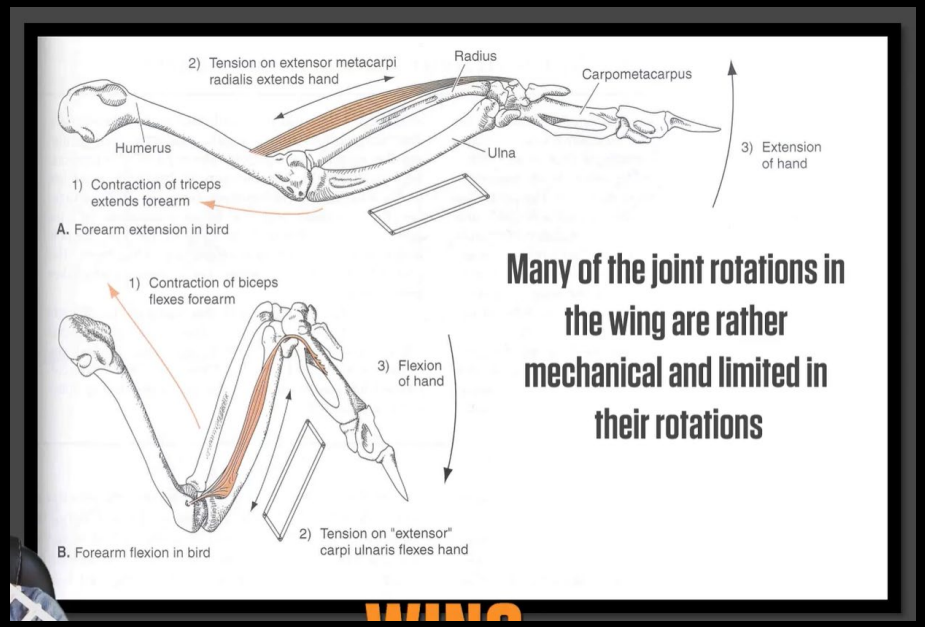
Bird&Wings

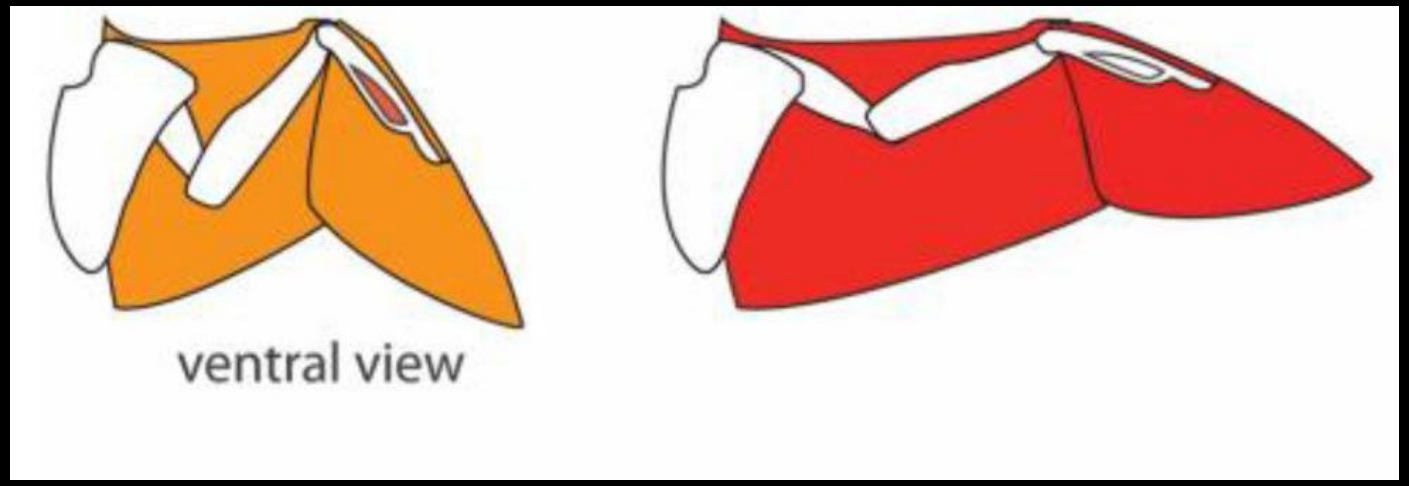
Creature Animation

Peihang&Chuhan&Skyler&Weize

- Dove
- Crane& Eagle
- Owl
- **Hummingbird**
- Bat

Dove - Wing Type





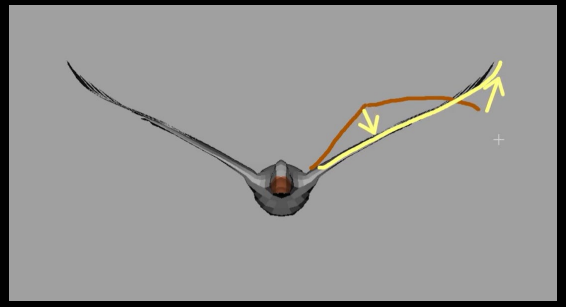
You can think of a bird's wing as three segments: the upper arm, the middle section, and the outer part.
When the wing opens or folds, the outer segment doesn't rotate freely but follows the front segment,
So in the end, these two parts appear to stay roughly parallel

Dove

1.

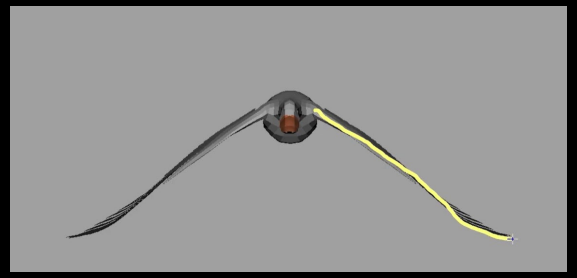
Wing at its highest point

2.



At the highest point, as the wing starts to push down, the mid-section moves downward while the tip lifts slightly upward

3.

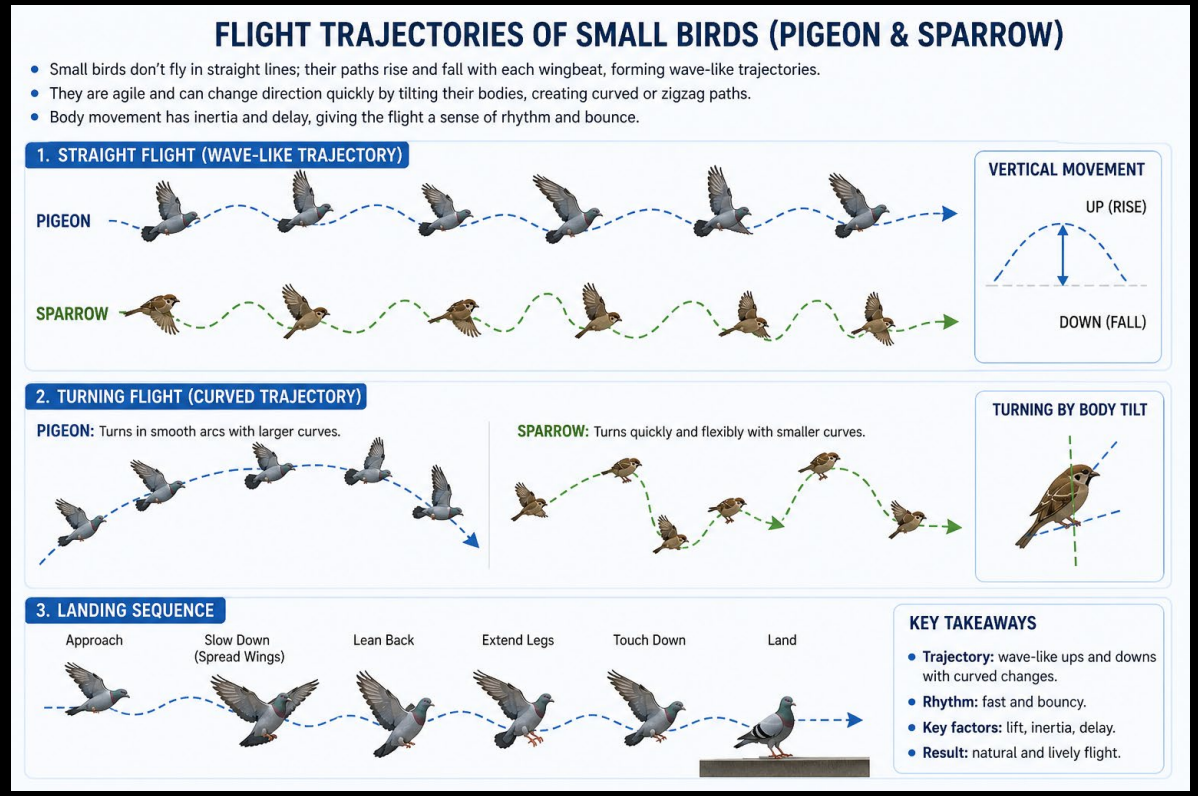


Wing at its lowest point

4.

