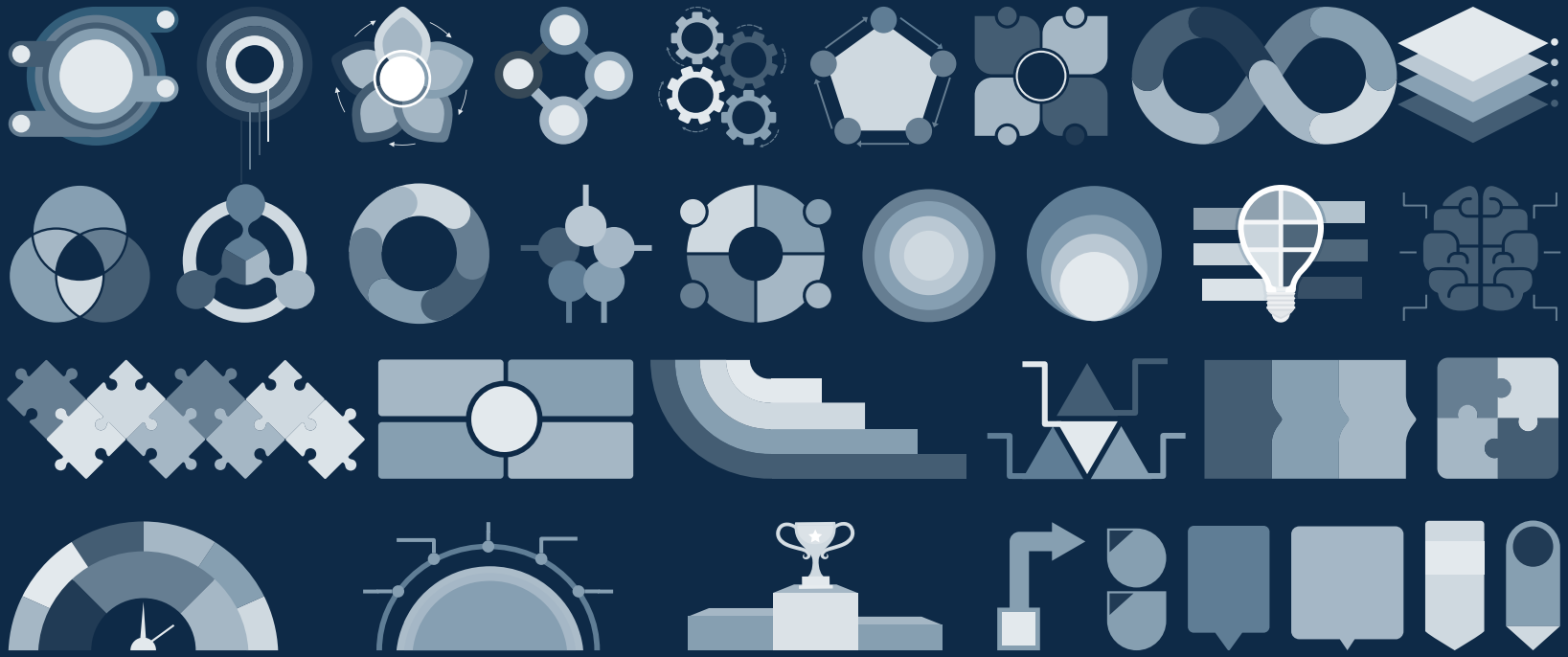

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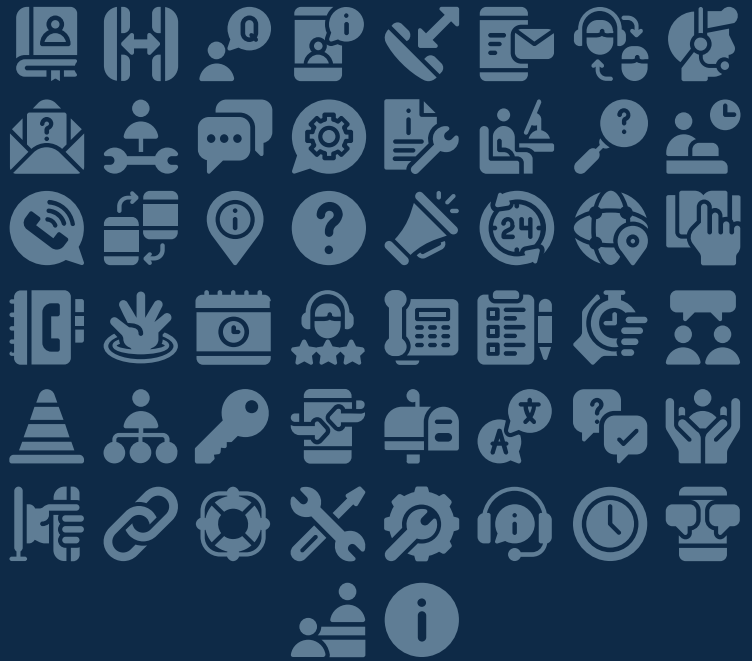

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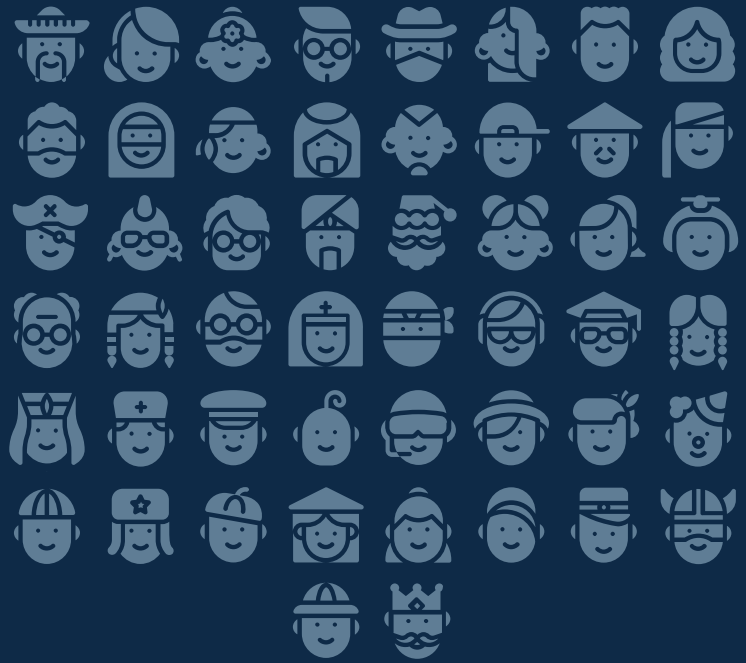

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