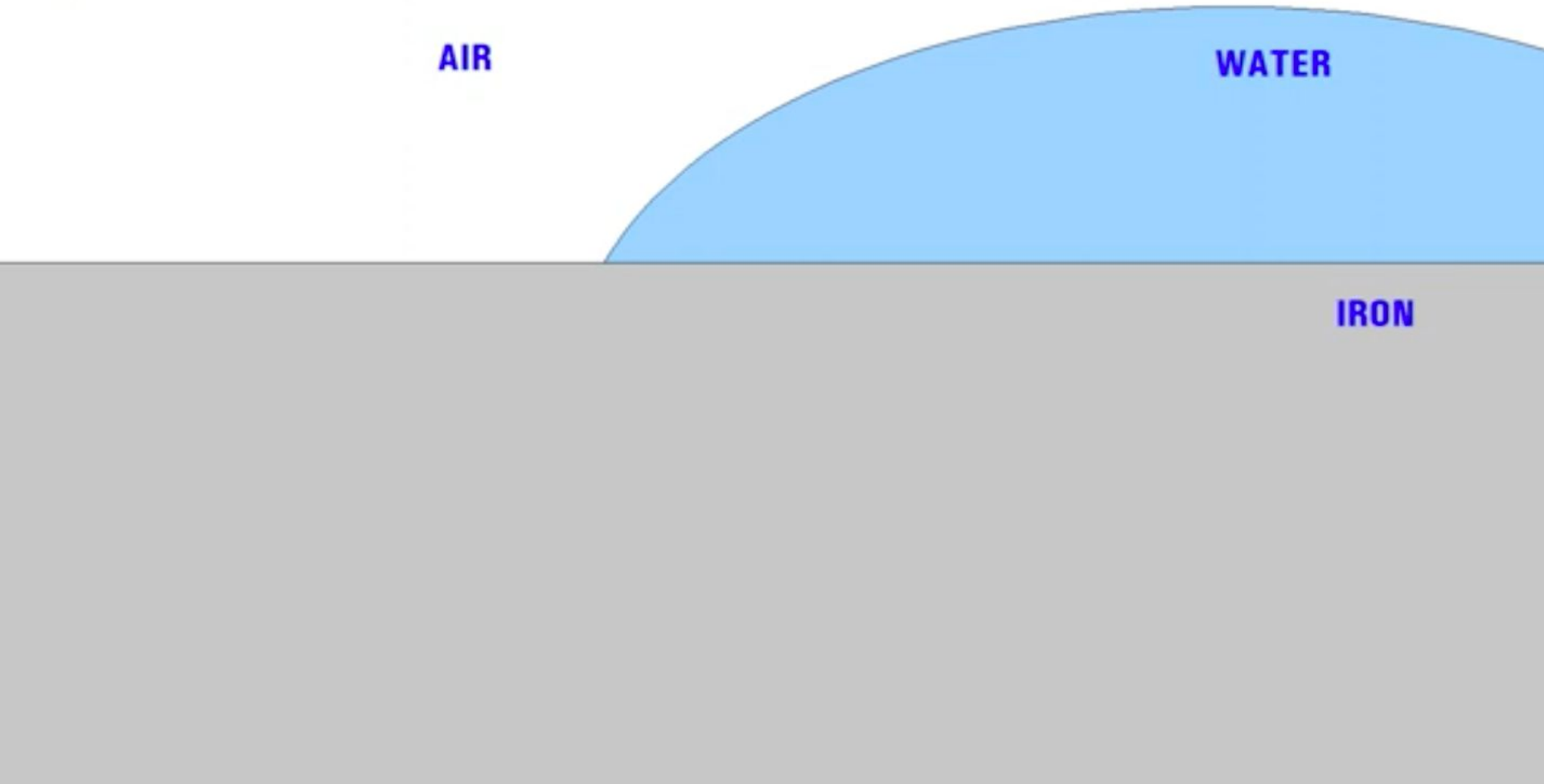
Lesson 9
Corrosion of Iron

Learning Goals

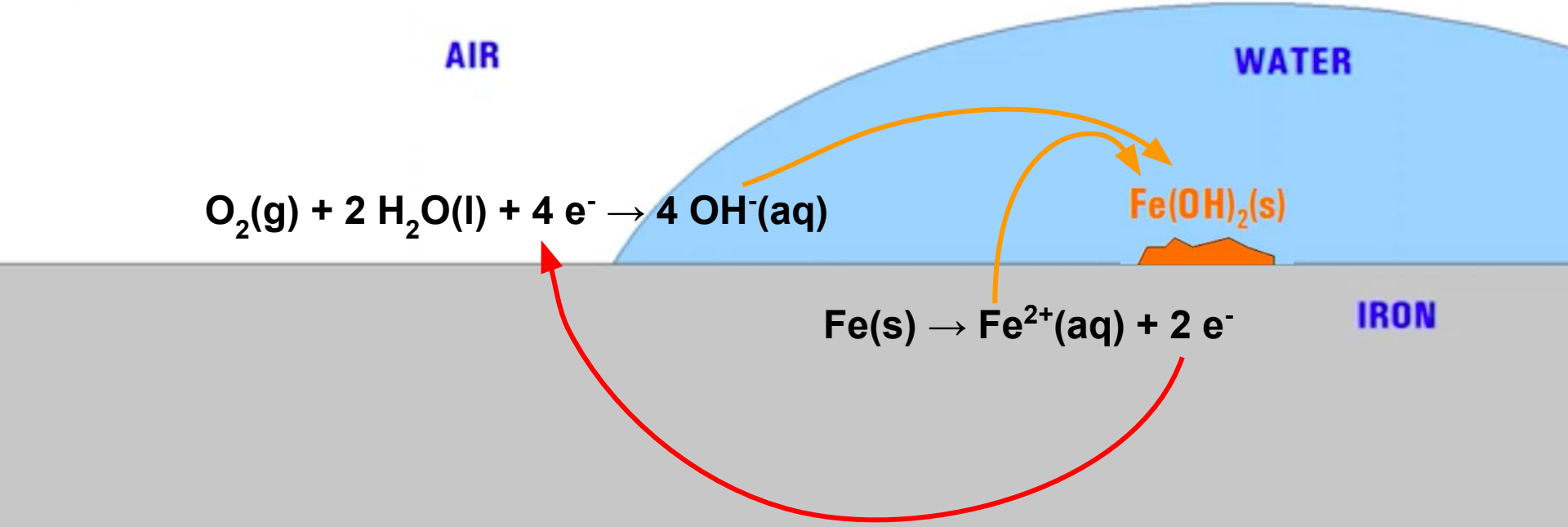
- ❑ I will be able to explain the corrosion of iron in terms of an electrochemical process, and describe some corrosion-inhibiting techniques.

Corrosion of Iron



	$I_2(s) + 2\,e^- \rightleftharpoons 2\,I^-(aq)$			+0.54
	$Cu^+(aq) + e^- \rightleftharpoons Cu\,(s)$			+0.52
SOA →	$O_2(g) + 2\,H_2O(l) + 4\,e^- \rightleftharpoons 4\,OH^-(aq)$			+0.40
	$Cu^{2+}(aq) + 2\,e^- \rightleftharpoons Cu\,(s)$			+0.34
	$SO_4^{2-}(aq) + 4\,H^+(aq) + 2\,e^- \rightleftharpoons H_2SO_3(aq) + H_2O(l)$			+0.17
	$Sn^{4+}(aq) + 2\,e^- \rightleftharpoons Sn^{2+}(aq)$			+0.15
	$Cu^{2+}(aq) + e^- \rightleftharpoons Cu^+(aq)$			+0.15