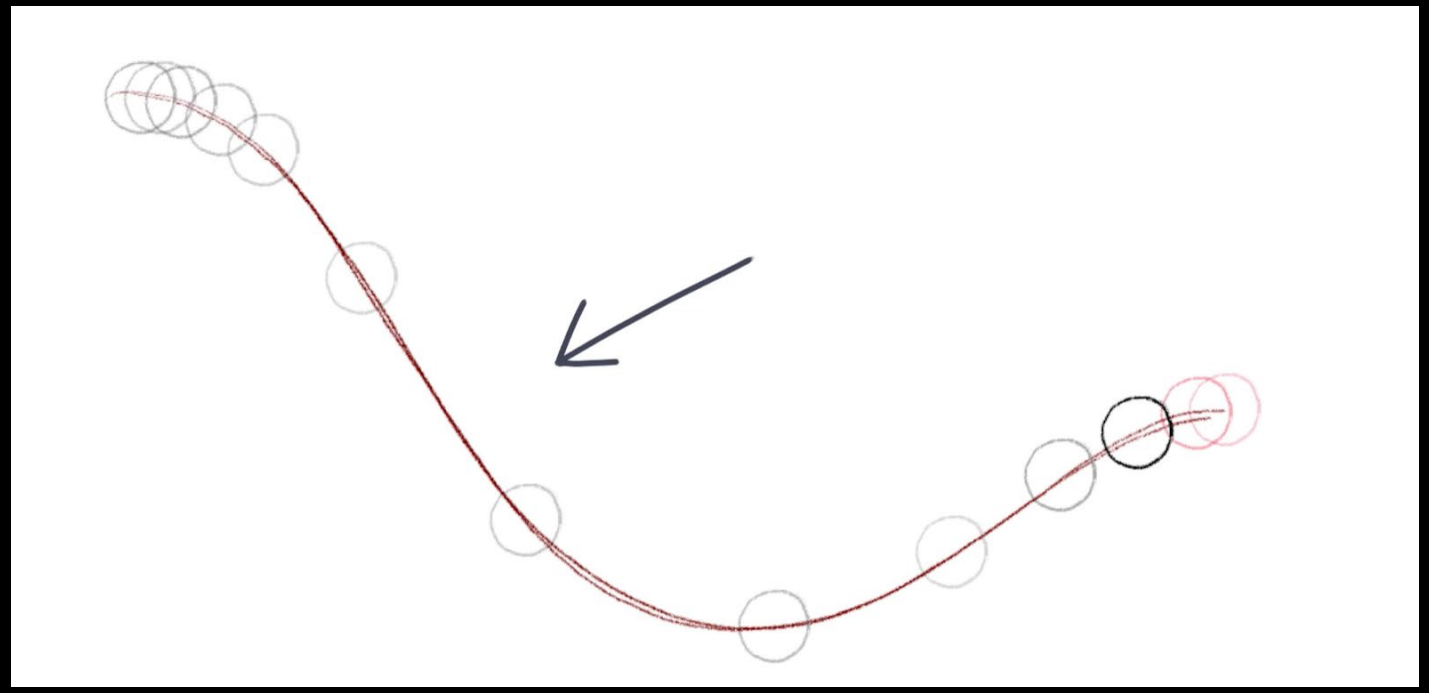
At the lowest point, as the wing begins to rise, the tip drops slightly while the mid-section lifts upward

Dove



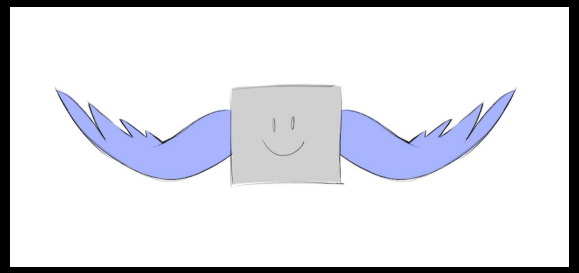
Small birds such as pigeons and sparrows rarely fly in perfectly straight lines. Their bodies rise and fall with each wingbeat, creating wave-like flight trajectories. They are also very agile when turning, often tilting their bodies to change direction, which creates many curved flight paths.
In animation, the most important thing for small birds is the body movement and rhythm. Adding vertical bounce, inertia, and slight delay can make the flight feel more natural and believable.

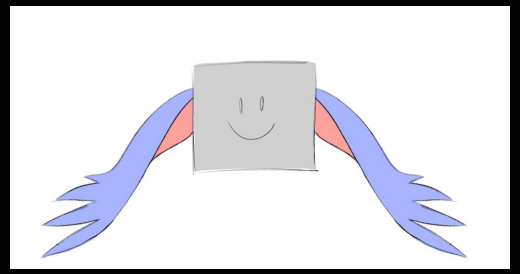
Dove - Flight Mode

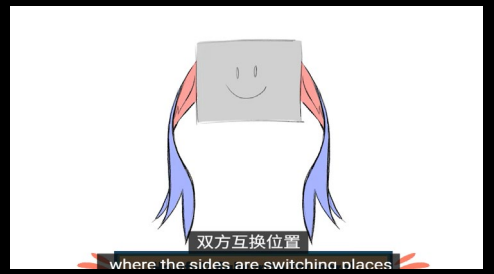


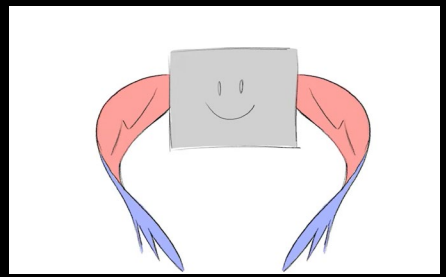
The bird’s flight path follows this trajectory: slow-in and fast-out on the downward motion, and fast-in and slow-out on the upward motion

Dove - Flight Mode





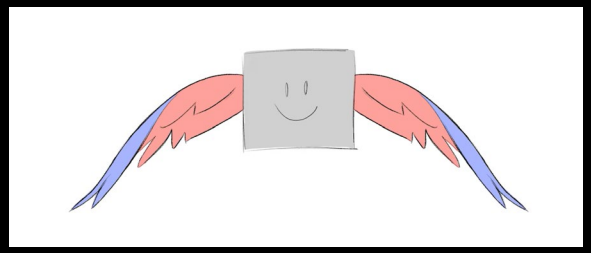
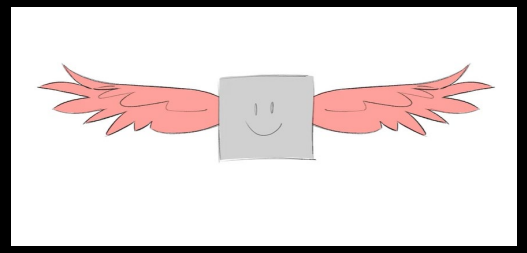
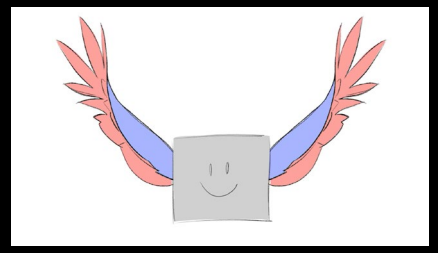
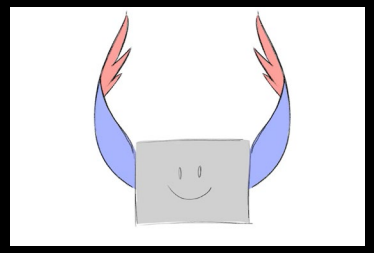




The wings not only flap up and down, but also rotate forward and backward; when divided into front and back surfaces, their motion is as follows.

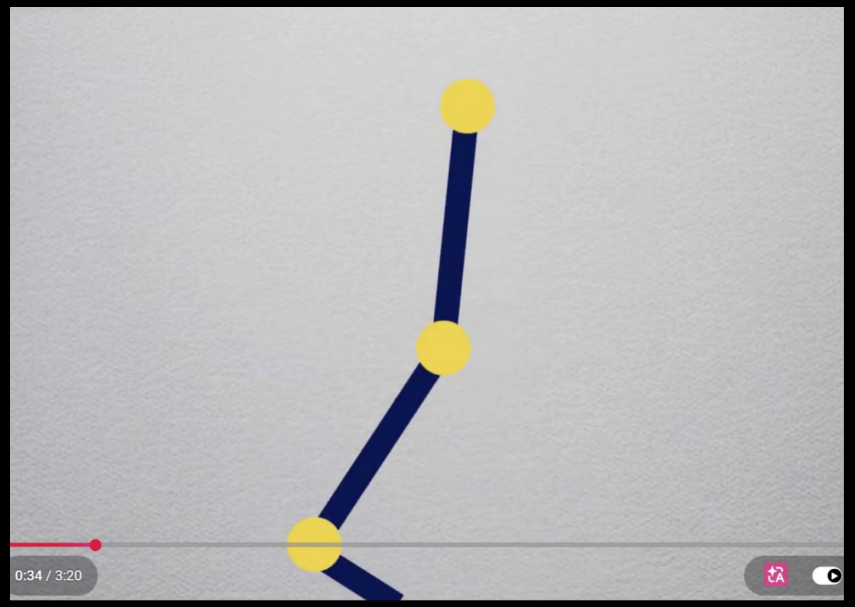
The wing’s front and back surfaces are constantly changing, showing its flexibility; when the wing begins to move downward, its upper surface turns forward as a whole.

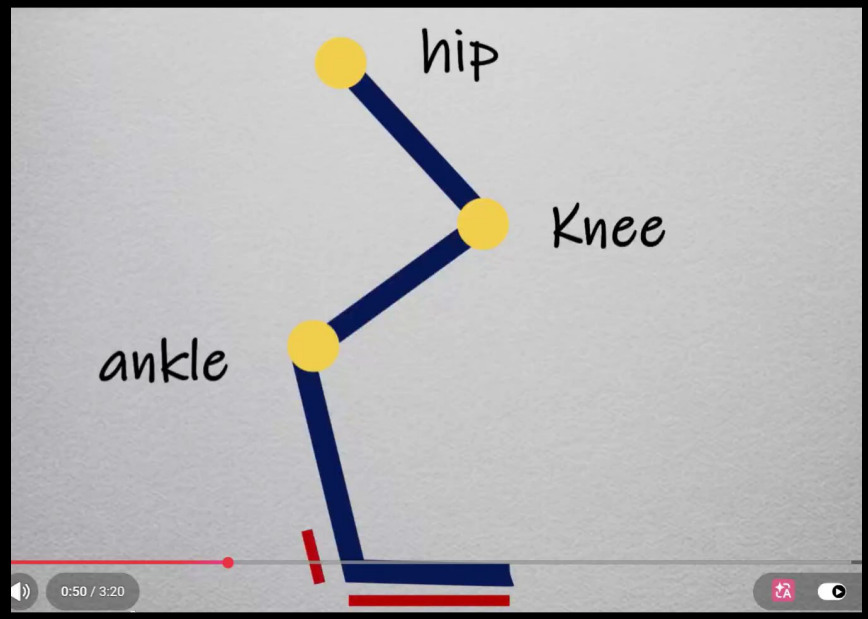
Dove - Flight Mode

When the wing moves upward, as it passes the midpoint, its underside turns more forward, making more of the underside visible.

Dove - Move Mode

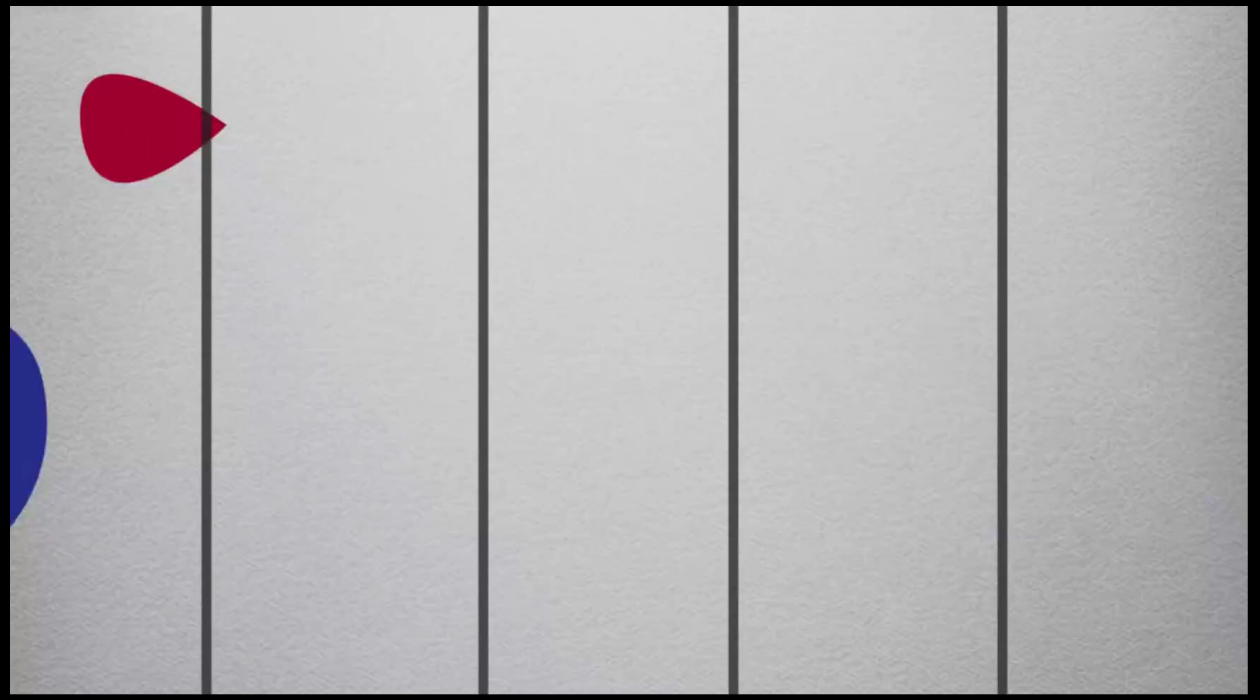




Bird legs are structured differently from human legs. A bird's real knee is actually hidden high inside the body, while the backward-bending joint we usually see is the ankle. Birds walk on their toes rather than flat feet, so their movement feels light and spring-like.

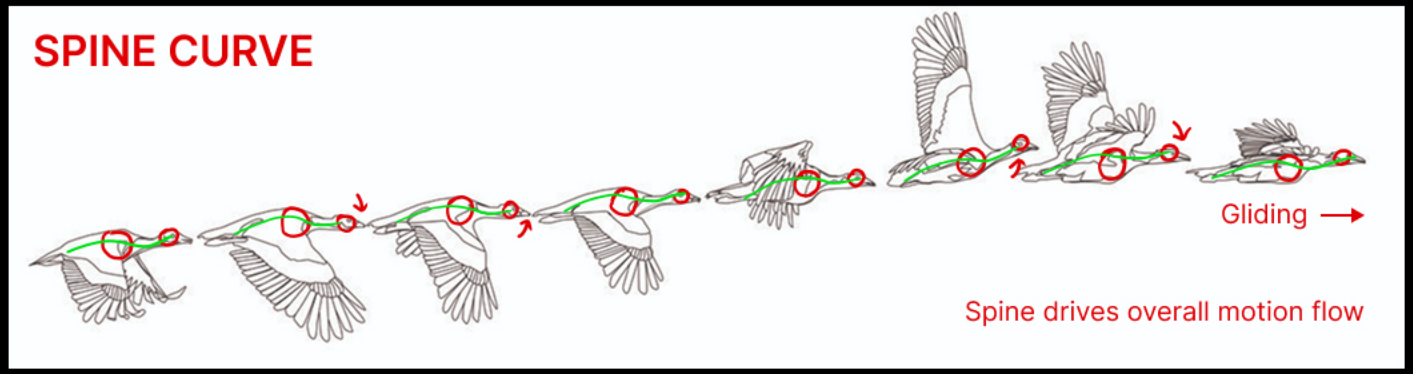
During walking, most of the motion comes from the ankle and toes, which quickly compress and extend to push the body forward, creating the fast and bouncy rhythm common in bird locomotion.

Dove - Move Mode

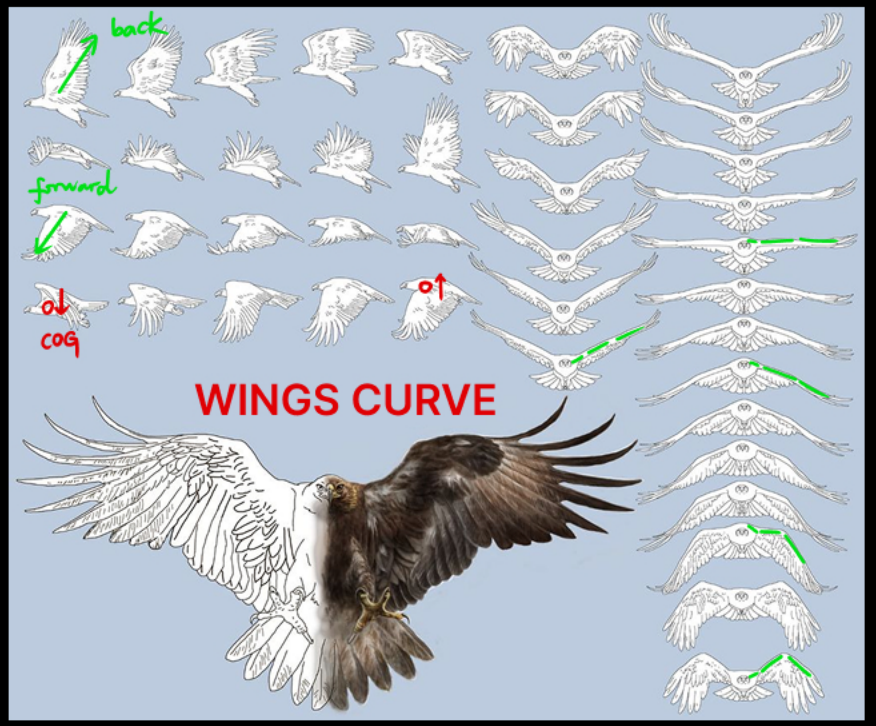


When birds walk, the movement of the head and body follows different rhythms. The head quickly moves forward to a new position and briefly stays stable there, almost like it is fixed at a point in space, while the body continues moving forward and gradually catches up to the head. Once the body catches up, the head quickly moves forward again, creating a repeating rhythm of “reach forward — hold — follow.” This is why birds appear to “bob” their heads while walking. In animation, the head and body should not move forward at the same speed. Instead, the head should have quick movements and short pauses to create a more natural bird-like motion.