	$2\,H^+(aq) + 2\,e^- \rightleftharpoons H_2(g)$			0.00
	$Pb^{2+}(aq) + 2\,e^- \rightleftharpoons Pb\,(s)$			–0.13
	$Sn^{2+}(aq) + 2\,e^- \rightleftharpoons Sn\,(s)$			–0.14
	$Ni^{2+}(aq) + 2\,e^- \rightleftharpoons Ni\,(s)$			–0.26
	$Co^{2+}(aq) + 2\,e^- \rightleftharpoons Co\,(s)$			–0.28
	$PbSO_4(s) + 2\,e^- \rightleftharpoons Pb(s) + SO_4^{2-}(aq)$			–0.36
	$Cd^{2+}(aq) + 2\,e^- \rightleftharpoons Cd\,(s)$			–0.40
	$Cr^{3+}(aq) + e^- \rightleftharpoons Cr^{2+}(aq)$			–0.41
	$Fe^{2+}(aq) + 2\,e^- \rightleftharpoons Fe\,(s)$	← SRA		–0.44
	$Zn^{2+}(aq) + 2\,e^- \rightleftharpoons Zn\,(s)$			–0.76
	$2\,H_2O(l) + 2\,e^- \rightleftharpoons H_2(g) + 2\,OH^-(aq)$			–0.83
	$Cr^{2+}(aq) + 2\,e^- \rightleftharpoons Cr\,(s)$			–0.91