Eagles & Crane

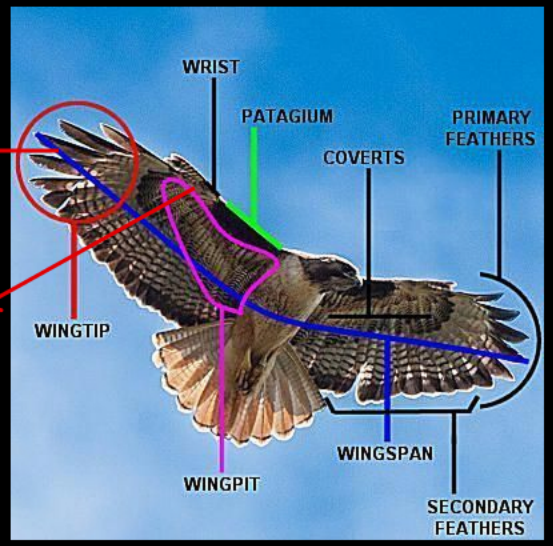


- Low frequency (much slower than a bird)
- Every stroke feels really 'heavy'
- There is a pause between each flap of the wings; they do not flap continuously.



- Power stroke
  forward + down
- Recovery
  back + up
- COG Path
  Power stroke ↑ Up
  Recovery ↓ Down

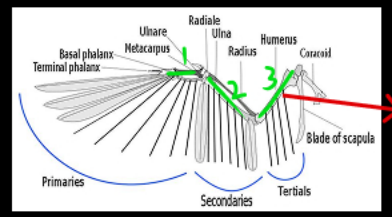
WINGS STRUCTURE



These feathers
Opens or closes first

Changes in the shape of a bird's wings begin at the wrist

- Position
  Flight: The chest area (slightly behind the base of the wings)
  Stand: Front of the upper thigh

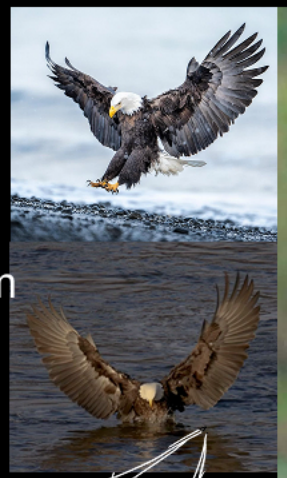


When the humerus3 moves towards the body, the elbow2 joint automatically bends significantly, with the wrist1 joint following suit

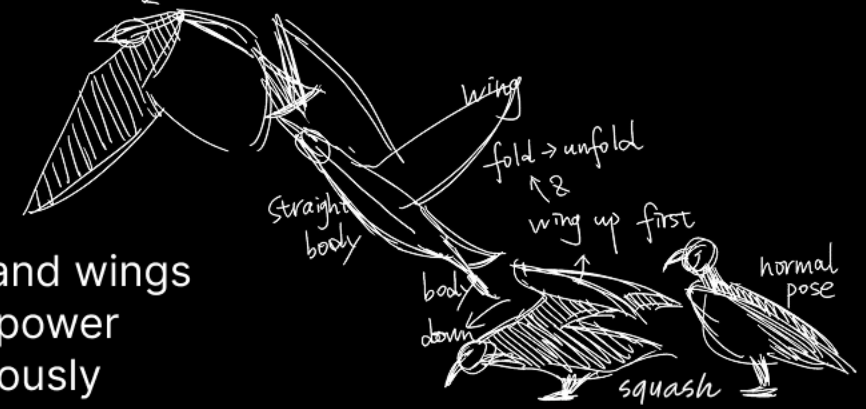
Flight Mode

Eagles

- **Landing**
  The body will have a noticeable forward momentum

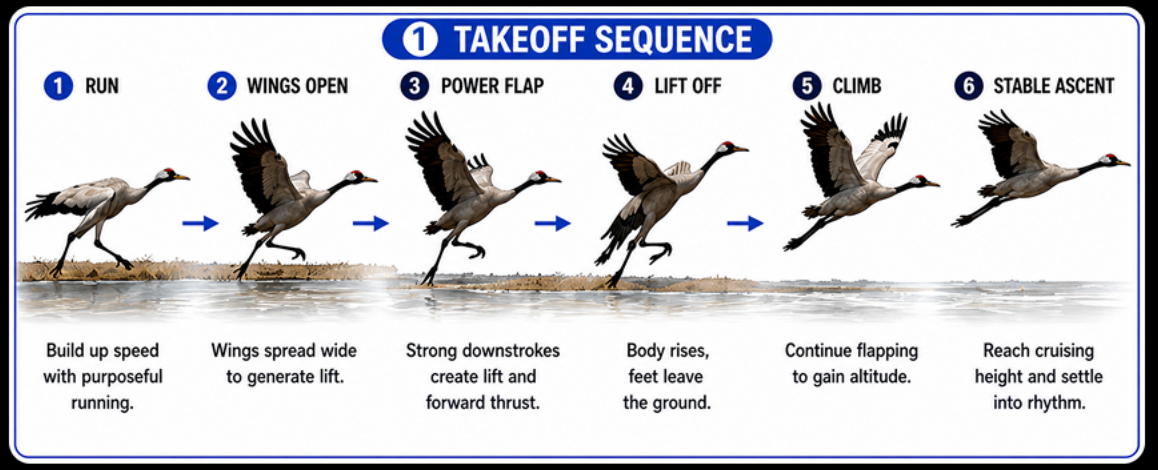


Fold wings → Accelerate → Unfold again

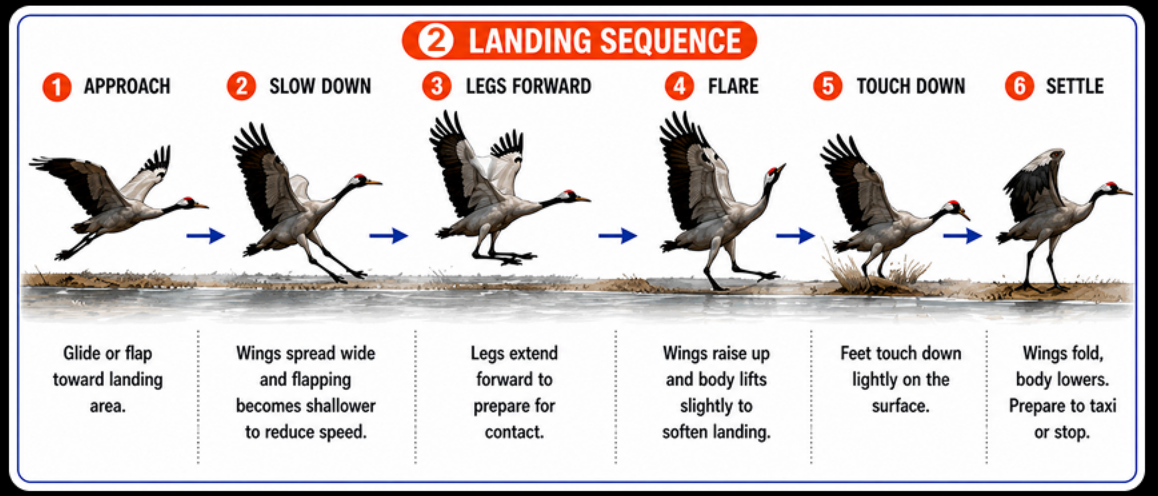


- **Take off**
  The legs and wings generate power simultaneously

Crane



Cranes need a run-up before taking off (especially large waders)



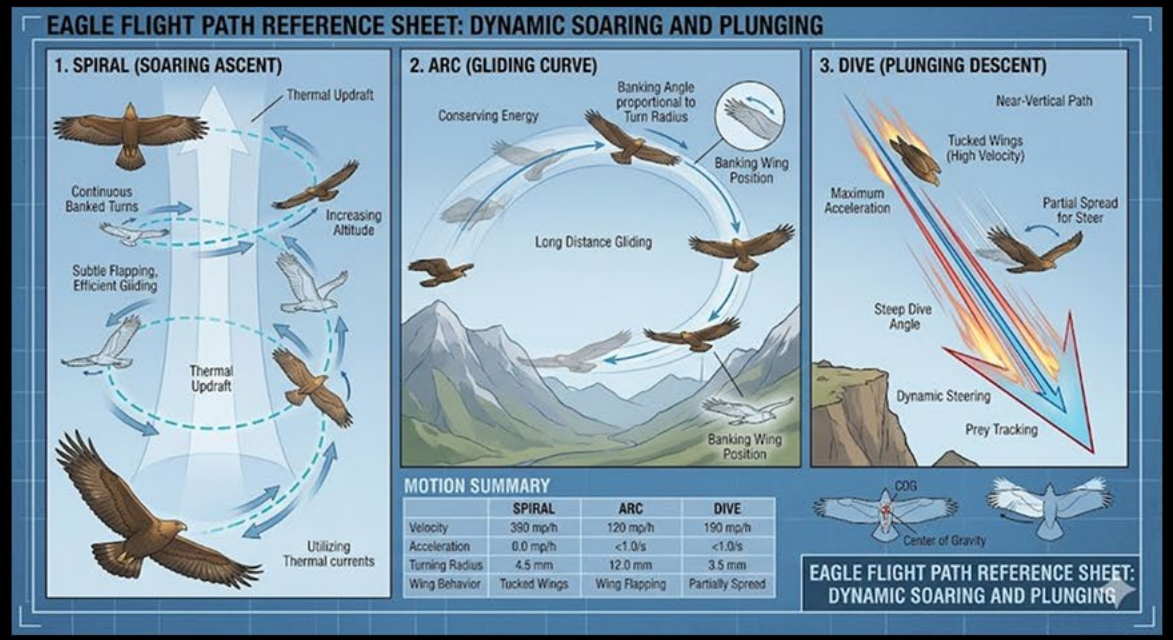
The body produces a noticeable secondary cushioning effect

Flight Path

Eagles

Maneuverability > Endurance

With significant variations in path curvature and vertical elevation, it is well-suited to hunting scenarios



- **Main Mode**

  Soaring; Thermal Soaring; Gliding; Intermittent Flapping

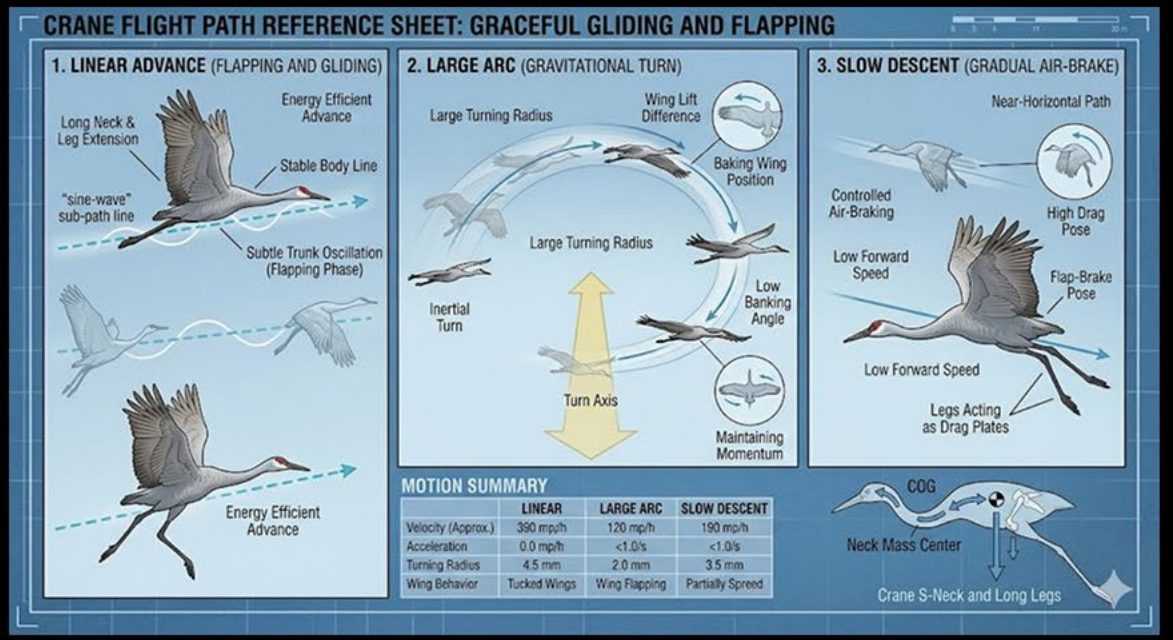
Ref Video:

https://www.bilibili.com/video/BV1sC4y1b7Mn/
https://www.bilibili.com/video/BV1ih4y1V7mZ/

Crane

Endurance > Maneuverability

Straight paths with a regular rhythm are suitable for migration/flock flight scenarios



- **Main Mode**

  Migration paths are either straight or have large arcs, are highly stable, and have a strong sense of rhythm (slow but powerful)

https://www.bilibili.com/video/BV1roUGYAEBG/
https://www.bilibili.com/video/BV1t5411Y7Jg/

Special Behavior

- **Head & Vision**

  The eyes remain almost still → the gaze is controlled by the head

  Regardless of how their bodies move (flapping their wings, jumping), their heads remain almost perfectly still in space. This is for visual focusing.

https://youtu.be/z-gjVgsN2S0?si=mGrTXyter713I46k
https://youtu.be/rLnd4V8Gfq4?si=k0hNk40IV_apE8bM

Eagles

- **Stoop dive attack**

- **Thermal Soaring**

- **Courtship / Aerial combat**

1. Near-stationary wings
2. Slight corrective flapping
3. Airflow-driven spline path

Crane

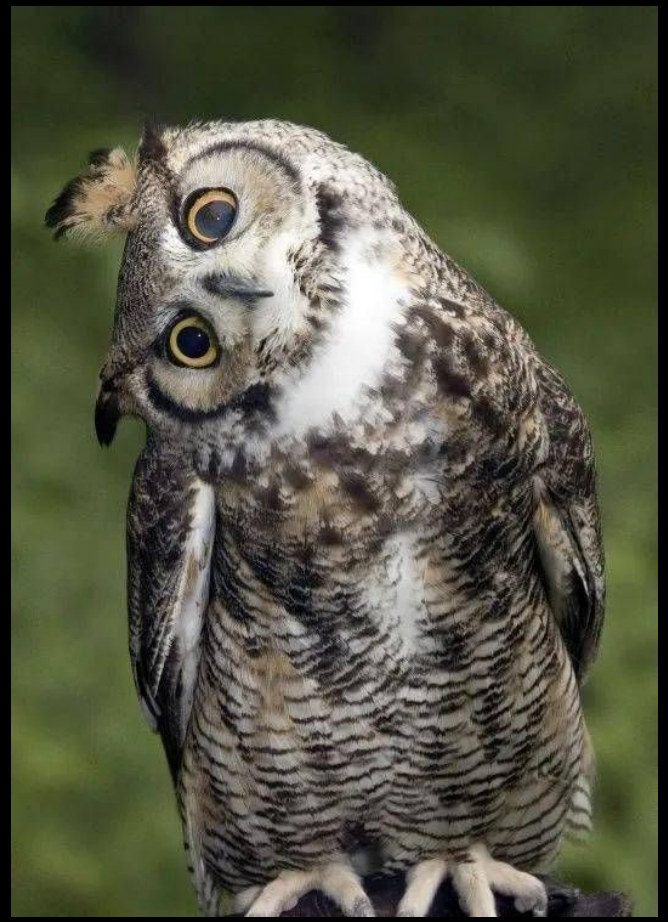
- **V-formation / Line formation**

1. Cycle is more uniform and symmetrical
2. Rig emphasizes a long neck & leg

- **Dance and Social Performance**

Owl - Behaviors

- Nocturnal predators
- Silent, low-speed flight
- Fixed forward-looking eyes
- Head guidance and tracking
- Designed specifically for covert hunting rather than long-distance migration

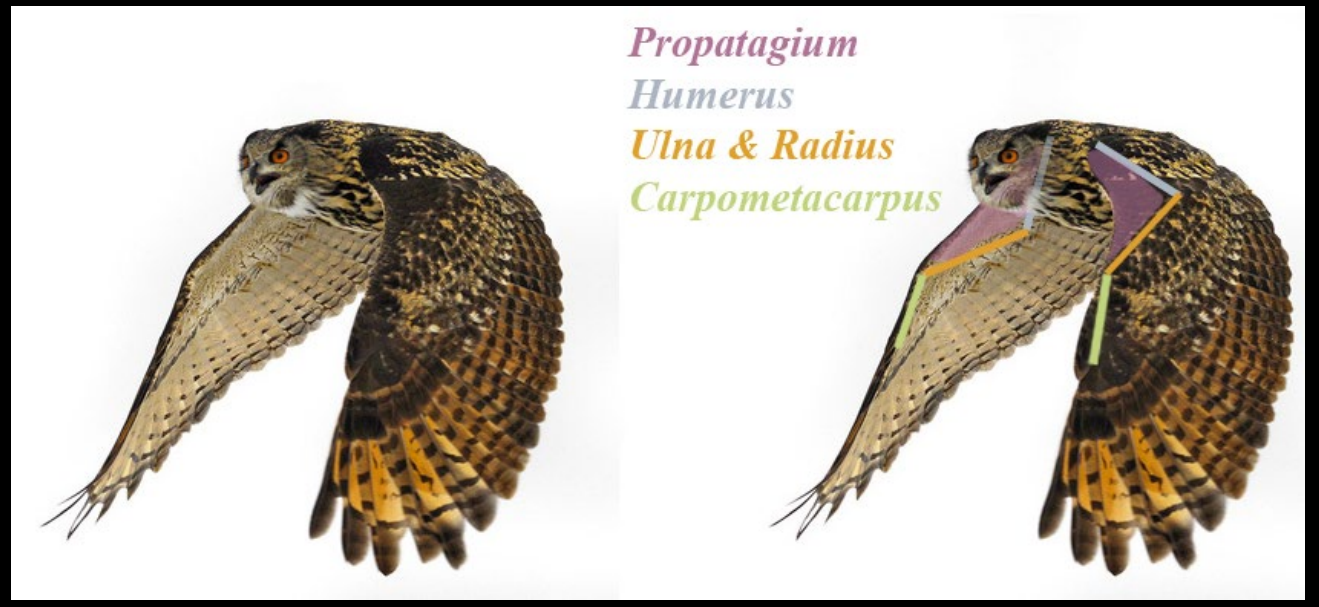


Owl - Behaviors

- The eyes remain fixed, while the head is responsible for tracking
- The head can rotate by approximately 270 degrees