Corrosion of Iron



NET REACTION: $2\ Fe(s) + O_2(g) + 2\ H_2O(l) \rightarrow 2Fe(OH)_2(s)$

Preventing the Corrosion of Iron

1. Protective Coating (paint, oil, etc)

- isolates the iron from the oxidizing agent (oxygen and water)

Preventing the Corrosion of Iron

2. Cathodic Protection

- provides a replacement source of electrons for the iron

A. **Sacrificial Anode**

- attach a more reactive metal to the iron

$PbSO_4(s)$	+ 2 e^-	⇌	$Pb(s) + SO_4^{2-}(aq)$	–0.36
$Cd^{2+}(aq)$	+ 2 e^-	⇌	Cd (s)	–0.40
$Cr^{3+}(aq)$	+ e^-	⇌	$Cr^{2+}(aq)$	–0.41
$Fe^{2+}(aq)$	+ 2 e^-	⇌	Fe (s)	–0.44
$Zn^{2+}(aq)$	+ 2 e^-	⇌	Zn (s)	–0.76
2 $H_2O(l)$	+ 2 e^-	⇌	$H_2(g) + 2\ OH^-(aq)$	–0.83
$Cr^{2+}(aq)$	+ 2 e^-	⇌	Cr (s)	–0.91
$SO_4^{2-}(aq) + H_2O(l)$	+ 2 e^-	⇌	$SO_3^{2-}(aq) + 2\ OH^-(aq)$	–0.93
$Al^{3+}(aq)$	+ 3 e^-	⇌	Al (s)	–1.66
$Mg^{2+}(aq)$	+ 2 e^-	⇌	Mg (s)	–2.37
$Na^+(aq)$	+ e^-	⇌	Na (s)	–2.71
$Ca^{2+}(aq)$	+ 2 e^-	⇌	Ca (s)	–2.87
$Ba^{2+}(aq)$	+ 2 e^-	⇌	Ba (s)	–2.91
$K^+(aq)$	+ e^-	⇌	K (s)	–2.93
$Li^+(aq)$	+ e^-	⇌	Li (s)	–3.04

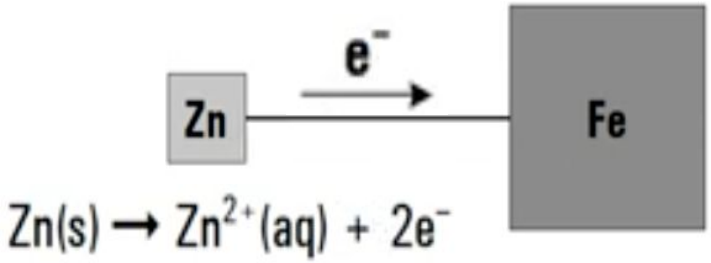
Preventing the Corrosion of Iron

2. Cathodic Protection

- provides a replacement source of electrons for the iron

A. **Sacrificial Anode**

- attach a more reactive metal to the iron



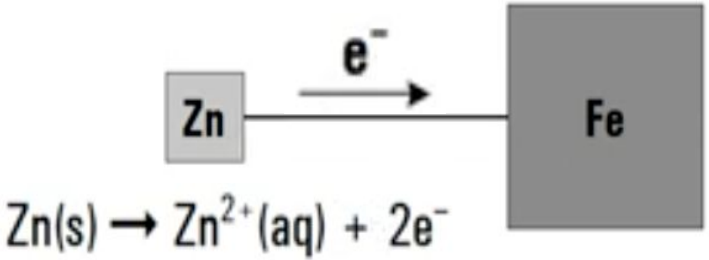
Preventing the Corrosion of Iron

2. Cathodic Protection

- provides a replacement source of electrons for the iron

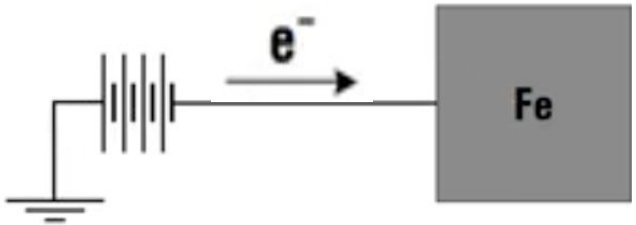
A. **Sacrificial Anode**

- attach a more reactive metal to the iron



B. **Impressed Current**

- attach the negative terminal of a current source to the iron



Preventing the Corrosion of Iron

3. Galvanization

- coating the iron with zinc
- zinc is a protective coating and a sacrificial anode

Success Criteria

- ❏ I can explain the corrosion of iron in terms of an electrochemical process, and describe some corrosion-inhibiting techniques.

WORK:

- Read **section 10.6** in textbook.
- Do questions **1 to 7** on page 662.
- Check your **answers** and **review** as necessary.