Owl - Wings Type

- Broad and rounded wings
- With a larger wing area compared to body weight
- Flying slowly without stalling
- Supporting gliding and gentle wing flapping

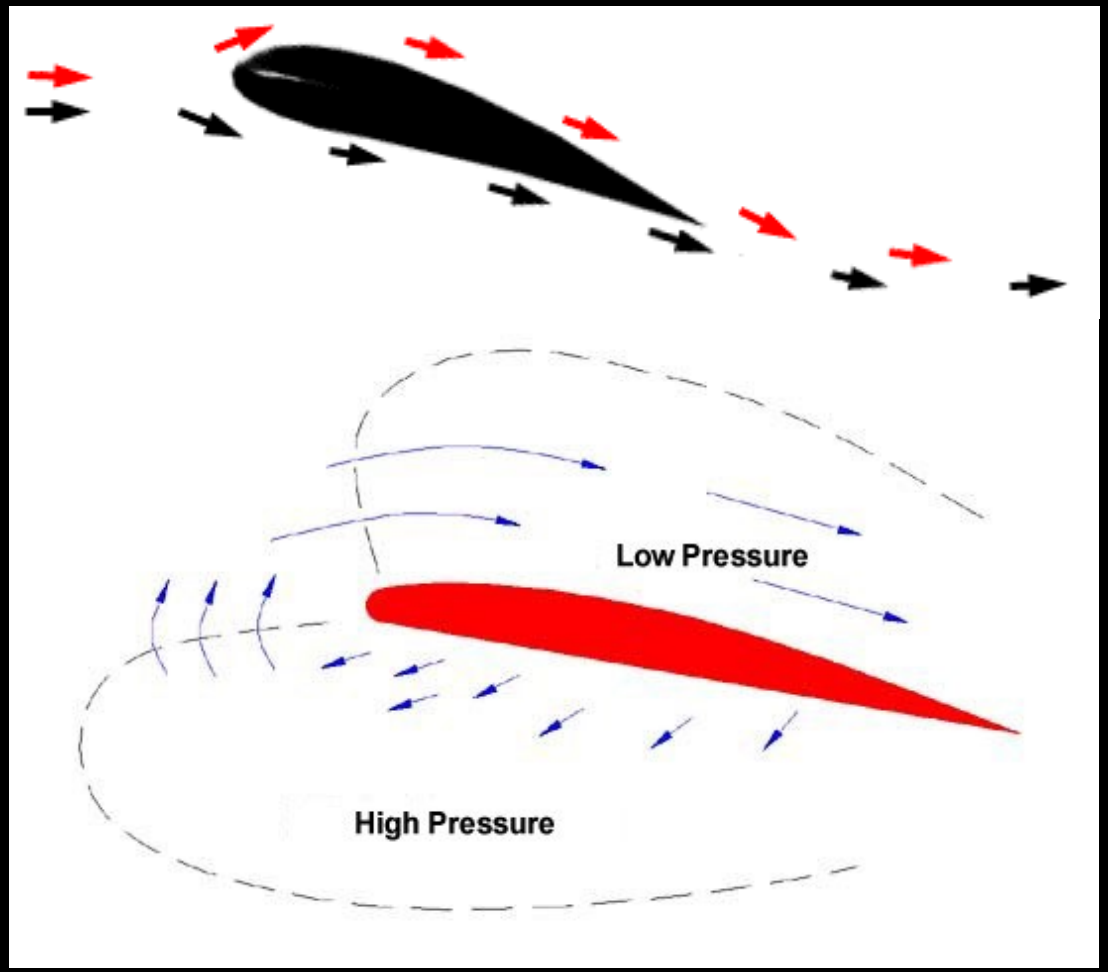


Owl - Principle of Power

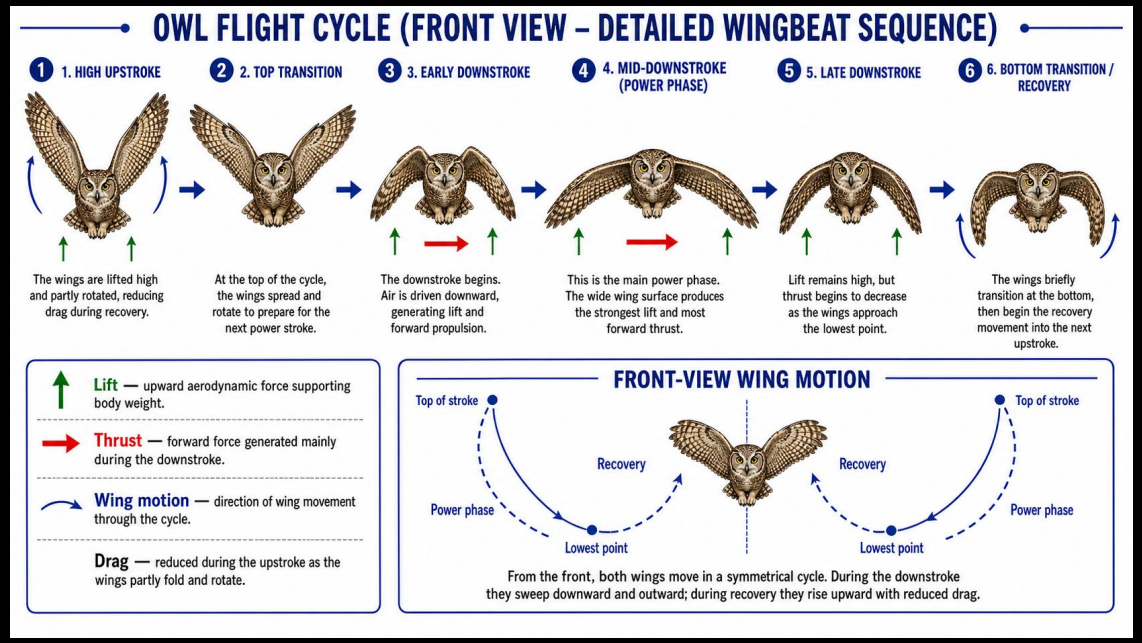
Airfoil

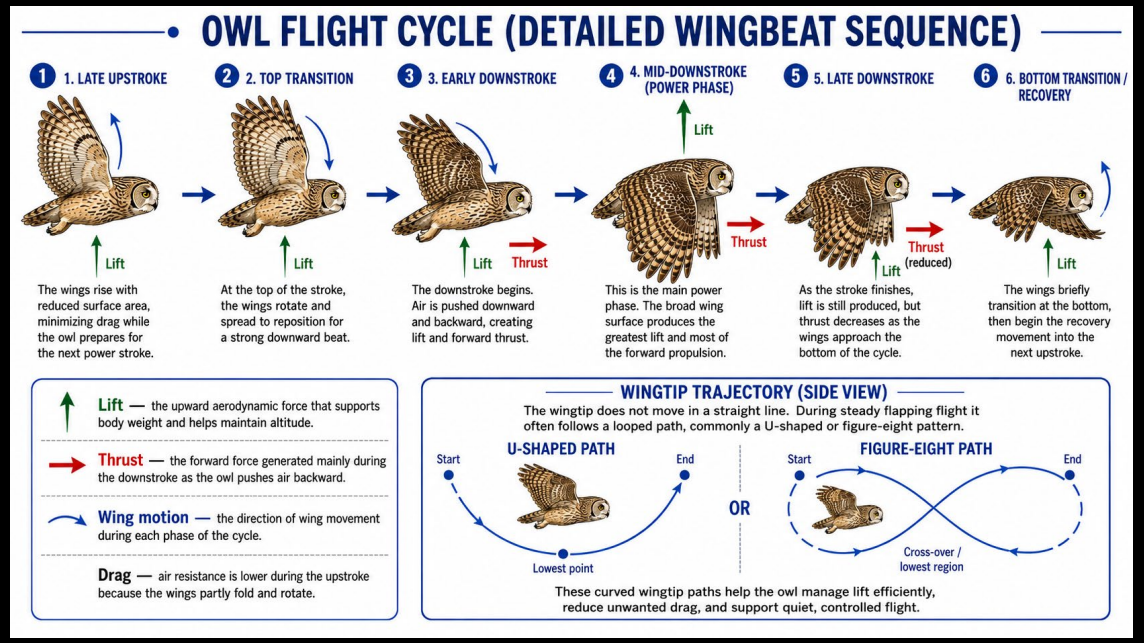
This pressure difference generates lift, enabling owls to take flight.

During the flapping process, the wings push the air backward, generating thrust.



Owl - Flight Mode





From the front view, the wings form a smooth “U”-shaped path.
From the side view, the wing tips can follow a circular or figure-eight motion.
The downstroke generates lift and thrust, while the upstroke allows the wings to recover for the next beat. This makes owl flight stable, efficient, and quiet.

Owl - Flight Mode

OWL TAKEOFF AND LANDING BREAKDOWN

TAKEOFF SEQUENCE

1 PREPARATION

The body crouches and the center of mass lowers. The wings open slightly and the legs bend, storing energy for takeoff.

2 PUSH-OFF

The legs push forcefully against the ground. The body rises quickly, gaining initial upward motion and forward momentum.

3 INITIAL DOWNSTROKE

The wings beat strongly downward, accelerating air downward and generating lift and forward thrust.

4 LIFTOFF AND CLIMB

The body is fully airborne. Lift exceeds weight, allowing the owl to continue climbing while moving forward.

5 CONTINUED ASCENT

Repeated strong wingbeats generate more lift. The legs tuck in and the body climbs steadily.

6 STABLE FLIGHT

The owl transitions into steady flight, where lift and thrust become balanced.

LANDING SEQUENCE

1 APPROACH

The owl maintains a steady flight posture, keeps its eyes on the target, and adjusts direction, height, and approach speed.

2 WINGS SPREAD FOR DECELERATION

The owl spreads its wings and tail to increase drag and reduce forward speed in preparation for landing.

3 BRAKING WITH BODY ANGLE

The body tilts slightly upward, changing the airflow and helping the owl slow down further.

4 LEGS EXTEND

The legs stretch forward and the talons open, preparing to grasp the landing surface while maintaining balance.

5 CONTACT WITH PERCH

The feet touch the perch. The owl grips the landing point and keeps the wings partly open to control balance.

6 WINGS FOLD AND STABILIZE

The wings fold in, the center of mass stabilizes, and the landing is completed.

LEGEND

Lift: Upward aerodynamic force generated by the wings, helping support body weight.

Thrust / deceleration control: Provides forward propulsion during takeoff, or increases drag to slow down during landing.

Wing motion: Shows *the direction of wing movement and the main motion path.*

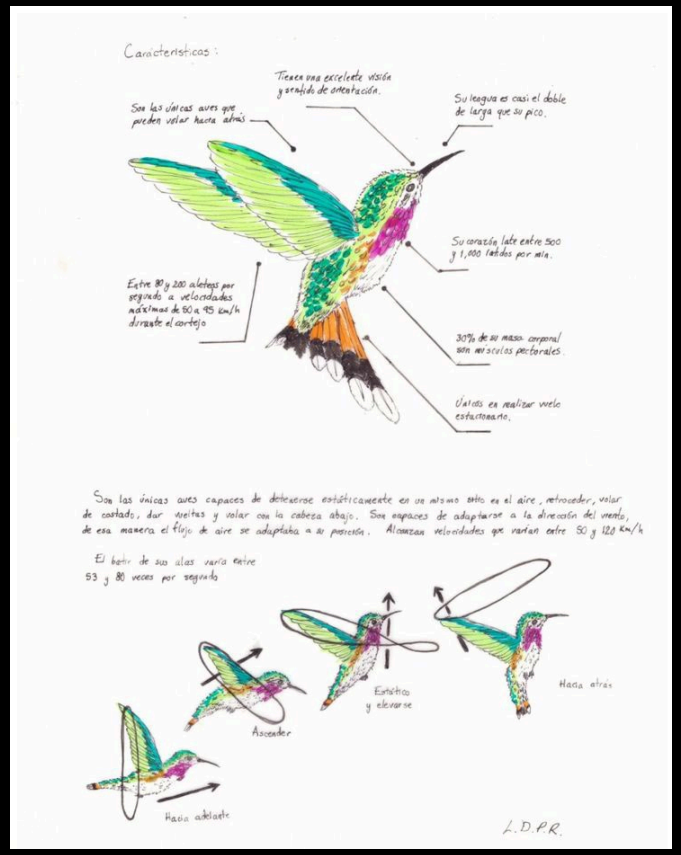
KEY POINTS OF TAKEOFF AND LANDING

- Takeoff relies on a forceful leg push and powerful downstrokes to create initial lift.
- Landing relies on spreading the wings, raising the body angle, fanning the tail, and extending the legs to slow down and stabilize.
- Takeoff focuses on gaining height and forward momentum; landing focuses on speed control and precise contact.

Hummingbird - introduction

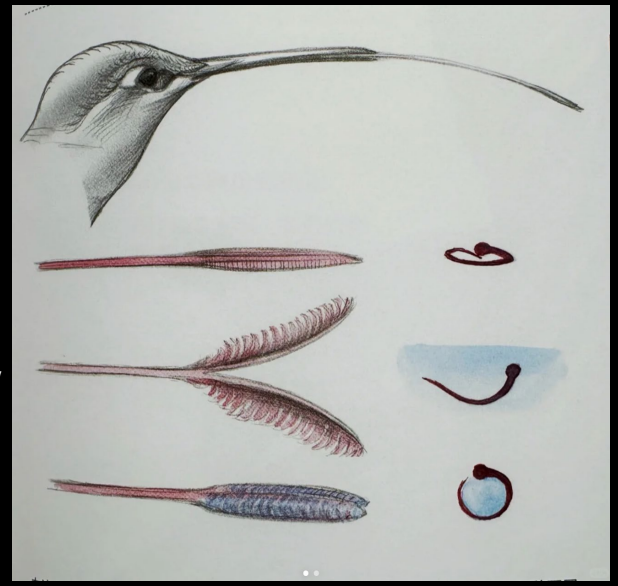
Smithsonian CHANNEL

Hummingbird - Hovering



Tips: 蜂鸟神奇的刷状舌头

- 蜂鸟会将细长的舌头伸入花朵吸食花蜜，蜂鸟的舌头尖端分叉，每个叉上都有一个像软刷一样的边缘，这个边缘可以灵活地卷成一根装盛液体的管子。，蜂鸟所做的就是将舌头伸入花中，盛满花蜜后缩回来享用，整个过程就像用画笔沾水一样。



蜂鸟解剖结构爆炸图

自然界的飞行奇迹

头部
大而灵活，可近180°旋转，长喙适应吸食花蜜。

肌肉组织
胸肌发达，占体重的约30%，为高速拍翅提供强大动力。

血管与神经
血管密集，心脏占体重约2%，神经系统精细控制飞行与平衡。

内脏器官
代谢旺盛，消化快，以支持高能量需求。

骨骼结构
骨骼轻盈中空，提供支撑的同时减轻重量。

物种信息

中文名：蜂鸟
拉丁名：Trochilidae
体长：7–13 cm
体重：2–20 g
翼展：约10–16 cm
分布：美洲热带及亚热带地区
特征：唯一能够悬停飞行的鸟类，新陈代谢极快，心率可达每分钟1200次以上。

头部细节

舌头结构
舌长约等于喙长，末端分叉用于吸蜜。

整体骨骼（侧视）

心脏细节

心跳极快，静息心率可达250–500次/分钟，飞行时可达1000–1200次/分钟。

羽毛结构

羽毛轻盈且色彩由光的折射产生而非色素。

足部结构

锐利爪，用于栖息

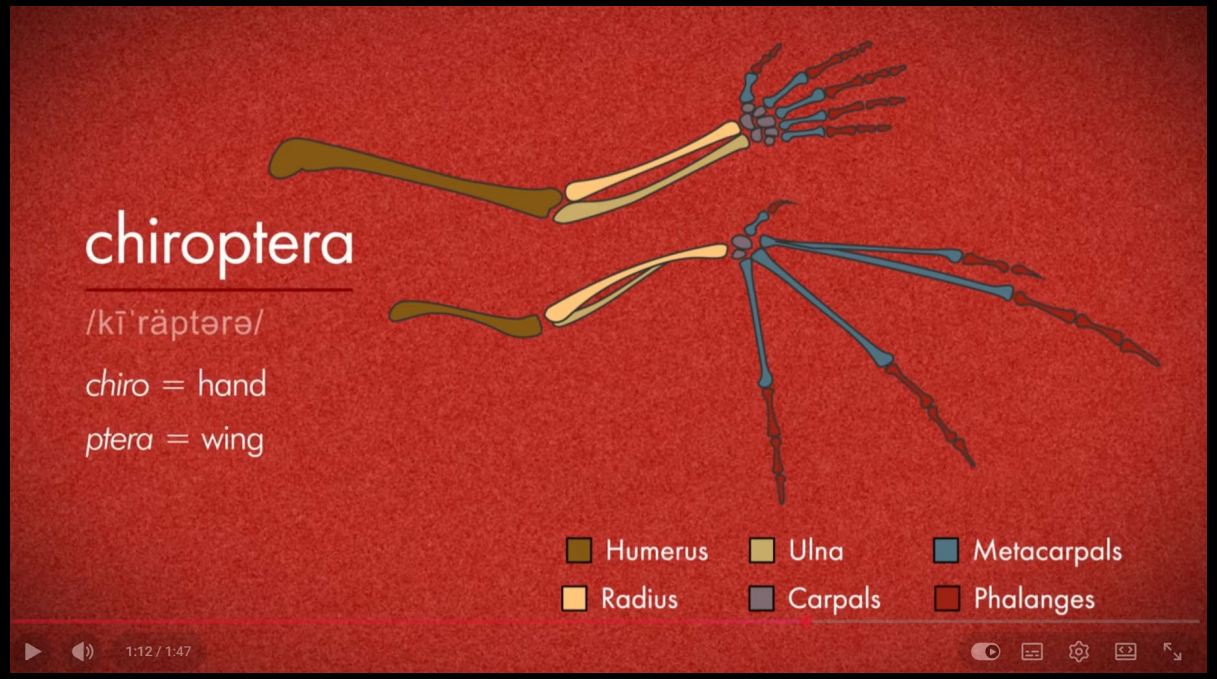
翅膀结构

每秒拍翅可达50–80次甚至更高，形成八字形轨迹。

尺寸对比

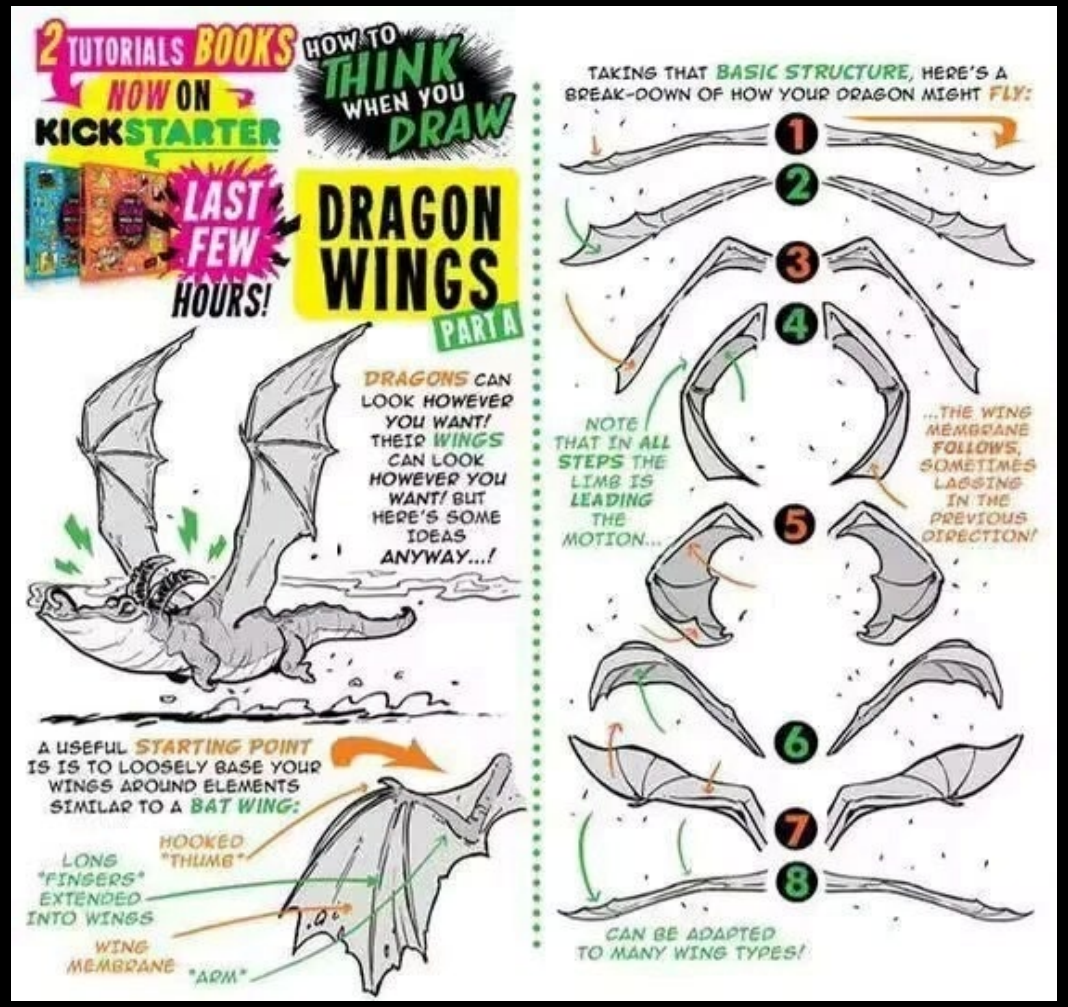
“自然从不为自己辩解，却处处展现其精妙的设计。”
——莱昂纳多·达·芬奇

Bat - Wing Type



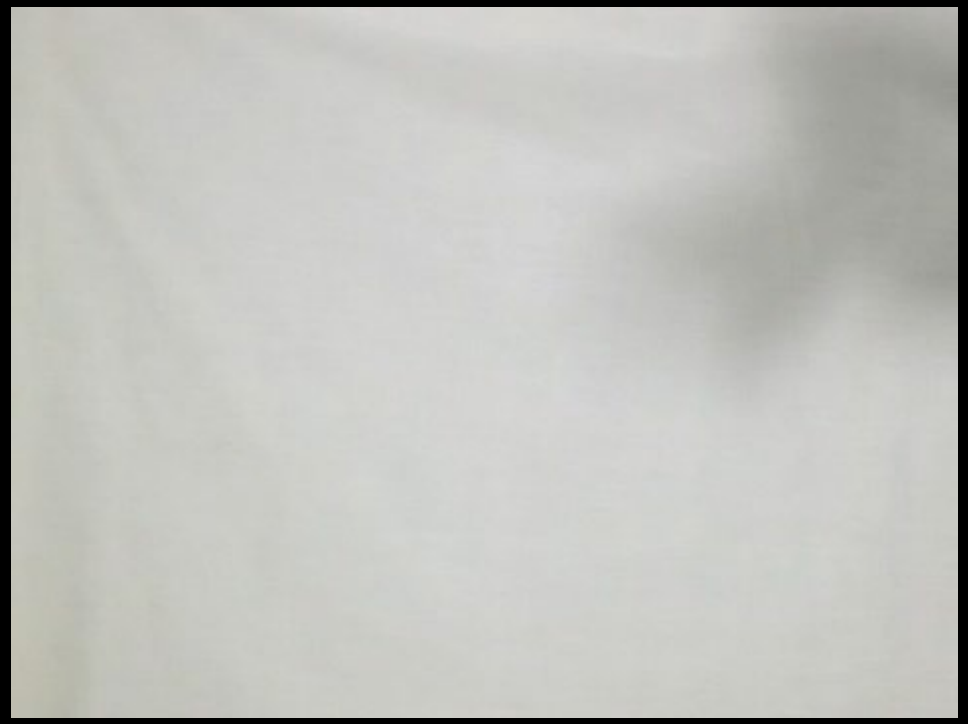
Bat wings are formed by elongated fingers connected by a flexible membrane, enabling highly agile and controlled flight

Bat - Flight Mode



Bat - Flight Mode + Hanging

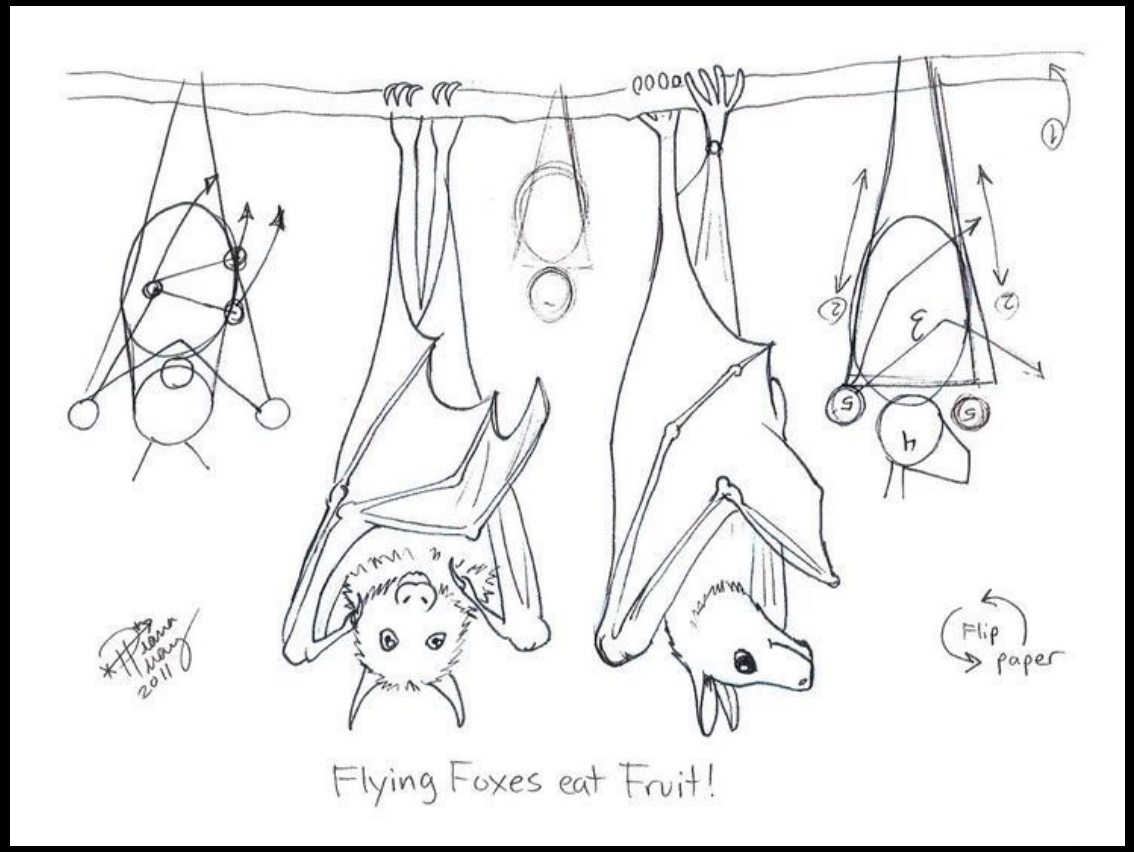
Mode 1



Mode 2

Mode 3

Bat - how they hanging



Thank You